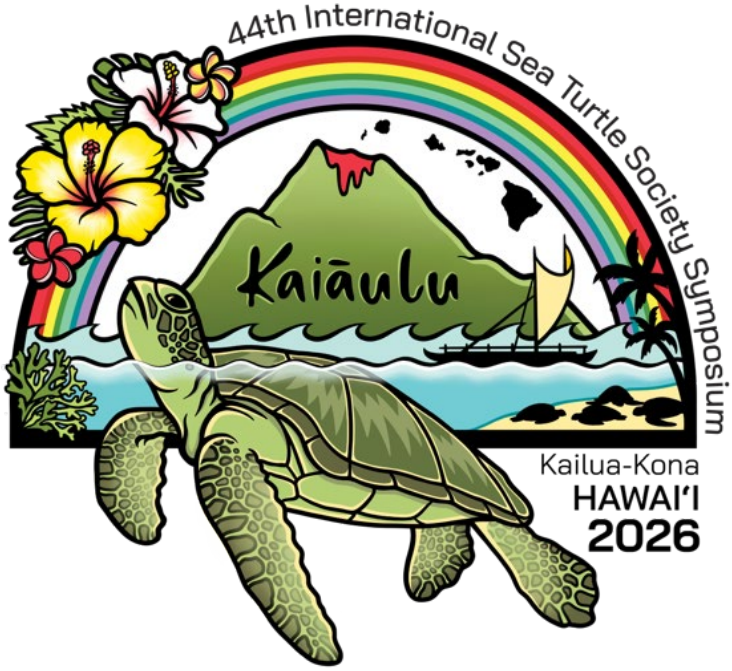
ISTS Technical Memorandum

ISSN 3106-1397

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



February 28 – March 6, 2026
Kailua-Kona, Hawai'i, USA

Compiled by:
Paul A. Whittock, Lisa C. Belskis, & Joseph B. Pfaller

June 2026

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PRESIDENT'S WELCOME

44th Symposium on Sea Turtle Biology and Conservation

28 February to 6 March 2026, Kailua-Kona, Hawai'i, USA

Alexander Gaos

Dear sea turtle 'Ohana,

It's an incredible privilege to welcome you to the 44th International Sea Turtle Society (ISTS) Symposium, held for the first time ever in Hawai'i (or the Pacific Islands!), a place where sea turtles are more than symbols of marine life, they are spiritual kin, cultural anchors, and reminders of the deep connections between people and ocean.

This year's gathering is unlike any before it. It's not just the setting, it's the intention. The organizing team and I set out to create a symposium that honors not only the science of sea turtle conservation, but the humanity behind it. Many of us are carrying heavy things -personal losses, burnout, transitions, and uncertainty- and this event is an opportunity to show up whole, to acknowledge what we've weathered, and to lean on the strength of this global community.

The theme for the symposium, *Kaiāulu*, speaks to that spirit. Though often translated as "community" or "neighborhood," *Kaiāulu* embodies something deeper — the living network of people, place, and environment that allows us to sustain and uplift one another. It captures the idea that we are shaped by the people and places around us, and that true conservation work must be rooted in those relationships, between generations, disciplines, geographies, and values.

As a community, we also find ourselves at a pivotal moment in sea turtle conservation. After decades defined by crisis response and the fight against extinction, some populations are showing real signs of recovery while others remain deeply imperiled. These mixed realities challenge us to think differently, to embrace new approaches, acknowledge shifting baselines, and remain open to diverse perspectives, including those shaped by culture and tradition. This is a time to reflect on what conservation means when success looks different across places, and how we can move forward with humility, curiosity, and respect for the many ways people relate to turtles and the sea.

This year, you'll see a strong emphasis on the Pacific Islands. We've worked to elevate voices from these places where sea turtles have long histories and where conservation efforts are deeply entangled with culture, sovereignty, and survival. We've also reimagined some elements of the program to make more space for storytelling, for rest, for honesty, and for reconnection, because this isn't just about producing knowledge, it's about sustaining the people who carry it.

So as you join workshops, plenaries, poster sessions, socials, and spontaneous oceanside conversations, I hope you'll take a moment to reflect on why you're here. What brought you into this field, what keeps you in it, and what needs tending in your own *kaiāulu*. We are deeply honored to host this gathering in Hawai'i. We're here not just to talk about sea turtles, but to reaffirm our responsibility to each other, to the places we come from, and to the work ahead.



With aloha and appreciation,

Alexander R. Gaos, PhD
President
International Sea Turtle Society

PRESIDENT'S REPORT

Summary Report - 44th International Sea Turtle Society Symposium (2026)

By Alexander Gaos, Symposium President

Introduction

The 44th International Sea Turtle Society (ISTS) Symposium was held from February 28 to March 6, 2026 in Kailua-Kona, Hawai'i. This meeting marked a historic milestone as the first symposium hosted in Hawai'i or anywhere in the Pacific Islands, bringing the global sea turtle conservation community into a region where sea turtles are deeply embedded in cultural, ecological, and spiritual systems.

Convened under the theme *Kaiāulu*, the symposium emphasized interconnected relationships between people, place, and environment. This framework shaped both the design and delivery of the meeting, guiding an approach that placed equal value on scientific exchange, cultural grounding, and community well-being. The result was a symposium that not only advanced scientific knowledge, but also intentionally created space for reflection, dialogue, and connection across diverse perspectives.

Plenary Program and Intellectual Impact

A defining feature of the 44th ISTS Symposium was the structure and impact of its plenary program, which, together with the Opening Ceremony, was intentionally designed as a cohesive intellectual and cultural foundation for the week.

The symposium opened with a traditional Hawaiian oli and blessing, grounding the meeting in place and establishing a tone of respect, connection, and shared responsibility. Invited speakers emphasized themes of stewardship, responsibility to place, and the deep relationships between people, place, sea turtles, and ocean. This opening was not simply ceremonial, but set the conceptual framework for the sessions that followed, reinforcing the symposium theme of *kaiāulu* and positioning conservation within broader social, cultural, and ethical contexts.

Building on this foundation, three plenary sessions moved beyond traditional keynote formats to create space for dialogue around complex and, at times, contested issues in sea turtle conservation.

The first plenary, *Pacific Island Nations, Shared Seas: Indigenous Perspectives on Sea Turtle and Marine Conservation*, elevated Indigenous leadership and Pacific Island voices, centering customary stewardship, cultural relationships with sea turtles, and the integration of traditional knowledge into conservation practice. This session reframed conservation as a process grounded in place, culture, and community, rather than solely as a scientific or management exercise.

The second plenary, *Headstarting Revisited: Effectiveness, Ethics, and Evidence*, revisited a long-standing and historically debated practice in sea turtle conservation, situating it within the broader question of how conservation strategies evolve over time. The session critically examined the biological effectiveness and ethical considerations of headstarting, while also addressing its appropriateness in a modern conservation context. Discussion reflected continued divergence within the field, with some practitioners supporting its use under certain conditions and others questioning its value relative to alternative strategies.

The third plenary, *Surviving to Thriving: Evolving the Ethos of Sea Turtle Conservation*, explored the transition from crisis-driven conservation toward long-term stewardship. As some populations recover while others remain imperiled, the session challenged the field to reassess its assumptions, adapt its strategies, and incorporate a broader range of perspectives into conservation decision-making.

Together, the Opening Ceremony and plenary sessions created a deliberate progression, from grounding in place and values, to critical examination of existing practices, to forward-looking reflection on the future of the field. This structure marked a clear shift in the role of the symposium, from a venue primarily for presenting results to one that more intentionally fostered dialogue, reflection, and direction-setting within the global sea turtle conservation community.

These themes were not confined to the plenary sessions, but were further explored through complementary workshops and discussions during the symposium, including sessions addressing decolonization in conservation practice and the role of sustainable use in contemporary management frameworks. Together, these elements reflected a broader engagement across the program with evolving and, at times, challenging questions in the field.

Innovation, Technology, and Firsts

The 44th ISTS Symposium introduced several first-of-their-kind advancements in symposium delivery, communication, and long-term accessibility, fundamentally expanding how the meeting is experienced and accessed.

The symposium marked the first comprehensive effort to record core components of the meeting, including oral presentations, poster sessions, plenaries, and the opening ceremony. A total of 342 (87.9%) of presenters opted in to recording, with only 47 opting out, reflecting strong community support for broader dissemination of content.

This effort extended beyond documentation to significantly expand access and extend the lifespan of the symposium. Recordings create opportunities for participants who were unable to attend specific sessions, as well as for the broader global community, particularly those facing financial, geographic, or logistical barriers to participation. They also establish the foundation for a lasting digital archive, enabling continued learning, reference, and engagement well beyond the meeting itself.

The symposium also marked the first time a dedicated mobile program application was developed, with 640 installations, representing adoption by the vast majority of attendees. Used alongside the printed program, the app significantly improved real-time communication, scheduling, and participant engagement, demonstrating the value of integrated digital tools for large international scientific meetings.

The scale of coordination required for the symposium was also substantial, with more than 21,000 system-generated communications supporting registration, scheduling, and participant coordination.

Together, these advancements represent a meaningful step toward a more accessible, connected, and resilient model for future ISTS symposia.

Participation and Global Reach

The symposium attracted 693 participants, representing 53 nations. Participation reflected strong global engagement across regions and sectors.

Attendees included representatives of NGOs, government agencies, and academic institutions. Registration data also reflected the broad diversity of the symposium community, including 128 students, 54 participants from Pacific Island regions, 205 participants from low-income countries, 228 from high-income countries, 34 non-ISTS members, and 44 single-day registrants. These categories highlight important dimensions of participation, though they are not mutually exclusive. Extensive travel support also played an important role in enabling attendance from a diverse and globally distributed community.

A total of 363 participants had no prior recorded attendance since tracking began at the 40th ISTS Symposium, underscoring the meeting's success in expanding its reach to new and previously unrecorded members of the global sea turtle conservation community.

Scientific Program

The scientific program was substantial, with 437 abstracts submitted and 1,177 completed reviews conducted by Session Chairs. Following withdrawals prior to the symposium, the final program included 389 scientific contributions, consisting of 180 oral presentations and 209 poster presentations.

Sessions covered the full breadth of sea turtle science and conservation, including in-water ecology, nesting biology, population monitoring, fisheries interactions, conservation management, and socio-cultural dimensions of conservation.

Delivery of the scientific program was supported by three Program Chairs, 41 Session Chairs and 118 volunteers, whose contributions were essential to coordinating reviews, managing sessions, and ensuring the smooth execution of the program.

Student Participation and Engagement

Student participation continued to be a defining strength of the symposium, spanning both the scientific program and a range of dedicated engagement activities. A total of 126 students applied for Student Presentation Awards, reflecting strong interest in competitive recognition within the scientific program. In parallel, 145 student presentations were evaluated through the symposium's student evaluation process, including 83 poster presentations and 62 oral presentations, supported by 129 volunteer evaluators. Because participation in both the awards and evaluation processes was optional, the total number of student contributions to the symposium was likely higher than these figures alone.

Engagement extended beyond the scientific program through a well-attended suite of student-focused events. The student mixer brought together 69 participants, while 42 students and 5 experts participated in the student workshop. Speed chatting sessions included 19 students and 9 experts, contributing to a total of 14 experts engaged across student programming.

Together, these efforts facilitated meaningful interaction between students and established researchers, supported professional development, and reinforced the symposium's role in cultivating the next generation of sea turtle scientists and conservation practitioners.

Workshops, Regional Meetings, and Capacity Building

Workshops and regional meetings held during the first three days of the symposium remained a central component of the program, providing structured opportunities for training, collaboration, and regional coordination. Nineteen workshops engaged a total of 846 participants, providing opportunities for technical training, skill development, and collaboration. Individual workshops ranged from approximately a dozen to over 90 participants, reflecting both specialized and broadly attended topics. Several workshops also engaged directly with themes highlighted in the plenary program, extending discussions on topics such as decolonization in conservation practice and the role of sustainable use into more applied and participatory settings. In addition, six regional meetings brought together 243 participants to discuss region-specific conservation priorities, strengthen networks, and coordinate efforts across geographic areas. Together, these sessions played an important role in building capacity, fostering collaboration, and supporting coordination across the global sea turtle conservation community.

Outreach, Community Events, and Cultural Programming

A diverse suite of community, cultural, and special events complemented the scientific program and were intentionally integrated into the symposium to reinforce the theme of Kaiāulu, fostering connection, place-based engagement, and shared experience.

The Welcome Social and Farewell Luau served as cornerstone events, each integrating cultural elements that grounded the symposium in its Hawai‘i setting. The Welcome Social featured traditional Hawaiian music and performances, alongside hula, Tahitian dance, and fire knife dancing, and was attended by approximately 500 participants. The Farewell Luau similarly combined a traditional Hawaiian culinary experience with live local music, drawing more than 440 attendees and providing a meaningful and celebratory close to the symposium.

Additional events supported both community engagement and professional exchange. These included Video Night, which provided a public-facing platform for storytelling and outreach and featured 24 films representing a wide range of countries and perspectives. The Origin Stories session created space for personal narratives from individuals working in sea turtle conservation, highlighting diverse pathways into the field and the experiences that have shaped practitioners' careers. The IUCN Marine Turtle Specialist Group (MTSG) meeting also served as an important forum for global coordination and collaboration.

The Makana Aloha program offered a mechanism for participants to support the symposium while sharing locally inspired goods, reinforcing the event's connection to place and community.

Together, these events extended the impact of the symposium beyond the formal scientific program, reinforcing its role as both a professional gathering and a vibrant global community.

Sponsorship, Partnerships, and Fundraising

The 44th ISTS Symposium achieved the highest level of financial support and partnership engagement in its history, reflecting an unprecedented level of investment in both the scope and delivery of the meeting. In total, sponsorship and partnership contributions generated approximately $290,000 in support of the symposium, representing the highest level of financial support in its history.

The symposium was anchored by Wild Earth Allies as Lead Partner, whose support was instrumental in shaping both the scope and ambition of the meeting, including the development of the plenary program and other key initiatives. Additional major contributions were provided by three Platinum Sponsors, the Coastal Wildlife Club, Oceans and Wildlife Institute, and the National Oceanic and Atmospheric Administration. Further support was provided by the Pacific Cooperative Studies Unit at the University of Hawai‘i at Mānoa as a Gold Sponsor, alongside a broader base of event-specific and general sponsors whose contributions supported student participation, program delivery, and community events throughout the week.

The symposium's live and silent auctions were exceptionally successful, generating a combined total of $39,185, including $12,161 from the silent auction and $27,024 from the live auction. This represents a record-breaking outcome for the symposium and reflects a high level of engagement and generosity from the global sea turtle conservation community.

Merchandise sales were also highly successful. Through an in-kind contribution from Free Fly Apparel, sun hoodies were made available for on-site purchase, generating $15,290 in gross revenue. With production costs of approximately $5,000, net proceeds of roughly $10,000 directly supported the symposium.

The symposium also included 18 exhibitors and vendors, including 6 commercial exhibitors and 12 non-profit exhibitors.

Travel grant support remained a major priority, with 180 applications received and 121 grants awarded (67.2% of applicants). Delivering this level of support in Hawai‘i required substantial investment, with approximately $149,000 allocated to support participant accommodations, reflecting both the success of fundraising efforts and the symposium’s commitment to accessibility.

Together, these contributions enabled an expanded scope of programming, accessibility, and participant support beyond what has been achieved in previous symposia.

Legacy and Forward Impact

The 44th ISTS Symposium represents a clear inflection point in the evolution of the Society’s flagship meeting.

By combining one of the largest scientific programs to date with strong global representation, expanded accessibility, and a willingness to engage directly with complex and evolving conservation topics, the symposium broadened both the scope and purpose of the meeting.

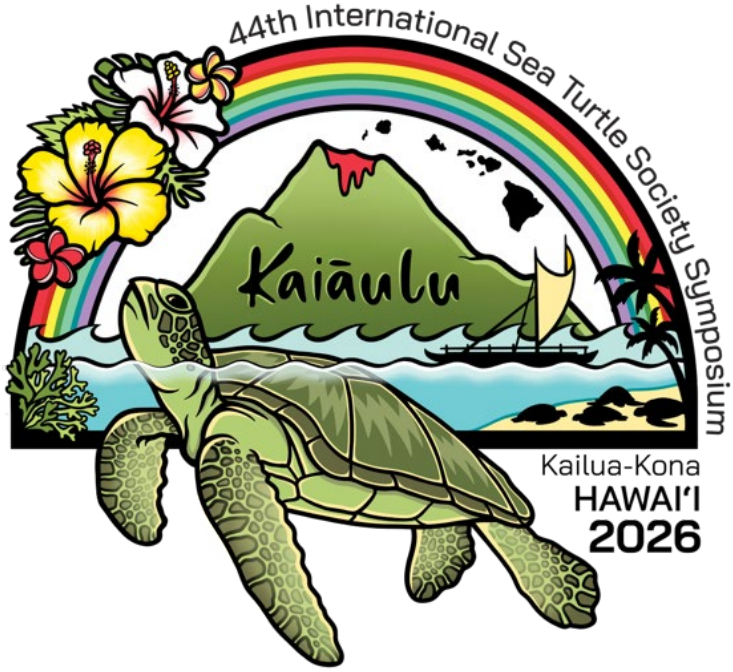
Together, these elements reinforced the symposium’s longstanding role as a platform for sharing research while elevating its function as a space for reflection, dialogue, and direction-setting within the global sea turtle conservation community. The conversations initiated in Hawai‘i, particularly those centered on Indigenous leadership, contested conservation practices, and the evolving ethos of conservation, are likely to influence both discourse and practice in the years ahead.

In this way, the 44th ISTS Symposium not only reflected the current state of the field, but also contributed to shaping its future trajectory.

SYMPOSIUM LOGO

The logo for the 44th ISTS Symposium, designed by the amazing author and illustrator Mollie Ginther, portrays various elements important to Hawai‘i. It is common to see Hawaiian green turtles swimming in nearshore waters, thus this species is featured in the forefront of the logo. Hawaiian green turtles (*honu*) also emerge from the sea to bask (pictured in the bottom right) on many beaches around the state. Hawai‘i is known as the (*ānuenue*) state because of the rapid weather fluctuations between intense rains and sunny skies, which lead to abundant rainbows. The Hawaiian Islands represent a volcanic archipelago, with one still currently active volcano (*Kīlauea*) located on Hawai‘i Island, not too far from the symposium venue. The large (*Ma‘o hau hele*) flowers pictured over the rainbow are common to Hawai‘i and the yellow hibiscus is the state flower. The smaller flowers next to the hibiscus are from the plumeria tree and are used in the making of lei, a garland common in Hawaiian culture that is used as a symbol of love, friendship, celebration, honor, and greeting. The *limu* pictured in the bottom left is a common seaweed found around the shores of Hawai‘i that is a favorite of the *honu*, and is often harvested for consumption by humans as well. The traditional Hawaiian boats are outrigger canoes (*wa‘a*) and Pacific Islanders developed extraordinary navigation skills using the stars, sun, ocean swells, and other signs of nature that allowed them to traverse vast expanses of the Pacific Ocean.

Kaiāulu is a Hawaiian word that translates to “Community” (as well as “neighborhood” and “village”). The theme reflects the close-knit nature and camaraderie of people working with sea turtles, celebrating how we support one another to achieve common-sense management approaches and successes around the world.



COMMITTEES, CHAIRS, AND KEY ORGANIZERS

Executive Committee

Executive Committee Role	Member
Executive Director	Sylvia Gonner
President	Alexander Gaos
Secretary	Manjula Tiwari
Treasurer	Nicholas Blume
President Elect	Ronel Nel
Past President	Andrews Agyekumhene

Board of Directors and End of Terms

Board Member	End of term
Andrea Phillott	2026
Justin Perrault	2026
Itzel Sifuentes Romero	2027
Joseph Pfaller	2027
Seh Ling Long	2028
Richard Reina	2028
Kate Mansfield	2029
Andrés Estrades	2029
Daniella Freggi	2029

Organizing Committee

Organizing Committee Role	Member
President	Alexander Gaos
Support Team	Andrew Glinsky, Anna Ortega
Webmaster / I.T. Liaison	Paul Whittock
Bookkeeper	Terry Meyer
Registrar	Natalia "Naty" Teryda
Exhibitor/Vendor Chairs	Yonat Swimmer, Melissa Snover
Workshops & Regional Meeting Chairs	Irene Kelly, Josefa "Sefa" Muñoz
Oral and Poster Recording	José Urteaga, Aileen Lavelle, Michelle Early Capistrán, Connie Ng, Amanda Robbins
Volunteer Committee	Daniela Rojas-Cañizales, Itzel Sifuentes-Romero, Adriana Córtes
Student Committee	Derek Aoki, Lindsay Curl
Video Night Committee	Retno Ningrum, Eley Meeth, Christina Netta
Origin Stories Committee	Lynn Massey, Suzie Graham, Sabrina Mashburn, Aiyana Chapin
Sea Turtle Trading Post	Kate Mansfield
Silent and Live Auction Team	Marina Zucchini, Roderic Mast
Fundraising Support	José Urteaga, Jennifer Homcy, Ingrid Yañez
Visa Support Chair	Camryn Allen
Design Support	Velkiss Gadea, Karen Zavala
In Memoriam Team	Helena Fernandez, Agnese Mancini
Archie Carr Awards Committee	Andrea Phillott, Natalie Wildermann
Grassroots Conservation Award Committee	Gustavo Stahelin (Chair)
ISTS Career Awards Committee	Ryan Welsh (Chair), Mike Liles, Juan Manuel Rguez-Baron, Earl Possardt, Jacques Fretey
ISTS Nominations Committee	Mustapha Aksissou (Chair), Kellie Pendoley, Wendy Dow Piniak, Thushan Kapurusinghe, Alan Rees
MTSG Group Meeting	Roderic Mast, Paolo Casale
Social Media Support	Laura Prosdocimi (Chair), Tara Lanzer, Hamed Mallet, Jordan Wisner
Things-to-do Support	Laura Jim

Program Committee

Program Committee Role	Member
Program Chairs	Shaya Honarvar, Shawn Murakawa, John Wang
Session Chairs	Héctor Barrios Garrido, Maria Chadam, Kara Dodge, Kimberly Finlayson, Daniela Freggi, Alexandre Girard, Matthew Godfrey, Daphne Wrobel Goldberg, Heather Haas, Stacy Hargrove, Heather Harris, Chris Madden Hof, Laura Jim, Thushan Kapurusinghe, Deasy Lantoh, Robin LeRoux, Summer Martin, Luli Martinez, Eric Matzen, Erin McMichael, Eley Meeth, Tony Michel Nalovic, Connie Ng, Aliki Panagopoulou, Samir Patel, Nick Pilcher, Wendy Piniak, Trevor Proctor, Juan Manuel Rodriguez, Chris Sasso, Jeffrey Seminoff, Erin Seney, Kartik Shanker, George Shillinger, Tammy Summers, Cali Turner Tomaszewicz, Roldán Valverde, Bryan Wallace, Sean Williamson, Brett Michael Wilson, Jeannette Wyneken
Poster Session Chairs	Marylou Staman, Jan Willem Staman
Proceedings Compilers	Paul Whittock, Lisa Belskis, Joseph Pfaller
Proceedings Chair	Joseph Pfaller

Travel Grant Committee

Travel Grant Committee Role	Member
Chair	Andrew Maurer
Regional Chair – Africa (except North Africa)	Angela Formia
Regional Chair – Caribbean (English speaking)	Karen Eckert
Regional Chair – Mexico, Central America, and Spanish-speaking Caribbean	José Urteaga
Regional Chair – North Africa, and Middle East	ALan Rees
Regional Chair – Europe	Daniela Freggi
Regional Chair – South America	Alejandro Fallabrino
Regional Chair – South Asia	Andrea Phillot
Regional Chair – Southeast Asia/Pacific	Mark Hamann
Regional Chair – USA and Canada	Kelly Stewart

Regional Meeting Organizers

Regional Meeting	Organizer
Africa	Andrews Agyekumhene
East Asia	Connie Ng, Takashi Ishihara
Indian Ocean and Southeast Asia (IOSEA)	Lalith Ekanayake
Oceania	Irene Kelly, Josefa Muñoz
Latin American Meeting (RETOMALA)	Jimena Gutiérrez, Daniela Rojas, Ana María Moncada, Eneida Fajardo, Antonio Trujillo
Mediterranean Reunion	Aliki Panagopoulou

PARTNERS AND SPONSORS

The 44th International Sea Turtle Society Symposium and the International Sea Turtle Society gratefully acknowledge the generous and valuable financial support from our sponsors.

Lead Partner:

Wild Earth Allies

Platinum Sponsors:

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National Oceanic and Atmospheric Association (NOAA)

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Sea Turtle Inc.

Video Night:

Oceans & Wildlife Institute

Live Auction:

Sea Turtle Conservancy

Large General:

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World Wildlife Fund (WWF)
Fair Wind Cruises
New England Aquarium
National Save the Sea Turtle Foundation
Disney Conservation Fund
Ocean Conservancy
Free Fly
Wildlife Computers

Small General:

Oceanic Society
Hawai'i Preparatory Academy
Mālama i nā honu
University of Massachusetts
SAFE (Saving Animals from Extinction) Sea Turtle
Hawai'i Wildlife Fund
Shoreline Conservation Initiative
Marine Institute, Maui Ocean Center
Telonics Inc.

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The Kohala Center
SWOT (The State of the World's Sea Turtles)
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PeerJ
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SMRU Instrumentation
Taiwan Cetacean Society
TurtleSpot Taiwan
Wildlife Computers
Wild Earth Allies
Wild Wildlife Fund

ISTS AWARDS

ISTS Lifetime Achievement Awards

Carlos E. Diez

Carlos E. Diez has dedicated more than four decades to sea turtle conservation in Puerto Rico and the wider Caribbean, leading long-term monitoring and management programs that directly inform recovery actions. His work bridges science, policy, and implementation, with lasting impact through both his research contributions and sustained agency leadership.

Victor de la Toba ("Don Victor")

Victor de la Toba, affectionately known as Don Victor, was a community-based conservation leader whose decades of hands-on monitoring in Baja California Sur were foundational to understanding North Pacific loggerhead mortality in the Gulf of Ulloa. His persistence, collaboration, and commitment to field-based conservation left an enduring legacy for regional and international conservation efforts.

ISTS Champions Awards

Hedelvy Guada

Hedelvy Guada has built and sustained national sea turtle conservation capacity in Venezuela through long-term program leadership, research, and training. Her work has strengthened both scientific and institutional foundations for conservation while mentoring the next generation of practitioners.

Juma Al Araimi and Antonia Vegh

Juma Al Araimi and Antonia Vegh have led intensive nesting beach monitoring and protection efforts in Oman, combining field leadership, training, and threat mitigation. Their work ensures consistent, high-quality conservation delivery across seasons and directly supports nesting success.

Asociación ProCosta

Asociación ProCosta has advanced hawksbill conservation in El Salvador through nearly two decades of community-based conservation, working with hundreds of coastal families. Their efforts have contributed to both on-the-ground protection and national-level conservation outcomes, including the establishment of a marine protected area.

Ko Myint, Salai Nyi Nyi Lin Mon, and Phone Maw

This team has sustained sea turtle conservation in Myanmar under challenging conditions, maintaining monitoring, outreach, and training programs despite instability. Their leadership has preserved national conservation capacity and ensured continuity of field efforts.

Blair and Dawn Witherington

Blair and Dawn Witherington have combined science and communication to advance sea turtle conservation through widely used educational materials and applied management guidance. Their work has influenced both public understanding and practical conservation actions, including efforts to reduce hatchling disorientation.

Michael J. Bresette

Michael J. Bresette has built long-term in-water research and conservation capacity through leadership of the Inwater Research Group, developing programs, protocols, and partnerships that support applied conservation and training. His work has created durable infrastructure for sea turtle research and management.

Ed Drane Award for Volunteerism

Roger John Jessop

Roger John Jessop has provided more than a decade of hands-on, volunteer-driven nest protection and monitoring in Kenya, maintaining an exceptionally detailed long-term dataset while directly supporting nesting success. His sustained personal commitment exemplifies the impact of dedicated volunteer conservation.

Don McLeish

Don McLeish has contributed to sea turtle conservation in Hawai‘i through volunteer rescue efforts and scientifically valuable underwater documentation, including work that has supported peer-reviewed research. His efforts bridge citizen science, outreach, and direct conservation response.

ISTS President's Awards

Summer Martin

Summer Martin leads the Marine Turtle Biology and Assessment Program at the Pacific Islands Fisheries Science Center, where she has helped advance sea turtle research and conservation throughout the Pacific Islands region. Known for her collaborative leadership, mentorship, and commitment to international partnerships, she has fostered meaningful connections among researchers, managers, and conservation practitioners working to protect sea turtles across the Pacific.

Jessy Hapdei

Originally from Yap in the Federated States of Micronesia and now based in Guam, Jessy Hapdei is widely respected for his contributions to sea turtle conservation throughout the Mariana Islands. Drawing upon a lifetime of experience on the water and deep knowledge of the marine environment, he has played a key role in sea turtle monitoring, research, and capacity building while mentoring and inspiring conservation practitioners across the Pacific.

Grassroots Conservation Award

Care of Hedland, Australia: “*Flatback Turtles and the Power of Community: Two Decades of Community-Led Conservation in Port Hedland, Western Australia*”.

Archie Carr Student Awards

There were 62 oral presentations and 62 poster presentations nominated for consideration. Presentations were assessed under one of six award categories (nominated by the student presenter): Conservation Oral (n=20), Conservation Poster (n=21), Biology Oral- Nesting and Early Life Stages (n=19), Biology Oral- Juveniles to Adults (n=23), Biology Poster- Nesting and Early Life Stages (n=18), Biology Poster- Juveniles to Adults (n=23). Judges for each category selected a winner and a runner-up. Twelve student presentations were selected for awards, with Winners receiving US$500 each and Runners-up receiving US$250 each, for a total of US$4,500. PeerJ also offered free publications in one of their journals to the six winners. Student presentations were judged by (in alphabetical order by first name): Adriana Cortés Gómez, Brian Shamblin, Cali Turner Tomaszewicz, Connie Ka Yan Ng, Gabriela Velez-Rubio, Hannah Vander Zanden, Hector Barrios-Garrido, Holly Stokes, Itzel Sifuentes Romero, Joe Pfaller, Justin Perrault, Katie Fowler, Katrina Phillips, Lisa Komoroske, Marco Garcia Cruz, Mariela Pajuelo, Mark Hamann, Matt Ware, Matthew Ramirez, Nicole Esteban, Omar Attum, Suzana Machado Guimaraes, Wendy Piniak, and Yonat Swimmer.

Biology (Oral and Poster)

Category	Prize	Student	Institution	Presentation Title
Biology Oral (Nesting to Early Stages)	Winner	Eugenie 'Charley' Yen	Queen Mary University of London, UK	DNA methylation reveals buffering responses to climate induced sex ratio skew in vulnerable sea turtles
	Runner up	David Dor	University of New South Wales, Australia	POV: You're a sea turtle that just hatched
Biology Oral (Juveniles to Adults)	Winner	Estefany Argueta	University of Massachusetts, USA	Amherst Can mating behaviors buffer climate impacts? Evidence from Fernando de Noronha green sea turtle reproductive dynamics
	Runner up	Sophia A. Coveney	Swansea University, UK	Revealing immature hawksbill and green turtle diets using optimised dietary DNA metabarcoding in the western Indian Ocean
Biology Poster (Nesting to Early Stages)	Winner	Emily Turla	Florida Atlantic University, USA	Optimal, suboptimal, and lethal conditions for developing leatherback sea turtle embryos
	Runner up	Michael Vrbanac	University of Central Florida, USA	Effect of upwelling-induced marine cooling events in loggerhead nesting behavior
Biology Poster (Juveniles to Adults)	Winner	Nupur Kale	Swansea University, UK	Hitchhiker load reduces host grazing efficiency
	Runner up	Alexa Putillo	Florida State University, USA	Effects of green turtle herbivory on seagrass ecosystems: An experimental test in the context of a global meta-analysis

Conservation (Oral and Poster)

Category	Prize	Student	Institution	Presentation Title
Conservation Oral	Winner	Cristina Langford	Scripps Institution of Oceanography, USA	Artisanal fishers at the helm: Co-designing illuminated nests for sea turtle bycatch
	Runner up	Fred Baggs	Swansea University, UK	Artificial irrigation to combat warming of sea turtle nest environments: Dampened sand can increase heat transfer to nest depth
Conservation Poster	Winner	Daniela Rojas-Canizales	University of Florida, USA	Beyond the shell: Exploring the dimensions of sea turtle take in Bocas del Toro, Panama
	Runner up	Nisha Hamann	James Cook University, Australia	Sea turtle mortality in Queensland's shark control gear

FEATURED SESSIONS AND PLENARY PROGRAM

The featured sessions of the 44th ISTS Symposium were intentionally designed to foster reflection, dialogue, and constructive discussion on some of the most important opportunities and challenges facing sea turtle conservation today. With support from Wild Earth Allies and additional partners, the plenary program elevated Indigenous leadership, revisited long standing debates within the field, and encouraged participants to consider how conservation must continue to evolve in a rapidly changing world.

Opening Ceremonies

The symposium opened with a traditional Hawaiian oli and blessing led by Danny and Anna Akaka, grounding the gathering in the cultural traditions and stewardship values of Hawai‘i. Additional remarks from conservation leaders and symposium organizers highlighted the importance of collaboration, community partnerships, and the connections between people, place, and conservation. Together, these speakers established a theme that would carry throughout the week: effective conservation depends not only on science, but also on relationships, cultural understanding, and shared responsibility.

Emcee: Josefa Muñoz

Cultural Opening and Blessing: Danny Akaka and Anna Akaka

Welcome Message: Alexander Gaos

Invited Speakers: Cindi Punihaole, Larry Katahira, José Urteaga, Summer Martin

Plenaries

Plenary 1: Pacific Island Nations, Shared Seas: Indigenous Perspectives on Sea Turtle and Marine Conservation

Moderator: Noelani Puniwai

Panelists: Jessy R. Hapdei (Federated States of Micronesia), Nohealani Ka‘awa (Hawai‘i), Alphina (Phinah) Liusamoa (American Samoa), Uncle Mac Poepoe (Hawai‘i), Karalaini Rereavosa (Fiji), and Ann Singeo (Palau)

Organizers: José Urteaga, Nohealani Ka‘awa, Aileen Lavelle, Josefa Muñoz, Michelle Early Capistrán, Summer Martin, Alexander Gaos

Description: This session highlights the deep-rooted relationships that Pacific Island communities maintain with the ocean and sea turtles. Indigenous leaders and practitioners from Melanesia, Polynesia, and Micronesia will share cultural, spiritual, and ecological perspectives on stewardship, exploring how customary knowledge and modern conservation can work together to advance equity, collaboration, and resilience in marine conservation.

Plenary 2: Headstarting Revisited: Effectiveness, Ethics, and Evidence

Moderator: Jeffery Seminoff

Panelists: Brian Stacy, Vandanaa “Navi” Baboolal, Selina Heppell, Anna Ortega, Michael Liles

Organizers: Brian Stacy, Jeffrey Seminoff, Michael Liles, Alexander Gaos

Description: Headstarting, the captive rearing and release of young turtles to increase early survival, has long sparked debate over its biological, economic, and ethical merits. This session revisits the

practice through historical and more recent data and diverse perspectives, exploring its successes, limitations, and relevance to modern conservation. Speakers will discuss lessons learned and the role headstarting may play in evidence-based recovery strategies.

Plenary 3: Surviving to Thriving: Evolving the Ethos of Sea Turtle Conservation

Moderator: Bryan Wallace

Panelists: Jeffrey Seminoff, Neca Marcovaldi, Michelle Early Capistrán

Organizers: Bryan Wallace, Jeffrey Seminoff, Kartik Shanker, Michelle Early Capistrán, Michael Liles, Alexander Gaos

Description: Sea turtle conservation largely emerged from a crisis mindset focused on preventing extinction. Decades of protection have brought recovery in some cases, as well as new challenges, inviting reflection on what conservation means in an era of recovering populations and greater recognition of the value of multiple perspectives. This session explores how strategies, ethics, and communication can evolve to sustain credibility, inclusivity, and resilience as conservation transitions from crisis response to long-term stewardship.

Workshops

1. **All Hands on Deck: Exploring evidence, uncertainty, and pathways for Pacific leatherback conservation**

   Organizers: Anna Ortega (anna.ortega@research.uwa.edu.au), George Shillinger, Guillermo Otuño Crespo, Yonat Swimmer, Juanma Rguez-Baron, Nicolas Pilcher, Matt Dunn

   Description: Pacific leatherback conservation has reached an exciting inflection point. Decades of dedicated work across the Pacific Basin—from reducing bycatch to protecting nesting beaches—have laid a strong foundation. This workshop builds on that momentum, offering an unprecedented opportunity to align efforts across countries, sectors, and strategies to ensure the survival of two Pacific leatherback populations that are critically endangered. We will present the Pacific Leatherback Hub, a new decision-support tool that synthesizes data from across the region to help stakeholders evaluate which conservation actions can be most effective, and where. Built on a multilingual systematic review of academic and grey literature, the tool integrates spatial risk maps, fisheries behavior data, and individual-based population viability models for six nesting regions (Mexico, Costa Rica, Nicaragua, Indonesia [Jamursba-Medi, Wermon], and Papua New Guinea). These models estimate the levels of bycatch reduction required to stabilize populations, allowing users to explore conservation scenarios and prioritize interventions. The Hub also includes a growing database of mitigation strategies and a quiz that offers gear- and region-specific recommendations. Workshop participants will engage with the Hub directly, explore findings, and provide input on adapting or expanding its functionality. We'll also discuss national-level capacity scores and behavioral insights to explore how best to support both high-capacity and under-resourced regions. Presentations and discussion sessions will highlight real-world conservation successes and tackle the shared challenge of scaling impact through coordination, targeted action, and open information-sharing. The goal is to spark a Pacific-wide conversation: Can we collectively update action plans and work together to direct effort where it’s most urgently needed? This workshop offers a platform to connect science with strategy: amplifying

the great work already happening, and shaping the future of Pacific leatherback conservation together.

2. **Practicing the 5 Domains of Decoloniality**

   Organizers: Madhusudan Katti (aranyak@me.com), Amanda Robbins (amandaelainerobbins@gmail.com)

   Description: Ecology and conservation biology remain rooted in Western European knowledge traditions aligned with a history of colonial appropriation of land and resources and erasure of indigenous knowledge systems. Therefore the work of conservation is often conducted in indigenous places where the relationship of all the things of the place and the people of the place is a critical element of understanding that underpins the ability to work through decolonizing and moving through conflict. A fundamental step for decoloniality is building that understanding.

3. **An Introduction to Mathematical Modeling**

   Organizers: Sheila Miller Edwards (sheila.miller@asu.edu), Michelle Mancenito

   Description: In the morning session we will give a gentle introduction to mathematical modeling. We will answer questions like: What is a model? What is the purpose of a model? What are some of the more common model types relevant to sea turtles? How do I choose a model? What are common mistakes to avoid? We will introduce the modeling process through relevant case studies to highlight the iterative nature of the modeling process. Also in the morning session we will discuss statistical modeling and explore the fundamentals of experimental design, including guidelines for how to design experiments to facilitate statistical analysis. In the afternoon session, we will explore select mathematical models more deeply (always in the context of a particular question related to sea turtle biology or conservation), review available software resources, discuss the modeling process for a limited number of case studies shared in advance by participants, and identify limitations and challenges in applying models.

4. **Practical Cold Stun Case Management**

   Organizer: Matthew Rendle (matthewrendlervn@hotmail.co.uk)

   Description: Cases of cold stun in sea turtles is increasing in number year on year in various parts of the world, including the UK. In this workshop we will hear from teams working with cold stun and review the evidence and discuss the delegates experiences of managing these challenging cases and how we can improve the welfare and the number of positive outcomes, in the context of contextualised care.

5. **Where are the Males? Shaping the Future of Sea Turtle Conservation. Investigating artificial irrigation as an emerging climate mitigation strategy to lower nest temperatures**

   Organizers: Marco García-Cruz (marcogarcia@ufl.edu), Nicole Esteban (n.esteban@swansea.ac.uk), Hector Barrios-Garrido, Holly Stokes, Fred Baggs, Melissa Staines, Graeme Hays

   Description: Over the past four decades, sea turtle conservation has largely centered on nesting females and hatchlings, generating valuable insights into reproductive biology, population dynamics, and threats. Yet, this emphasis has left male sea turtles—who never return to land—virtually invisible in research and management frameworks. This omission is increasingly untenable. Climate change is altering sex ratios, with warming sands skewing populations toward

females. Without robust knowledge of male abundance, ecology, and reproductive behavior, conservation strategies remain built on only half the demographic equation. Since 2019, a series of international workshops has worked to redress this imbalance. From the inaugural meeting in Charleston (ISTS 2019) to the recent session in Accra, Ghana (ISTS 2025), more than 150 scientists from over 20 countries have advanced the Global Male Sea Turtle Initiative (GMSTI). These workshops have identified critical knowledge gaps, piloted innovative methodologies and fostered an expanding professional network committed to integrating males into conservation science. The 2026 workshop in Hawaii—the fifth in this series—builds on this momentum under the title "Where Are the Males? Shaping the Future of Sea Turtle Conservation." It will provide a global platform to synthesize lessons learned, introduce new approaches, and strengthen collaborations. By convening researchers, managers, and students, the workshop will highlight why studying males is not optional but essential for accurate population modeling, reproductive success assessments, and climate adaptation strategies. The workshop will also include consideration of climate adaptation strategies with a focus on artificial irrigation as a tool for lowering turtle nest temperatures. Various beach management strategies have been tested including nest shading, vegetation restoration and relocation but are challenging to implement at large-scales. Artificial irrigation offers a potential scalable and minimally invasive tool but there are concerns relating to nest inundation and salinity increase if seawater is used. In the last decade, artificial irrigation has been implemented as a nest-cooling strategy in Costa Rica, Florida and Australia with varied experimental designs (e.g. irrigation volume, frequency, timing, water temperature) that make direct comparison difficult. This workshop component will include: (a) Information-sharing and discussion about outcomes of controlled laboratory-based and field-based irrigation experiments to test effectiveness of different volumes, frequencies and application times; consideration of the effects of freshwater and saltwater irrigation on temperature reduction and salinity, and comparison of irrigation outcomes at different rookeries, (b) Discussion about potential and observed threats to sea turtle reproduction output from artificial irrigation and (c) Launch of a global study for direct comparison of irrigation across rookeries by development of an experimental protocol to test optimal irrigation regimes on turtle nesting beaches that have a range of physical characteristics (e.g. sand particle size, temperature, wave energy and tidal range). At a moment when conservation must move beyond partial perspectives, this workshop offers a unique opportunity to make sea turtle management more inclusive, balanced, and forward-looking.

6. Sea Turtle Rehabilitation and Medicine Workshop

Organizers: Daniela Freggi (freggidaniela@gmail.com), Gregg Levine (glevinedvm@gmail.com), Mariluz Parga, Maria Chadam, Heather Harris, Deb Torraca, Douglas Johnson, Robin Schumacher

Description: In recent years, sea turtle rescue and rehabilitation centers have expanded significantly across the globe, representing an important advancement in marine conservation. Yet, many centers continue to face critical challenges, particularly during emergencies where timely access to specialized expertise remains limited. In such situations, gaps in knowledge and communication can result in inefficiencies, misallocated resources, uncertain outcomes and, most critically, avoidable suffering for the animals in care. This workshop is dedicated to professionals actively engaged in the rehabilitation and medical treatment of sea turtles. It will serve as a dynamic forum to exchange clinical expertise, share case studies and discuss standard operating procedures while fostering stronger collaboration within the international rehabilitation

community. Core themes will include diagnostics, husbandry, critical care, trauma management, anesthesia and surgical interventions. By comparing approaches and exploring innovative practices, the workshop aims to generate constructive dialogue, encourage problem-solving, and support the dissemination of cutting-edge techniques. Beyond clinical practice, the session will emphasize the essential role of rehabilitation centers in global sea turtle conservation strategies. Strengthening connections among centers, we aim to outline future directions, promote the adoption of best practices and work toward harmonized protocols that ensure high standards of veterinary care, rehabilitation, and convalescence. We warmly welcome all participants to contribute actively to this collaborative platform. Together, we can advance the quality, effectiveness and impact of sea turtle rehabilitation worldwide.

7. **Designing behavior change strategies for effective sea turtle conservation**

   Organizers: Ashleigh Bandimere (bandimere@oceanicsociety.org), Roderic Mast, Brian Hutchinson, Rachel Smith, Kelley Anderson, Lindsay Mosher

   Description: Behavioral science offers powerful tools to address conservation challenges, yet many practitioners lack training in how to apply these approaches. Team BEACH, a collaboration between Human Nature Group and the State of the World's Sea Turtles (SWOT) program, is dedicated to filling this gap by equipping researchers, educators, and practitioners with the skills to design and implement evidence-based behavior change campaigns. This interactive workshop provides a step-by-step framework for developing sea turtle behavior change strategies, blending theory with practice. The format includes an introduction to behavioral science principles and their application to conservation, a guided strategy design process that enables participants to translate theory into actionable plans, and an interactive component in which participants work in small groups to design tailored strategies for real case studies. This ensures immediate relevance and application for those involved, while producing a tangible product (behavior change action plans) that can benefit the broader community. Past workshop feedback references an improved their ability to design strategies, conduct impact evaluation, and seek funding for applied social science approaches. Example testimonial: "This is my first time attending such a workshop, it has helped me shape my thoughts towards motivation driven conservation. I am really excited to be part of making a change." The Hawai'i context makes this workshop especially timely and relevant. Turtles are woven into the islands' cultural identity and traditions, while modern pressures such as tourism and development create new conservation challenges. As one of the only places in the world where foraging, nesting, and basking sea turtles coexist alongside people, participants of ISTS44 will not only build their capacity, but also explore these concepts in a place where sea turtle conservation and human behavior intersect daily.

8. **Sustainable Use of Sea Turtles: Pathways, Challenges, and Cultural Perspectives**

   Organizers: Michelle Maria Early Capistran (earlycapistran@gmail.com), Jeffrey A. Seminoff, Nicolas Pilcher, Asuka Ishizaki

   Description: Decades of conservation work are paying off – many sea turtle populations are recovering worldwide, bringing new management considerations and challenges. How can we ensure healthy sea turtle populations into the future while recognizing their value as a fundamental resource for numerous communities and cultures that have long depended on them? How do we foster more open dialogue about sustainable use, which is often avoided or sidelined in conservation circles? In this workshop, we'll collectively explore the complex landscape of

sustainable sea turtle use by discussing the social, technical, and ecological factors that may influence the viability or success of sustainable use. We'll bring together scientists, community members, and managers to share experiences—both successes and challenges—from established experiences in sustainable use of marine wildlife. Our discussions will unpack "the good, the bad, and the ugly" of real-world implementation, analyzing what works, what doesn't, and why. We'll examine technical viability alongside social realities, with particular attention to local and indigenous communities and subsistence harvest practices. We will identify the overarching socioeconomic, ecological, and governance conditions that make sustainable use viable, and where it is likely to face challenges. This overall framework can then aid evaluating conditions and management frameworks for sustainable use at national, region, and local scales. We'll also explore international frameworks and provide suggestions on how local approaches can harmonize with global conservation goals, including the Global Biodiversity Framework, IUCN Policy Guides, and UN Sustainable Development Goals. Through collaborative dialogue and shared learning, we'll develop conceptual frameworks that can facilitate evaluations and decision-making around sustainable use across diverse contexts. Sea turtle use has always existed and is here to stay. Our collective responsibility is to ensure it is sustainable, equitable, and compatible with long-term management.

9. Towards holistic strategies for bycatch reduction

Organizers: Bryan Wallace (bryan@ecolibrium-inc.com), Agnese Mancini, Joanna Alfaro-Shigueto, Tony Nalovic

Description: Incidental capture of sea turtles and other species of conservation priority in artisanal fisheries has negative impacts on these taxa and on fishers themselves. Thus, conservation strategies must balance reducing bycatch impacts on these threatened populations with supporting the well-being of the small-scale fishing sector. Building on discussions from previous ISTS workshops, we will continue to promote truly holistic strategies that recognize the wide range of possible activities, not just experimental trials, that could be implemented to achieve the 'win-win' goals of bycatch reduction and sustainable fisheries. In order to do so, we need first to understand the connections between these activities, and how to effectively design and implement such holistic strategies. During ISTS43, we conducted the first version of this workshop, inviting presenters from around the world to share their experiences with fisher-first bycatch reduction projects, discuss lessons learned and how those could be adapted to other situations, and began to cultivate a 'community of practice' in holistic bycatch reduction. The goals of this workshop will be to explore real-world examples of implementation of holistic initiatives in turtle conservation projects, analyze strengths and weaknesses of holistic approaches versus top-down approaches, and identify gaps and opportunities to adapt and promote holistic approaches. This workshop will roll out a newly developed ‘best practices’ manual that provides a clear roadmap for creating holistic solutions to address bycatch, and will feature a dynamic mix of expert presentations and interactive discussion groups on successful collaborative strategies from across the globe. If the workshop is approved, we plan to focus on Oceania-specific lessons learned in developing and implementing bycatch reduction activities in real-world fisheries. Participants will engage in activities fostering exchange with like-minded professionals, exploring best practices for designing and implementing comprehensive bycatch reduction strategies that build from the bottom-up, focusing on the human components.

10. International Basking Turtle Working Group

Organizers: Camryn Allen (camryn.allen@noaa.gov), Caitlin Smith, Kimberly Finlayson

Description: Sea turtle "basking" is described as the behaviour of emerging from the water to rest on land, and has been documented in a few regions globally, including Hawai'i, the Galápagos Islands, and Australia. Proposed explanations for this behaviour include thermoregulation, predator avoidance, and evading courtship, yet these hypotheses remain largely untested. Nocturnal basking, in particular, is poorly understood due to limited empirical evidence and the remoteness of study sites, leaving a critical gap in our understanding of sea turtle ecology. To address the paucity of data in this space, in 2023 the International Basking Turtle Working Group was established to foster global collaboration and research on this understudied behaviour. The group now includes over 20 researchers from North and South America and Australia, with ongoing recruitment in other regions. Since its inception, the International Basking Turtle Working Group has met quarterly to share findings, compile a global database of basking sites, and has begun a comprehensive literature review. We propose a workshop at the International Sea Turtle Symposium to convene members of this working group, many for the first time in person, and invite new collaborators to join the working group. This session will solidify international relationships, foster new partnerships, and define priorities for future collaborative research. The proposed workshop will be structured as a full-day interactive session featuring a combination of short presentations, group discussions, and breakout activities. It will begin with an overview of current knowledge on sea turtle basking behaviour, followed by updates from participating researchers representing different regions. This will set the stage for facilitated breakout groups focused on key workshop goals, such as refining the global basking database, identifying research priorities, and addressing data gaps. Materials from the workshop including notes, presentation slides, and the updated basking locations database will be shared with all participants and stored in a shared, open-access repository.

11. (*Withdrawn*)

12. Student Workshop: Career paths in sea turtle conservation and techniques in data organization, visualization, and analysis in R

Organizers: Janie Reavis (jreavis3@asu.edu), Derek Aoki, Lindsay Curl

Description: Each year, the ISTS Student Committee organizes a workshop designed for prospective and current students. Its purpose is to provide valuable insights into career guidance, job prospects and opportunities, and specialized techniques related to sea turtle research. We invite up to four experts from different sectors of sea turtle research (i.e., government, non-profit, industry and academia) to give a short 10-20 minute presentation outlining their career path, current position, and share any advice on how to succeed in their job sectors. A Q&A session will follow each presentation, time permitting. The Committee tries to include presenters based across the world with different backgrounds and skillsets so attendees can see how diverse careers in sea turtle conservation can be. For the 2026 Workshop in Kona, we intend to split the four hour workshop into two halves. The first two hours will be reserved for expert presentations, which have yet to be determined. We will begin brainstorming and contacting potential presenters in October-November 2025. Following a short coffee break, Ian Silver-Gorges, a postdoctoral scholar at University of Central Florida, will present a practical overview on R, demonstrating key skills such as data organization, basic analyses, and data visualization. Additionally, we

would like to open this demonstration beyond students and early career individuals to any symposium attendee who wishes to have a refresher in R.

13. Improvements to ESA Section 10 scientific research permitting process

Organizers: Amy Hapeman (amy.hapeman@noaa.gov), Erin Markin

Description: The NOAA Fisheries, Office of Protected Resources, Permits and Conservation Division will host a half-day workshop to present and discuss updates to ESA Section 10(a)(1)(A) scientific research permitting for those working with sea turtles in the marine environment. This workshop will have 2 parts. In the first half, we will provide an overview of the permitting process and recent streamlining efforts, including new national sea turtle standard methods for in-water research, and seek feedback on topics, such as permit requirements and researcher qualifications. This will be an opportunity to discuss any permitting questions or concerns you have. In the second half, we will demonstrate our new online permit application and reporting platform under development. This platform will replace the current application and reporting system, APPS (https://apps.nmfs.noaa.gov), which will go offline in the coming months. We encourage existing permit holders to attend so that you can prepare for this transition. We will give a short presentation of why APPS is changing and how this will affect applicants and permit holders and solicit opportunities to test the new platform. This workshop will be a great opportunity for individuals to discuss the permitting process and provide feedback to Permits and Conservation Division staff.

14. Epibiont insights: Coordinating species lists, collections, and experimentation to inform sea turtle biology

Organizers: Theodora Pinou (Pinout@wcsu.edu), Nathan Jack Robinson, Eric Lazo-Wasem

Description: Over the past century, a wealth of information has been published on the diversity and evolution of sea turtle epibionts. Behind these studies are likely vast collections of epibionts; however, this information is frequently under reported and thus little is known about the care and curation of sea turtle epibiont collections worldwide. For example, a significant/majority of epibiont data are not available as curated records. The purpose of this workshop is to identify collected sea turtle epibiont material and begin discussions of how to make them more accessible and useful. For this half day workshop, leading sea turtle epibiont scientists will offer short talks about their work and collected material. These talks will be followed by an opportunity for researchers to identify collections of sea turtle epibionts that are available but little known (orphan) to potential users. The workshop will offer an opportunity to work collaboratively to propose a strategy to network these collections in hope of making them accessible to the broader community. By Building a network of such “orphan” Epibiont collections, this workshop will allow attendees to share their research, identify material they have collected, and share the current storage location of the material. It is an opportunity to discuss strategies for building a network of global material, and how best to connect/network this material to make it searchable and accessible. We will also explore best practices for storing and sharing DNA samples and sequence data. We may also discuss ways to rate material as appropriate for teaching and/or research. Additionally, we will discuss destructive sampling, and how to handle requests for material that is rare and difficult to collect.

15. Biologging for Conservation: Linking Animal Movements, Human Dimensions, and Management Solutions

Organizers: Sara Maxwell (smmax@uw.edu), Kristen Hart, Tiffany Dawson

Description: This four-hour workshop will explore how biologging can be used most effectively to advance conservation measures for sea turtles and other marine species, while also identifying gaps in technology, management connections, and interdisciplinary integration. We invite participation from those who regularly use biologging as well as those who see its potential in conservation applications, including social scientists, educators, managers, and biologging manufacturers. Participants will hear a series of short presentations showcasing diverse applications, such as: Using animal-borne cameras to guide habitat protection by documenting vessel encounters, risk exposure, or prey resources; Integrating tracking data with social-science approaches to reduce bycatch and collaborate with ocean users; Pairing accelerometers with telemetry to reveal fine-scale turtle behaviors on land (e.g., nesting and non-nesting emergences) and in water (e.g., foraging activity), improving protection and threat reduction; Applying acoustic and spatial telemetry for dynamic fishery management; Using biologging and telemetry data to inform marine protected area design; Combining physiological metrics such as stable isotopes and genetics with biologging to advance population-level conservation; Perspectives from biologging companies on linking technology with conservation outcomes and highlighting upcoming innovations. Presentations will emphasize not only the biological insights gained, but also how biologging facilitated collaboration with managers, local actors, and industry partners. Complementary elements—such as policy frameworks, social-science contributions, and technological advances—will also be highlighted as critical for conservation success. The audience will be asked to actively engage during the presentations to codify common tools, themes, and lessons across the case studies, and connecting these to their own experiences using biologging or other tools. Following the presentations, participants will engage in a facilitated discussion to integrate insights from the case studies. Furthermore, they will be asked to identify biologging needs that still exist, such as tagging technologies or social science approaches for engaging management or users with biologging. The workshop will conclude with the development of a shared framework for conservation action, and envisioning next steps for more effectively integrating biologging with other approaches to advance marine species conservation. The outcomes will be broadly shared as a paper.

16. Emerging Genomic Tools for Sea Turtle Biology & Conservation

Organizers: Lisa Komoroske (lkomoroske@umass.edu), Camila Mazzoni

Description: Genomic resources and approaches have been rapidly increasing for sea turtles and other wildlife species, expanding opportunities for their use to address in a wide range of research in sea turtle biology and conservation. Many researchers have developed genomics-based tools and best practices in the field, lab and analyses that can benefit others, saving time, resources, and sanity. The goal of our workshop is advance these efforts, and to increase access and understanding of the potential and limitations of genomics-based tools for sea turtles. Building on prior ISTS workshops on related topics, this workshop will focus on connecting the community of researchers using these approaches and/or those interested in learning about them for possible future application in their study systems. This workshop will be a mixture of presentations, discussion panels and focus groups, and hands-on demonstrations.

17. Applying 3D Photogrammetry to Monitor and Measure Sea Turtles

Organizer: Spencer Miller (spencermiller@settide.com)

Description: Photogrammetry, the science of creating accurate 3D models from overlapping photographs, is rapidly becoming a powerful tool in marine conservation. While this technology has been widely adopted for coral reef monitoring, and other ocean sciences, its potential for sea turtle research, rehabilitation, and outreach has only recently begun to be explored. This workshop will introduce participants to the fundamentals of 3D photogrammetry and provide practical guidance on how to incorporate it into their sea turtle projects. The session will begin with an overview of what photogrammetry is and why it is valuable for sea turtle work. Applications include non-invasive morphometric measurements, documenting visual injuries in rehabilitation, monitoring growth and condition of turtles under care, and creating digital records of nesting females and hatchlings on beaches. Beyond science and husbandry, the 3D models also offer unique opportunities for outreach and education by allowing the public to interact with highly realistic digital turtles that can build support for conservation programs. Participants will learn about the equipment needed (cameras, software) and how to scale projects based on available resources and budgets, and practice walking through step-by-step on how to build their first 3D model of a sea turtle. The workshop will also cover project planning, including how to design a workflow for specific objectives, logistical considerations in the field or at facilities, and realistic cost and time estimates. Hands-on demonstrations will show how photographs are captured, processed, and transformed into 3D models. Attendees will see example outputs ranging from precise morphometric datasets to visualizations suitable for many applications such as outreach and communication.

18. Machine learning in sea turtle science and conservation: Recent Developments and Future Opportunities

Organizers: Matthew Lettrich (matthew.lettrich@noaa.gov), Christopher Long, Nathan J. Robinson

Description: The use of machine learning (ML) tools is growing rapidly within sea turtle research and conservation. These tools, generally defined as mathematical models that perform a specific task without explicit instructions, have the potential to transform the way we process and analyze large and expanding datasets. To maximize the potential benefits of this movement, we propose to convene a workshop at the ISTS to connect participants that are, or have the interest to start, using ML tools. In doing so, we have three goals: (1) To assess the existing needs, capabilities, perspectives, and prevailing attitudes of the sea turtle research and conservation community with regard to ML tools; (2) To establish a community of practice for ML within the field of sea turtle research and conservation; and (3) To outline key directions and opportunities for collaboration. The workshop will consist of presentations to introduce topics and demonstrate the use of ML tools, breakout sessions to discuss potential ML uses and a discussion to scope the needs and activities of participants in a potential ML community of practice. As ML encompasses a broad field, we will specifically focus on the topics of optics, telemetry, and remote sensing. Nevertheless, there will be flexibility for the discussion to follow the expertise and interest of the participants.

19. Advancing Lighting Initiatives for Sea Turtle and Wildlife Conservation

Organizers: Lucas Davis (lucas_davis@fws.gov), Kristin Halley

Description: Artificial light at night (ALAN) is a growing ecological threat, particularly in coastal regions where it disrupts critical behaviors in sea turtles, shorebirds, and other nocturnal wildlife. Despite increasing awareness, gaps remain in the implementation of effective lighting strategies that align with conservation goals and regulatory frameworks. This workshop aims to bridge the divide between lighting science, conservation practice, and policy development. Through presentations, case studies, collaborative discussions, and interactive testing, participants will learn the basics of exterior lighting, discuss the latest research, and explore practical tools for implementing wildlife lighting practices. Participants will gain a deeper understanding of: The physiological and behavioral effects of ALAN on coastal and migratory species; Current standards and technologies for wildlife lighting; Regulatory mechanisms and policy pathways for implementing lighting ordinances; Collaborative approaches to stakeholder engagement and compliance. By fostering interdisciplinary dialogue and hands-on learning, the workshop will support the development of regionally tailored lighting strategies. The outcomes will inform future conservation planning, enhance regulatory consistency, and promote the adoption of lighting practices that protect habitat while meeting human safety and property needs. This workshop is especially timely as coastal development pressures increase, and agencies seek to align infrastructure projects with conservation goals and environmental regulations. It will serve as a platform for knowledge exchange, network building, and policy innovation to responsibly and effectively light the coastal environment and beyond.

20. 6th Environmental Education Workshop: PBE for Sea Turtle Conservation

Organizers: Pablo Antonio Trujillo Susunaga (ayotzintli@hotmail.com), Amalia María Cano-Castaño, Diana del Pilar Ramírez Acosta, Alba López Bobadilla, Silvia Consuelo Yee Sánchez, Eneida Fajardo Escalona

Description: The Environmental Education Workshop has established itself at the International Sea Turtle Symposium as a space for educators, biologists, environmental leaders, and coastal communities to meet, exchange ideas, and co-create. Its third edition, held in Cartagena, Colombia, was the setting for the proposal to create the Sea Turtle Environmental Education Network (REATOMA). Since then, the Network has organized this space on an ongoing basis, coordinating global efforts and promoting innovative methodologies. Place-Based Education (PBE) is a pedagogical approach that prioritizes experiential, community-based, and contextual learning, strengthening the connection with local environments, cultures, and knowledge. In recent years, it has gained relevance in environmental education by linking conservation projects with practices that are meaningful to communities. In the case of sea turtles, whose conservation depends on their interaction with coastal populations, PBE becomes a strategic path to foster social ownership and revitalize traditions. In line with Kaiāulu, which evokes the strength of community, the workshop seeks to bring sea turtle conservation closer to different actors beyond the coastline. The objective of the workshop is to promote the integration of PBE into conservation projects through the exchange of experiences, strengthening the capacities of environmental educators, and promoting contextualized and participatory learning. The methodology will include the presentation of international projects that apply PBE, along with spaces for dialogue to discuss what constitutes this approach and identify practices that can be adapted to different contexts. Participants will collaboratively develop a base document as

replicable material for environmental educators. In addition, interaction between organizations will be encouraged, strengthening REATOMA and its connection to the purpose of the symposium: to consolidate an active, connected, and collaborative community (Kaiāulu).

Video Night

ENHANCING MARINE TURTLE CONSERVATION IN THE JORDANIAN GULF OF AQABA: PHASE II - FOSTERING INTERNATIONAL COOPERATION FOR BYCATCH REDUCTION AND CAPACITY BUILDING

Location/Country: Aqaba - Jordan

Presenter/Organization: Jordan Society for the Conservation of Turtles & Tortoises (JSCT)

Description: Protecting sea turtles begins long before a rescue at sea. It begins with preparation. This short documentary presents the work of the Jordan Society for the Conservation of Turtles & Tortoises (JSCT) in Jordan, where local capacity building is at the center of marine protection efforts. Through a focused training program in Aqaba, fishermen, divers, civil society members, and officers from the Royal Jordanian Navy are equipped with the practical skills needed to respond safely and effectively to sea turtle emergencies. Rather than isolated interventions, the initiative creates a coordinated network of trained first responders, strengthening long-term conservation impact. By investing in people and partnerships, the program offers a scalable model that can be replicated across coastal communities to protect marine life throughout the Red Sea region.

STC IN PANAMA: COMMUNITY BASED

Location/Country: Bocas del Toro, Panama

Presenter/Organization: Sea Turtle Conservancy

Description: The video highlights the involvement of local Panamanians and indigenous community members in Sea Turtle Conservancy's 23-year-long sea turtle research and conservation program in the Bocas del Toro region of Panama. The story of Felipe Baker, a member of the indigenous Ngäbe-Buglé community of Rio Caña, is a focal point of the video. Mr. Baker got involved with the project as a child, while his mother served as STC's station cook at Playa Chiriquí. Inspired by what he saw, Felipe aspired to become a marine biologist himself and would eventually obtain his degree from the University of Panama. After graduation, he was hired by STC as a field research coordinator and now serves as STC's senior biologist and spokesperson for both sea turtle conservation and the preservation of indigenous culture in Panama.

ECO CENTER BORA BORA

Location/Country: Bora Bora

Presenter/Organization: Eco Center Bora Bora

Description: This video introduces the Eco Center and its commitment to marine and coastal conservation. It presents the center’s key missions, starting with the rehabilitation of sea turtles through rescue, medical care, and release programs aimed at protecting endangered species. The video also highlights coral restoration projects designed to restore damaged reef ecosystems and strengthen marine biodiversity. These initiatives play a vital role in preserving ocean health and supporting local marine life. In addition, the Eco Center focuses on environmental awareness and community education, encouraging responsible behavior and long-term conservation through outreach programs, workshops, and public engagement. Finally, the video showcases field missions carried out by dedicated teams, including regular

patrols of sea turtle nesting sites. These patrols monitor egg-laying beaches, protect nests from threats, and collect valuable data to support conservation efforts. Overall, the video emphasizes the Eco Center's holistic approach, combining science, fieldwork, and education to protect marine ecosystems for future generations.

TURTLES OF THE EASTERN SEA PART -1

Location/Country: Coastal Areas of Odisha and Andhra Pradesh, India

Presenter/Organization: Dr. M. Prabhakara Rao - TREE Foundation, India

Description: This short film follows the work of TREE Foundation across Odisha and Andhra Pradesh during the peak breeding season, capturing powerful community led efforts to protect Olive Ridley Sea Turtles as they return to Indian shores. The film highlights critical sea turtle congregation surveys conducted offshore during the mating season an often unseen but vital phase of conservation. These surveys identify key hotspots where Olive Ridley turtles gather before nesting, tracking their movement, behaviour, and density at sea. The findings help fishing communities and conservation teams reduce accidental bycatch, promote safer fishing practices, and strengthen protection well before turtles reach nesting beaches. By mapping these congregation areas, the work also supports evidence-based policy change, paving the way for the demarcation of Seasonal Turtle Protected Areas. From recording offshore hotspots to safeguarding nests along the coastline, this film demonstrates how science, community stewardship, and timely action can come together to secure a safer future for Olive Ridley sea turtles.

EMPOWERING LOCAL YOUTH IN SEA TURTLE COMMUNITY-BASED CONSERVATION: THE STORY OF GERMÁN

Location/Country: Comunidad Protectora de Tortugas de Osa, Puerto Jimenez, Osa Peninsula, Costa Rica

Presenter/Organization: Grégoire Michel , Comunidad Protectora de Tortugas de Osa (COPROT)

Description: The Osa Peninsula, located on the southern pacific coast of Costa Rica, hosts major nesting populations of Olive ridley and green sea turtles. Since 2019, COPROT has conducted continuous monitoring of nesting beaches, with the objective of collecting nesting data, and to protect the nests against poaching and depredation. Since the start of the project, the community of Carate—a small village whose livelihood is based mainly on small-scale agriculture, tourism activities and property maintenance—has been actively involved alongside the COPROT team, with strong engagement in hatchery monitoring, decision-making, and hatchling releases. At the beginning of the 2025 season, Germán, a 14-year-old from Carate, joined COPROT as an intern for a few weeks. During this time and despite his young age, he developed a strong interest in turtle conservation and impressive fieldwork skills, which led him to stay longer, becoming a research assistant alongside the team of field biologists. This movie presents the daily life of German as a research assistant, showcasing his tasks such as day and night patrols, hatchery management, and nests excavation. This movie highlights the potential, benefits and opportunities this collaboration offers to both German and COPROT, as well as the challenges this situation entails, related to his young age. Germán, with his dedication, represents the essence of COPROT, and is a perfect example of the work COPROT is doing to reduce the gap between the local community and this international conservation program.

WATCHING TURTLES, PROTECTING THE RED SEA

Location/Country: Egypt - Red Sea

Presenter/Organization: Turtle Watch Egypt 2.0

Description: The video presents the mission, approach, and impact of Turtle Watch Egypt 2.0, the first citizen-science–based marine turtle initiative in the country. It explains how the project combines scientific guidance with public participation to generate long-term, reliable data on marine turtles in the Egyptian Red Sea. The content highlights how observations collected by divers, snorkelers, and sea users, such as turtle videos and photographs, are transformed into structured data. When aggregated over time, these contributions help identify key feeding areas, understand movement patterns, and support evidence-based conservation decisions. The video also emphasizes the project's strong educational and community dimension. Through training sessions, outreach tools, and hands-on activities, Turtle Watch Egypt 2.0 works with dive professionals, young people, and local communities to build knowledge, stewardship, and responsibility toward marine turtles and their habitats. Finally, the video reinforces the value of individual engagement, showing how simple, responsible observations can contribute to meaningful scientific knowledge. It positions citizen science as a powerful bridge between people and conservation, demonstrating how awareness, participation, and shared responsibility play a critical role in protecting marine turtles in the Red Sea.

FISHERMEN SAVING OLIVE RIDLEYS IN FRENCH GUIANA

Location/Country: French Guiana

Presenter/Organization: WWF

Description: In French Guiana since 2020, a voluntary no fishing zone is decided each year to protect olive ridleys. This zone is located in front of the biggest nesting site for this species and every year, depending on the Moon cycles (influencing dates of Arribada events), the dates of the no-fishing zone are decided with fishermen. This has allowed the numbers of olive ridleys' nesting events to bounce back.

COMMUNITY BASED MARINE ECOSYSTEM CONSERVATION OFF GOA INDIA

Location/Country: Goa, India

Presenter/Organization: Comdt AKS Panwar (Retd), TREE Foundation, Goa Indis

Description: The video shows the work being done by the TREE Foundation team in the state of Goa India. The workshops and outreach programmes conducted for stakeholders, fishers, and enforcement agencies. The video also brings out the impact of our programme which has motivated fishers to release turtles cough in their nets. The video also brings out our thrust for recovery of Ghost Nets and associated ropes etc from the sea and coastal areas.

INVESTIGATING DENSITY-DEPENDENT EFFECTS ON HATCHING SUCCESS IN GRANDE RIVIERE, TRINIDAD AND TOBAGO

Location/Country: Grande Riviere, Trinidad and Tobago

Presenter/Organization: Teal Guetschow, Arizona State University

Description: Leatherback turtles, the largest and most unique of all sea turtle species, require urgent conservation attention, particularly in the Wider Caribbean region where abundance has declined significantly in recent years. On the northeast coast of Trinidad in the West Indies, a small stretch of coastline around a kilometer long, hosts the densest leatherback nesting beach in the world. However, tradeoffs between high nesting female abundance and density-dependent effects on hatchling production could inadvertently have negative implications for population stability and recovery. Over three environmentally diverse nesting seasons (2023-2025), this study, in collaboration with the Grande Riviere Nature Tour Guide Association, relocated highly vulnerable clutches to a controlled hatchery of low, medium, and high nest density research plots. By manipulating nest density and monitoring incubation conditions, we aimed to better understand how nest crowding alters the nest environment and impacts hatching success. In this video, we briefly recap our 2025 field season, documenting each stage of field research—from clutch relocations to nest excavations—while highlighting the vital role of community stakeholder participation in conservation. Local collaborators, field assistants, and volunteers were all integral to each aspect of the research, demonstrating how science and community can work together to protect this iconic species.

HISTORIAS REPETIBLES PROYECTO MACURO

Location/Country: Gulf of Paria

Presenter/Organization: Provita/Fudena NGOs Vzla

Description: A more human perspective on the sea turtle conservation program centered in the fishing village of Macuro, Venezuela, reveals the significance of hawksbill turtles as critically endangered species and the importance of the Gulf of Paria as the second main rookery in the southern Caribbean Sea. Our initiative focused on training local residents, transforming them from poachers into dedicated turtle protectors and reliable local assistants. This effort not only helped to conserve the hawksbill turtle population but also fostered a sense of community responsibility towards environmental stewardship. Our experience was recognized by Bancamiga, a Venezuelan financial institution, which, along with our collaboration with local park rangers, highlighted our project as a commendable example of nature conservation and effective community engagement.

TURTLE PATROL STORY

Location/Country: Hilton Head Island, SC

Presenter/Organization: Sea Turtle Patrol Hilton Head Island

Description: The video expresses the struggle and significance of an animal that has contributed to the ecosystem with resilience and adaptability. The efforts of Sea Turtle Patrol HHI are highlighted to make visitors and residents aware of the hard work that provides the endangered loggerhead sea turtles with the best chance of nesting and emergence success. Public education contributes to the success of the nesting season by making visitors aware of their impact on the beaches.

"THE RESCUE" THE GREEN SEA TURTLE, "OCEAN GUARDIANS" ANIMATION OF THE HONG KONG MARITIME MUSEUM

Location/Country: Hong Kong Maritime Museum, Hong Kong SAR, People's Republic of China

Presenter/Organization: Dr. Connie Ka Yan NG, Head of Marine Discovery Centre, Hong Kong Maritime Museum

Description: "Ocean Guardians Series produced by the Hong Kong Maritime Museum is an engaging animation series to grow the bond of children to the ocean, enhance their awareness and motivate their conservation actions. Embark on an underwater adventure in Hong Kong with Dr. Connie in this journey! Follow Dr. Connie (Head of Marine Discovery Centre) and her marine friends as they dive into exciting underwater missions. Along the journey, Dr. Connie interacts with various local sea creatures and uses special magic tools to carry out rescue operations. The story highlights the impact of human activities on the marine environment, inspiring audiences to reflect and take action to protect our precious oceans. In this episode, Dr. Connie receives an SOS signal from marine animals at the Tung Ping Chau Coral Tower. She discovers her friend, the green sea turtle mother, entangled in fishing nets and plastic bags! Join Dr. Connie to see how she uses her magic tools to rescue the green sea turtle!"

PROFILE OF YAYASAN PENYU INDONESIA (YPI)

Location/Country: Indonesia - Working sites at Berau (Kalimantan), Simuelue (Aceh), Nias (North Sumatera), Sipora (West Sumatera) and Denpasar (Bali)

Presenter/Organization: Yayasan Penyu Indonesia (YPI)

Description: "Nestled between the Indian and Pacific Oceans, Indonesia is a biodiversity hotspot and an essential habitat for sea turtles. Of the seven sea turtle species found worldwide, six inhabit Indonesian waters, and five regularly nest on our shores. Their survival is crucial for maintaining the delicate balance of marine ecosystems. Yayasan Penyu Indonesia – YPI is dedicated to safeguarding sea turtles and their habitats. Our mission extends beyond conservation—we also work to address the threats they face while fostering sustainable community empowerment."

FROM RESCUE TO RELEASE - MISTY'S FIGHT FOR SURVIVAL

Location/Country: Juno Beach, Florida

Presenter/Organization: Bethany Holtz, SEE Turtles

Description: Episode 6 of Sea Turtle Week: The Mini Series features a heartwarming story of Misty, a majestic green sea turtle, as she embarks on a remarkable journey from rescue to her triumphant return to the ocean. Watch as Misty overcomes severe injuries with the help of dedicated staff at the Loggerhead Marinelife Center. Plus watch as they make a surprising discovery during her care. Follow Misty's inspiring recovery process, culminating in her release back into the wild. Celebrate the success as her baby sea turtles begin their own journey to the ocean. Misty's story is a testament to resilience, hope, and the dedication of those committed to protecting these incredible creatures. Join us in this inspiring tale of recovery and triumph, and learn how we can all contribute to marine conservation.

SAUTI ZA KWALE - VOICES OF KWALE: PRACTISING SEA TURTLE CONSERVATION IN KENYA

Location/Country: Kenya

Presenter/Organization: Olive ridley Project - Kenya

Description: Sauti Za Kwale (Voices of Kwale) is a short documentary film that highlights the powerful community-driven conservation work led by ORP's Education Outreach Officer, Juma Gwerenya, along with the dedicated Sea Turtle Ambassadors from four fishing communities in Southern Kenya. This inspiring film showcases how these local champions are empowering their peers and driving grassroots efforts to protect endangered sea turtles and preserve the marine environment.

SEA TURTLE AWAKENING - LAGOS NIGERIA

Location/Country: Lagos, Nigeria

Presenter/Organization: Chinedu Mogbo - Greenfingers Wildlife Initiative

Description: This video comments on the challenges facing sea turtles in Nigeria and how a captured sea turtle shows us how important it is to create marine protected areas. It also highlights our efforts in raising awareness for Sea Turtles in Nigeria

LISSENUNG ISLAND TURTLE CONSERVATION

Location/Country: Lissenung Island, Kavieng, Papua New Guinea

Presenter/Organization: Lissenung Island Turtle Conservation

Description: "Lissenung Island Turtle Conservation is a grassroots initiative based at Lissenung Island Resort near Kavieng in New Ireland Province, Papua New Guinea. Established in 2013 by resort owners Ange and Dietmar Amon, the program is dedicated to protecting endangered sea turtles from poaching and habitat loss. Covering only 2 small islands, it has successfully released over 30,000 live hatchlings so far. Key Aspects of the Conservation Program: Egg Protection & Relocation: During nesting season (roughly September to February), the team patrols two nearby islands at dawn to locate nests. Eggs are rescued from vulnerable areas and moved to a safe hatchery on Lissenung Island to protect them from poachers and natural predators; Data Collection & Rehabilitation: The team weighs, measures, tags turtles and collects tissue samples for DNA before releasing them to help scientific research. They also rehabilitate injured or weak turtles; Community Involvement: The project works with local communities to educate them on sustainable practices, aiming to reduce the consumption of turtle eggs and meat. Local school children are involved in release events as well as beach clean-ups."

DE SAL Y ARENA: EL FRÁGIL FUTURO DE LAS TORTUGAS MARINAS A TRAVÉS DE LA MIRADA DE UN PEQUEÑO GRUPO DE CONSERVACIONISTAS

Location/Country: Los Cabos, Baja California Sur, México

Presenter/Organization: Abilene Colin, Miguel SR y ASUPMATOMA A.C.

Description: In Baja California Sur, Mexico, "El Suspiro" Beach becomes a nesting ground for the olive ridley sea turtle (Lepidochelys olivacea). In 2025, more than 114,700 eggs were laid in the sand. Yet the

olive ridley shares a critical reality with most sea turtle species: it is estimated that only one in every thousand hatchlings will survive to adulthood, the stage required to reproduce and ensure the continuity of the species. Survival begins beneath the sand, inside the eggs. Rising temperatures linked to global warming are causing severe imbalances in sex ratios and, in many cases, preventing hatchlings from being born. Coastal habitat degradation, pollution, illegal poaching, and industrial fishing further increase the vulnerability of sea turtles. To confront this scenario, the civil association ASUPMATOMA has been patrolling thirteen kilometers of coastline for more than three decades. This local, non-profit organization works with a field team that rarely exceeds five people. Their work is constant and physically demanding: patrolling every night to locate nesting females, relocating eggs to protected hatcheries, monitoring nests and releasing hatchlings at the right time. After more than 150 million years in the oceans, sea turtles now survive within a fragile balance affected by human activity and sustained by the commitment of a few. All seven species of sea turtles are currently listed on the IUCN Red List of threatened species. “De Sal y Arena” is an independent production by Miguel SR, a documentary photographer and filmmaker pursuing long-term visual storytelling as a way of life.

MANY HANDS, ONE TURTLE

Location/Country: Maui, Hawaii

Presenter/Organization: The Marine Institute at Maui Ocean Center

Description: This video highlights the interconnected effort to rescue, rehabilitate, and protect Hawai‘i’s sea turtles and the coral reefs they depend on. It reflects how awareness, trained responders, medical expertise, and community participation unite to create lasting conservation impact.

SEA TURTLE INC - THEN, NOW AND ALWAYS

Location/Country: South Padre Island Texas

Presenter/Organization: Sea Turtle Inc

Description: This video offers an inside look at the relentless, often exhausting work behind sea turtle conservation at Sea Turtle Inc. From emergency rescues and hands-on education to global knowledge sharing, it highlights the people, passion, and perseverance that have driven the organization for nearly 50 years, all in service of protecting animals that cannot protect themselves.

TETIAROA ATOLL GREEN SEA TURTLE MONITORING

Location/Country: French Polynesia

Presenter/Organization: Dr Gaspar Cécile, Dr. Gouin Jade , TE MANA O TE MOANA

Description: Te mana o te moana team of veterinarians and biologists have set up a long term monitoring of green sea turtle besting on Tetiaroa atoll, the only HOPE SPOT from Mission Blue in French Polynesia.

LEATHERBACK CAPTIVE REARING AT THE PHUKET MARINE BIOLOGICAL CENTER

Location/Country: Thailand

Presenter/Organization: George Shillinger, Upwell Turtles, Hirun Kanghae, Phuket Marine Biological Center

Description: In a perfect world, ex situ interventions like captive rearing and rewilding would not be necessary, but the urgent need to recover the critically endangered East Pacific population warrants "out-of-the-box" thinking. Upwell is exploring the viability of ex situ methods as a complement to ongoing nesting beach protections and fisheries bycatch reduction efforts. In 2023, Upwell began a partnership with the Phuket Marine Biological Center (PMBC) after their unprecedented success in captive-rearing leatherback sea turtles for over one year. In this video, Upwell Executive Director George Shillinger interviews PMBC Senior Professional Level Fishery Biologist Hirun Kanghae about the PMBC's methods and insights on captive rearing leatherback sea turtles.

SEA TURTLE HATCHLINGS ARE NOT PETS

Location/Country: The Maldives

Presenter/Organization: Atoll Marine Conservation Centre

Description: This video highlights the illegal keeping of sea turtle hatchlings as pets in the Maldives and the serious consequences this practice has on their welfare. It explains why removing hatchlings from the wild is harmful, illegal, and a threat to ocean ecosystems, while also showing how education and outreach can make a difference. The message extends beyond sea turtles, reminding us that wild animals belong in the wild, not in captivity.

THE JUNIORS: GROWING TOGETHER WITH SEA TURTLES

Location/Country: Tortuguero, Costa Rica

Presenter/Organization: Sea Turtle Conservancy

Description: The Junior's Assistant Program is a community-based educational initiative developed by the Sea Turtle Conservancy in Tortuguero, Costa Rica. Since 2010, the program has accompanied local teenagers through a long-term learning process that combines sea turtle conservation, experiential education, and community engagement. The Juniors participate in real conservation activities alongside trained adults, including nocturnal beach patrols and morning census during the nesting season. The program emphasizes meaningful participation through observation, non-invasive data collection, environmental monitoring, and the care of ethical field practices. Roles are intentionally designed to balance scientific support with attentive observation and respect for the animals, allowing young people to connect deeply with the nesting process. Learning is rooted in direct experience in the territory and integrates action, emotional engagement, and conceptual understanding. Beyond technical skills, the Juniors Assistant Program fosters responsibility, critical awareness, and a sense of belonging to both the local community and the broader conservation effort. For many participants, the program represents a formative space for personal growth, environmental stewardship, and connection to their natural heritage.

Social, Cultural, & Community Events

Participatory Art Experience with Patrick Ching

Description: Patrick Ching is a Hawai‘i-born artist, author, and conservation educator widely known as Hawai‘i’s Nature Artist. His work centers on native wildlife and island ecosystems and has been featured in galleries, public murals, books, and educational programs throughout the islands. During the symposium, Patrick will lead a participatory art experience inviting attendees to collaboratively engage with themes of marine life and conservation. He will also have a table featuring prints and selected works available throughout the week.

Makana Aloha

Description: A gratitude program allowing participants to recognize mentors, colleagues, and peers by gifting a small item with a short note. Gifts may be pre-ordered through the symposium registration website or purchased in person while supplies last, with recipients notified by email for pickup.

Welcome Social

Description: The first large social event of the symposium, featuring live Hawaiian and Pacific music, hula and Tahitian dance, audience participation, and a fire dancing finale. Pūpūs will be served throughout the evening. This is a welcoming, festive way to start off the main events of the symposium.

Student Mixer

Description: An hour before the Welcome Social, the venue opens exclusively for students to meet one another in a relaxed setting. This dedicated student-only hour provides space for introductions, networking, and early connection building before the larger crowd arrives.

Speed Chatting with the Experts

Description: A dynamic networking event hosted by the ISTS Student Committee, designed to connect students with sea turtle experts through short, focused conversations. Modeled after “speed dating,” participants rotate through brief one-on-one discussions with experienced researchers who volunteer their time for Q&A. Students can ask about research, career paths, advice, or simply meet and greet. The event offers an informal and approachable way to speak with professionals whose work attendees may recognize.

Experts: Kristen Hart, Roldan Valverde, Armando Barsante Santos, Renato Bruno, Yonat Swimmer, Edwardo Resendiz, Larry Katahira, Kathy Zagzebski, Terry Meyer

Video Night

Description: An evening of short films highlighting sea turtle research, conservation, education, and outreach from around the world. Video Night will be open to the public this year, with admission for non-participants supporting travel grants and the ISTS (see list above).

Origin Stories

Description: A reflective event where turtlers share how they entered the field and what experiences, mentors, and turning points shaped their careers. The session can also simply highlight funny or intriguing

stories from the field. Join us as we celebrate the diversity of paths and experiences within the sea turtle conservation community.

Turtle Trading Post

Description: A free equipment raffle that helps move surplus field and lab gear from long standing projects to students and groups working in low income or hardship affected regions. Attendees may place tickets on items of interest, and winning tickets are drawn during the event. Donated items must be functional and submitted no later than the day before.

Silent Auction

Description: The Silent Auction raises funds for ISTS Travel Grants by offering unique turtle themed items donated by delegates. Donations will be accepted through 5 pm on Wednesday, March 4th, after which items will be sorted into the Silent or Live Auction. Bidding opens Monday morning and closes after lunch on Thursday the 5th at 2:00 pm. Winners must pick up and pay for items by 5:00 pm on Thursday the 5th. If items are not picked up by that time, they will be made available to the highest bidder at that time. Most major credit cards will be accepted.

Live Auction

Description: A lively and entertaining auction that raises significant funds for travel grants. Delegates donate distinctive or humorous items, experiences, services, and regionally inspired gifts. The event often features bidding battles, friendly competitions, and plenty of crowd participation.

Foraging with a Friend

Description: An informal mentorship and networking activity where experienced professionals host a meal for students or early career researchers. Participants coordinate the time and location on their own using contact information from an online sign-up sheet. The goal is to reduce the cost of meals for early career attendees and create space for meaningful conversation.

Farewell Lū'aū and Awards Ceremony

Description: The final event of the symposium. Attendees gather on the Hawai‘i Lawn for dinner and Hawaiian music before and the awards ceremony, which celebrates the Archie Carr Student Awards, Grassroots Conservation Award, and ISTS Lifetime, Champions, and Volunteer awards. The evening concludes with live music and closing words as participants say aloha until the next symposium.

ORAL AND POSTER SESSION DESCRIPTIONS

Anatomy, Physiology, & Health

This session includes research on all aspects of sea turtle form and function, and how these relate to the environment. Studies and reports fitting in the anatomy, physiology, and health session include anatomy, functional morphology, physiology, reproductive biology, embryonic development, physiological stress, toxicology, thermal biology/thermoregulation, osmoregulation, and their relationships to normal turtle health. Studies of abnormal health or treatments do not belong in this session. Priority for oral presentations will be given to those studies demonstrating clear scientific methodology, presenting innovative approaches, methods, technology, and/or analyses, and those studies yielding novel findings.

Rehabilitation & Veterinary Care

This session includes research on rehabilitation and veterinary care and on individual and population-wide health problems. Includes studies and reports on diseases, veterinary care, rehabilitation, and health assessment. Priority for oral presentations will be given to those studies demonstrating clear scientific methodology, presenting innovative approaches, methods, technology, and/or analysis, and those yielding novel findings.

Nesting Biology (Ecology, Behavior, & Reproductive Success)

This session will focus on nesting beaches, nesting females, nests, hatchlings, eggs, and closely related topics. Relevant subjects include assessments of nesting population size, modelling 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. Priority for oral presentations will be given to studies that have a clear scientific methodology, report new findings, and/or involve innovative methods, technology or analysis.

In-Water Biology (Behavior, Ecology, Migration, Telemetry, & Foraging)

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. Priority for oral presentations will be given to those works developed under a scientific method approach and those reporting new or innovative findings.

Population Biology & Monitoring (Status, Modeling, Demography, Genetics, Nesting Trends, & In-Water Trends)

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 modelling approaches to population biology in which mathematical or simulation models are used to elucidate marine turtle population parameters and vital rates. Priority for oral sessions will be given to presentations that involve novel, integrative approaches to defining demography and population structure, as well as reports involving long-term monitoring programs. Short-term assessments of nesting populations and descriptive studies should be submitted as poster presentations.

Fisheries & Threats

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. Priority for oral presentations will be given to those studies showing a clear scientific method approach, and those presenting innovations in their approaches, technology and/or analysis.

Conservation, Management, & Policy

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. Priority for oral presentations will be given to presentations that meet several of the following criteria: includes new data and/or a new perspective; presents novel approaches to sea turtle conservation, management, and/or public policy; highlights a global geographic area that has previously been under-reported; includes robust evaluation of implementation, methodology and policy; describes use and application of new tools in management initiatives that result in successful conservation outcomes.

Education, Outreach, & Advocacy

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. Priority for oral presentations will be given to those who highlight innovative approaches, methods, results, and lessons that may be widely applicable to outreach and advocacy efforts in many regions worldwide.

Social, Economic, & Cultural Studies

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. Priority in oral presentations will be given to authors who provide clear indications of social science or other recognized approaches in their abstracts, those discussing under-reported geographic regions, and those with compelling case studies that may hold global lessons.

ABSTRACTS

Anatomy, Physiology, and Health

VALIDATION OF A COMMERCIAL ELISA KIT FOR DETECTING CORTICOSTERONE IN PLASMA AND CLAWS OF SEA TURTLES

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Chelonians deal with natural ecological stressors and anthropogenic stressors such as incidental capture in fishing gear and environmental contaminants like polyfluoroalkyl substances (PFAS). Corticosterone is a hormone associated with the hypothalamic-pituitary-adrenal (HPA) axis stress response in vertebrates that has been used in various studies as a proxy for stress and energy mobilization (Neuman-Lee et al. 2020). Corticosterone has been documented in wildlife tissues, such as plasma, feathers, and claws. Plasma has been used to study corticosterone in chelonians but is not effective for studying chronic and long term stress, as plasma corticosterone levels fluctuate within minutes of exposure to acute stressors (Romero and Reed 2005). To examine long-term stress exposure, a keratin-based tissue like claws is more suitable, because claws accumulate corticosterone over longer periods of time (Fokidis et al 2023). Additionally, collecting claw samples is a less invasive way to study physiological changes in chelonians. Plama corticosterone has been measured in sea turtles using radioimmunoassay techniques but not by commercial immunoassay kits that are more widely available and do not require the use of radioactive materials. My research aims to validate the use of a commercially available enzyme-linked immunosorbent assay (ELISA) kit to measure corticosterone in sea turtle plasma and claws. These validation studies are the first step towards a more widely available technique to monitor stress levels of these species. Blood and claw samples obtained from wild-caught sea turtles were processed using methods described for other chelonian species (Baxter-Gilbert et al. 2014, Williard et al. 2015, Harden et al. 2015). Corticosterone in blood plasma and claw extracts will be quantified using the Arbor Assay Corticosterone ELISA kit (KO14-H1/H5). The ELISA uses enzyme-labeled antibodies to bind to corticosterone and then creates a color reaction through addition of the enzyme's substrate. The color reaction is quantified by intensity using a microplate reader that measures absorbance, providing a measure of corticosterone. Competitive binding in this ELISA will be sensitive and suitable for quantifying low levels of corticosterone. Parallelism studies will be conducted to validate the use of the ELISA kit for each tissue type in each species (Baxter-Gilbert et al 2014). In brief, linear regression analyses and ANCOVA will be used to compare serial dilutions of the corticosterone standard and the tissues samples to assess the efficacy of the assay in detecting corticosterone in the samples. Coefficients of Variation (CVs) will be used to assess precision and repeatability of corticosterone measurements within and between assays. Accuracy of the assay will be assessed by evaluating the relationship between observed vs. predicted values of corticosterone from tissue samples spiked with known quantities of corticosterone. Validation of a commercially available corticosterone ELISA on multiple tissue types would expand research techniques to understand the stress physiology of sea turtle species of conservation concern. Not only will the results be beneficial to management and conservation, but researchers will have a widely available way to study acute and chronic physiological responses to stress.

LINKING MOLECULAR BIOMARKERS TO SEA TURTLE HATCHLING SEX: PROGRESS AND CHALLENGES

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Temperature-dependent sex determination (TSD) complicates accurate primary sex ratio assessment in sea turtles and increases vulnerability to climate-driven warming, which is predicted to produce increasingly female-biased cohorts. Reliable, non-lethal methods for sex identification are therefore critical for large-scale population monitoring and conservation management. However, most currently available techniques require euthanasia or invasive laparoscopy, limiting their practical and ethical application. Molecular biomarkers derived from blood represent a promising alternative because blood can be collected non-lethally and contains both nucleated cells and circulating proteins suitable for molecular analyses. We investigate RNA- and protein-based approaches for non-lethal sex identification in loggerhead (*Caretta caretta*) sea turtle hatchlings using samples from both controlled incubation experiments and in situ nests. Building on prior transcriptomic discovery analyses of hatchling blood from controlled temperature treatments, we tested whether candidate sex-associated genes retain sex-biased expression patterns under natural thermal regimes. RNA was extracted from nucleated red blood cells, and expression of candidate genes was quantified using reverse transcription quantitative PCR (RT-qPCR). Candidate markers were selected from previous RNA-seq results and targeted for validation across incubation contexts. In parallel, we conducted a non-targeted proteomic screen of hatchling plasma to evaluate whether sex-associated protein differences are present and could inform future biomarker development. Plasma samples from hatchlings incubated under both controlled and in situ nest conditions were analyzed using non-targeted mass spectrometry. Preliminary analyses identified multiple proteins detected exclusively in either male or female hatchlings, indicating potential sex-specificity. Top candidate proteins are being prioritized for follow-up validation using targeted mass spectrometry approaches to evaluate reproducibility and diagnostic performance. Together, these RT-qPCR and proteomic results represent an important step toward identifying and validating blood-based molecular biomarkers for non-lethal sex identification in TSD species. Such tools would enable broader, less invasive primary sex ratio monitoring across nesting beaches. Improved sex ratio assessment will strengthen demographic modeling and conservation decision-making under projected climate warming.

TRACING MICROPLASTIC PATHWAYS IN GREEN SEA TURTLES: EVIDENCE OF RETENTION, TRANSLOCATION, AND DIETARY INTERACTIONS

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Green sea turtles (*Chelonia mydas*) are important marine herbivores, yet they are increasingly exposed to plastic pollution through their diet of seagrasses. Understanding the extent and distribution of microplastic accumulation in their gastrointestinal (GI) tract is critical for assessing ecological and physiological risks. This study quantifies seagrass, macroplastic, and microplastic content in both the stomach and intestines of green sea turtles and evaluates how these materials are distributed between tissue and digesta. Necropsies were performed on 12 turtles to date (target n = 50). GI tract sections were stored at –20°C and processed in a fume hood with filtered controls. Each sample—stomach content, stomach tissue, intestinal content, intestinal tissue, and a procedural control—were incubated in 10% KOH at 60°C for 24 hours with agitation, followed by vacuum filtration. Filters will be analyzed using μ-FTIR spectroscopy to identify and quantify microplastic particles as well as size, type, and color of microplastic. Preliminary results indicate that two turtles contained visible macroplastics, and seagrass is consistently present across all GI tract sections, reflecting dietary intake. This study aims to elucidate mechanisms of microplastic accumulation in green turtles by comparing stomach versus intestinal content and tissue, examining retention, translocation, and potential interaction with dietary seagrasses.

EVALUATING JUVENILE GREEN TURTLE HEALTH IN RELATION TO SIZE, HABITAT, AND DISEASE STATUS

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As human populations increase and coastal habitats continue to see anthropogenic stressors, ecoimmunological studies become increasingly important. Nearshore lagoons, estuaries, and reef structures in eastern central Florida (USA) are considered critical habitats for juvenile sea turtles but are subject to anthropogenic stressors such as recreational fishing, military activity, commercial vessel traffic, and agricultural run-off. We need a better understanding of how health and immune function in juveniles varies in response to anthropogenic stressors, disease, and naturally with season and turtle age. We used two near-shore juvenile green sea turtle aggregations to test for differences in sea turtle health and immune proxies (1) between two habitats with different anthropogenic stressors; (2) across turtle size and (3) water temperatures; and (4) between turtles across fibropapilloma (FP) tumor severity. Immune system proxies (differential white blood cells counts and plasma total protein concentration) and physiological proxies (Packed Cell Volume and plasma biochemistry analytes) were collected using blood samples from juvenile green turtles between 2021-2023 from two year-round foraging habitats in eastern central Florida (USA), the Indian River Lagoon (IRL, n= 87) and Trident Basin (n=68). On average, turtles captured in Trident Basin were smaller (Straight Carapace Length [SCL] 29.7 cm, range 22.0-43.6 cm) compared to IRL turtles (SCL 47.3 cm, range 27.6-74.0 cm) and both habitats had FP positive individuals, though in different quantities (10% of captures in Trident versus 54% in the IRL). Multivariate Bayesian linear mixed effect regression models and generalized linear mixed models were used to evaluate relationships between health

and immune proxies and predictor variables. We found a lack of significant difference in collective health-immune proxies between the IRL and Trident habitats, which pose additional questions about habitat quality at each location, as neither are pristine. Trends within the proxy data indicate that both habitats may have unique but similar magnitude of stressors present influencing the lack of statistical differences between the two habitats. Overall, we found that smaller green turtles with severe FP tumors may be at risk for declining health and compromised immune function during colder seasons, which can be exacerbated in habitats with poor nutrient quality. Further understanding relationships between anthropogenic stressors and health-immune function is important for establishing conservation and habitat restoration targets and monitoring population health, particularly during periods of environmental change such as harmful algal blooms, oil spills, or increased nutrient run-off.

PHYLOGENETIC ANALYSIS AND VARIABILITY OF INTERLEUKINS IL-1B AND IL-10 IN SEA TURTLES

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The evolution of the immune system has resulted in cytokines playing a key role as coordinators of the immune response. Unlike in mammals, the immune system of reptiles remains poorly understood, and sea turtles are no exception, raising the question of whether these proteins have been highly conserved throughout evolution. The marine aquatic habitat posed challenges, including interactions with novel pathogens and the rapid evolution of immune-response proteins. Environmental conditions influence the immune systems of ectothermic sea turtles; actual changes in marine ecosystems are making marine organisms increasingly vulnerable to disease and infection. A better understanding of sea turtle immune systems will help clarify how environmental factors have shaped the evolution and diversification of immune-related genes and proteins, as well as the regulation of immunity. Interleukin 1 (IL-1) is a key mediator of microbial invasion, inflammation, immunological reactions, and tissue injury; interleukin 10 (IL-10) downregulates immune responses, preventing damage caused by the host's inflammatory response. This study aimed to perform a phylogenetic analysis of IL-1β and IL-10 to determine how conserved these proteins are in sea turtles compared with other reptile groups (particularly freshwater turtles and tortoises), and with marine mammals that, like sea turtles, have adapted to a marine habitat. The hypothesis of this study is the IL-1β and IL-10 sequences of sea turtles will show high evolutionary conservation with respect to other groups (reptiles and marine mammals). The coding and amino acid sequences for IL-1β and IL-10 were downloaded from NCBI. Sequence alignments (MUSCLE/MEGA) were analyzed using IQ-TREE v3 (ModelFinder; SH-aLRT=1,000; UFBoot=10,000). Positional variability was estimated through Shannon entropy (H), and sites under selective pressure were identified. Monophyletic clades with high support at the main nodes were identified. The chelonians *Lepidochelys kempii* and *Caretta caretta* are a well-supported clade, with *Chelonia mydas* and *Natator depressus* closely related to this group; *Dermochelys coriacea* shows greater relative divergence. In contrast, pinnipeds and cetaceans formed distinct, consistently supported clades, separated from non-marine chelonians. Entropy analysis revealed

high conservation in both cytokines: most positions showed H<1.0; amino acid peaks were moderate (IL-1β max ~H=1.67; IL-10 max ~H=1.63), and nucleotide entropy was lower, consistent with functional constraints on central domains. These results indicate that, despite adaptations to the marine environment, IL-1β and IL-10 remain highly conserved in sea turtles, maintaining the expected evolutionary architecture within chelonians and clearly differentiating from marine mammals.

FIRST RECORD OF TRIPLET EMBRYOS IN SEA TURTLES: EVIDENCE OF NATURAL POLYEMBRYONY IN A WILD GREEN TURTLE (*CHELONIA MYDAS*) NEST FROM GUANAHACABIBES, CUBA

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Polyembryony, the development of two or more embryos from a single fertilized egg, is a rare and poorly understood developmental phenomenon in oviparous vertebrates. Among reptiles, including Chelonians, previous reports describe only occasional monozygotic or conjoined twins, mostly in captive freshwater turtles and tortoises, and rarely in wild sea turtle populations. To our knowledge, no confirmed records of triplet turtle embryos exist among Chelonians. This absence is remarkable given the extensive monitoring of sea turtle nesting populations worldwide. Understanding such anomalies is essential for comparative embryology and for advancing knowledge of early ontogenetic processes and their environmental or genetic influences. One clutch of green turtle eggs was excavated as part of a long-term monitoring program conducted by staff from the University of Havana, volunteers, and the Guanahacabibes National Park administration. The excavation took place on 23 August 2025, after the normal hatching period. The assessment of congenital malformations followed the standard protocol proposed by Bárcenas-Ibarra et al. (2019). Of 131 oviposited eggs, 120 developed and hatched successfully, eight showed no embryonic development, and three were nonviable, containing embryos that died before hatching. Necropsies revealed that all embryos from the three unhatched eggs were at various developmental stages and presented congenital malformations. Egg A contained one embryo at developmental stage 28, showing supernumerary vertebral scutes on the carapace. Egg B contained two embryos attached to a single yolk mass, consistent with polyembryonic twins sharing extraembryonic structures and lacking somatic fusion. Embryo B1 was at stage 28 and larger than Embryo B2 (stage 27); both exhibited supernumerary vertebral scutes on the carapace. Egg C contained three embryos attached to a single yolk mass, also lacking somatic fusion, and was interpreted as polyembryonic triplets sharing extraembryonic structures. Embryos C1 and C2 were at stage 28, similar in size, and both showed supernumerary scutes on the carapace. Embryo C3 was smaller at stage 27 and exhibited additional craniofacial malformations, including microcephaly, right anophthalmia, left macrophthalmia, and left mandibular hypoplasia. The presence of a single yolk mass, associated with independent embryonic axes and distinct vitelline vascular networks, supports a polyembryonic origin. This finding constitutes the first documented evidence of triplet embryos in a wild sea turtle nest and, more broadly, in Chelonians. Although polyembryony has occasionally been reported within this group, the natural occurrence of triplets raises key questions about the mechanisms underlying multiple embryogenesis. Possible causes include early cleavage irregularities, nest temperature variation, or genetic predisposition. While polyembryony can sometimes produce viable twins in other taxa, triplet formation likely results in developmental arrest before hatching, providing a rare opportunity to examine the limits of embryonic regulation and developmental plasticity in Chelonians. This case broadens the known spectrum of developmental variation in *Chelonia mydas* and provides a novel record for global Chelonian embryology. It highlights the importance of continuous monitoring and documentation of

congenital malformations within nesting programs, which can reveal environmental stressors and reproductive plasticity. Future histological and genetic analyses could clarify whether such phenomena originate from spontaneous cleavage or early developmental errors.

CARDIAC AND RESPIRATORY ACTIVITY IN LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) ARE INFLUENCED BY THE CIRCADIAN CYCLE

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Background: Daily variation in behaviour and physiology is observed across many species, often following an approximately 24-hour circadian cycle influenced by environmental cues (e.g., light and temperature). These rhythms affect key physiological processes (metabolism, hormone secretion, and cardiovascular functions); however, limited data exist on diel patterns in sea turtles. Methods: We investigated diel patterns in heart rate and activity in five wild juvenile loggerhead sea turtles (*Caretta caretta*; 41.8–57.7 kg) accidentally captured in set nets along the Sanriku coast, Japan, between June and August 2024. Turtles were housed individually at the Otsuchi Coastal Research Center, The University of Tokyo, in shallow circular tanks (150 cm diameter, 70 cm depth; suitable for diel cardiac measurements) with seawater at ambient temperatures (17–24 °C). Heart rate and activity were recorded using a physio-logger (ECG400-D3GT; Little Leonardo, Japan)1. After a minimum of 10 h acclimation, we collected ECG, tri-axial acceleration, and temperature data during 28 h. Breathing frequency was inferred from ECG, Overall Dynamic Body Acceleration (ODBA), temperature, and time of day using prior video data from the same individuals. Results: The mean heart rate recorded across all turtles was 10.5 ± 3.9 bpm. Heart rate exhibited diel fluctuations, averaging 11.2 ± 3.7 bpm during the day and 9.9 ± 4.4 bpm at night. When activity was classified using ODBA, heart rate during inactivity showed a right-skewed distribution, peaking at ~5 bpm during the day and ~6 bpm at night. In contrast, active periods were characterized by higher heart rates with a bimodal distribution, showing lower peaks at ~7 bpm during the day and ~8 bpm at night, and higher peaks around 15 bpm during the day and 14 bpm at night. A multifactor non-linear regression analysis identified activity (ODBA) as the main driver of heart rate variation during both day and night. Furthermore, inferred breathing frequency displayed diel patterns similar to those of heart rate, supporting a close relationship between cardiac and respiratory functions. Conclusions: Our findings demonstrate that loggerhead sea turtles exhibit clear diel rhythms in heart rate and respiration, primarily driven by activity and modulated by time of day. These results underscore the role of circadian rhythm in sea turtle physiology and provide new insight into daily metabolic regulation and energy use. Characterizing how heart rate varies with activity and diel phase can improve predictions of metabolic rate and diving capacity, key indicators of energy use and recovery. By establishing baseline diel physiological patterns under controlled conditions, this study provides reference frameworks for interpreting biologging data from free-ranging turtles and supporting management decisions.

MICROBIOTA OF HEALTHY AND FIBROPAPILLOMATOSIS-AFFECTED EAST PACIFIC GREEN TURTLES (*CHELONIA MYDAS*) FROM THE MEXICAN PACIFIC AND GULF OF CALIFORNIA

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Microbiota is an essential component for maintaining host homeostasis, functioning as a key regulator of physiological, metabolic, and immune processes. The main objective of this study was to characterize the microbiota of healthy and diseased East Pacific green turtles (*Chelonia mydas*) in two Protected Natural Areas of Baja California Sur: Complejo Lagunar Ojo de Liebre (CLOL) and Zona Marina del Archipiélago Espíritu Santo (ZMAES). To achieve this, turtles were captured, measured, weighed, assessed, sampled (blood, gastrointestinal mucosa, and feces), and released unharmed. Based on physical examinations, haematological analyses, and clinical-pathological evaluations, 5 turtles were classified as diseased (four in CLOL and one in ZMAES), showing epithelial tumors suggestive of fibropapillomatosis, classified as score 1, and 15 were classified as healthy. In gastrointestinal mucosa samples, the predominant phyla were Proteobacteria, Bacteroidota, and Firmicutes, which are associated with key digestive and metabolic functions. Significant differences were detected in the composition and structure of the microbiota between healthy and diseased turtles, with greater richness and diversity in the healthy individuals. However, the fact that most diseased turtles were from CLOL introduced a potential bias due to geographic location. In fact, analyses confirmed that the main structuring factor of the microbiota was the habitat. In CLOL, both healthy and diseased turtles shared a microbial profile dominated by Bacteroidota, Firmicutes, and Proteobacteria, whereas in ZMAES, Proteobacteria and Bacteroidota were predominant, along with a higher microbial diversity. Furthermore, this study characterized for the first time the fecal microbiota of healthy East Pacific green turtles, including bacteria, archaea, fungi, yeasts, protists, and viruses. Bacteria were the dominant group, with Firmicutes, Bacteroidota, and Proteobacteria as the main phyla. While the gastrointestinal mucosal microbiota represented a stable community closely linked to the host, the fecal microbiota reflected a more transient community associated with recent diet. Finally, opportunistic and potentially pathogenic microorganisms for animals and humans were identified.

INCREASED STRANDINGS AND DECREASED HEALTH IN GREEN TURTLES FOLLOWING EXTREME FLOODING EVENTS*

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Following a severe weather event in the summer of 2021/2022 that produced extensive flooding throughout southern Queensland, unusually high numbers of green turtles were reported stranded and/or in poor condition in Hervey Bay, Queensland. In response to this, the Commonwealth-state Disaster Recovery

Funding Arrangements (DFRA) assembled a multidisciplinary team of sea turtle biologists, wildlife veterinarians and toxicologists to assess the demographics, health, diet and toxicology of the local foraging green turtle population. A total of 145 turtles were assessed through physical examinations, blood sampling for health and toxicology, and gastric lavage for dietary analysis. Stranding data showed a marked increase in large turtles compared with previous years. Health indicators—including Scaled Mass Index, Body Condition Scores, and veterinarian-assessed categories of "healthy" or "unhealthy" (based on blood biochemistry and haematology)—revealed a disproportionately high number of unhealthy subadult and adult turtles in Hervey Bay compared to other southeast Queensland populations. Blood biochemistry parameters associated with health included white blood cell counts, heterophil-to-lymphocyte ratios, glucose, potassium, blood urea nitrogen, aspartate aminotransferase and creatine kinase. These results indicated physiological stress, possible immune disruption, prolonged fasting, metabolic dysfunction, and potential muscle, gastrointestinal, or liver disease. The age-specific differences in turtle health, combined with evidence of fasting, likely reflect reduced quantity and quality of local seagrass following the floods affecting food availability. Juvenile turtles may have a more diverse diet, making them more resilient to the loss of a particular forage item. Future research should focus on evaluating food availability and nutritional quality, habitat use across age classes, and metabolic demands to better understand the causes of nutritional stress in this vulnerable population and to inform effective conservation management.

RETINAL TOPOGRAPHY AND VISUAL ACUITY OF HAWKSBILL (*ERETMOCHELYS IMBRICATA*) HATCHLINGS

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Although hawksbills have unique habitat preferences and behaviors amongst sea turtles, hawksbill visual acuity has heretofore been mainly untested. To better understand hawksbill vision, we dissected five hatchling hawksbill eyes and calculated ganglia cell densities using a new methodology for three-dimensional analysis. One eye was obtained postmortem from each of five hatchlings found dead at Treasure Beach, St. Elizabeth Parish, Jamaica. Hatchlings were stored in 10% neutral buffered formalin for preservation of tissue. We serially thin sectioned the eyes, and after H&E staining, digitized the slides. Using QuPath bioimage analysis software, we programmed an algorithm that utilized the Random Trees classification method to identify ganglia cells based on hematoxylin and eosin levels of nucleus, cell, and cytoplasm; nucleus to cell area ratio; nucleus and cell area, perimeter, circularity, maximum and minimum caliper diameter, and eccentricity. The algorithm was trained on 783 ganglia cell nuclei and 735 detections of non-interest cells. Each detected ganglia cell was given an XY coordinate by QuPath which was exported for alignment in ArcGIS. We then plotted the cells as points in three-dimensions with a Gaussian kernel distribution to determine the ganglia cell density. Of the five eyes dissected, three of the eyes showed areas of high ganglion cell density central to the eye in both the dorsoventral and nasaltemporal directions, constituting possible areae centralis. One of these three eyes presented characteristics common of visual streaks, with decreasing cell density in the dorsal and ventral directions from the center line. Two of the five eyes analyzed had no discernible retinal organizational patterns, possibly due to tissue necrosis. Areae centralis may enable enhanced visual processing of complex, three-dimensional habitats such as when hatchlings emerge from nests in vegetation or later when juveniles and adults forage in coral reefs. Visual streaks may enable visual processing during the oceanic dispersal phase of the hawksbill life cycle. This represents the first study of hawksbill retinal topography, and the first three-dimensional, digitally derived

density map of the retinal ganglion cell layer. Additional studies will allow for the determination of hawksbill retinal organization, although multiple organizations may be possible due to the heterogeneity of hawksbill habitats across their life histories. Further refinement of the technique may allow for faster and more thorough retinal mapping.

LONG-TERM HEALTH AND POST-RELEASE BEHAVIOUR IN CAPTIVE-REARED LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*)

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Captive rearing is increasingly employed as a conservation strategy for threatened species. However, little is known about how captivity influences the ability of reared turtles to survive and integrate once released. By combining biomedical profiling with satellite telemetry of late-stage juveniles, this study provides critical baseline data on turtle health and development, and offers a novel opportunity to evaluate the effects of prolonged captivity on survival instincts and ecological reintegration. Unlike most sea turtle release studies, which predominantly focus on large adults or subadults, the turtles in this study were collected as hatchlings from Mon Repos Beach, Queensland—Australia's largest loggerhead nesting site—and reared in a controlled environment for almost four years, until reaching approximately 25 kg in body mass and 60cm in curved carapace length. This size corresponds to the stage at which wild loggerheads typically start migrating from temperate developmental habitats to tropical waters, offering a unique opportunity to evaluate the outcomes of releasing long-term captive individuals at this critical transitional phase. Throughout captivity, two key physiological metrics were monitored to establish reference health data. First, gut microbiome samples were collected at multiple timepoints during rearing and immediately prior to release. These data will be used to characterise microbial community composition across developmental stages under controlled dietary and growth conditions. Second, serial blood samples will be analysed to define reference intervals for haematological and biochemical parameters, providing valuable insight into normal physiological ranges for this life stage. In addition to these long-term physiological assessments, nine individuals will be equipped with high-accuracy Fastloc® GPS satellite transmitters upon release. The resulting movement data will be used to evaluate whether captive-reared juveniles retain the innate navigational and foraging abilities necessary for survival in the wild. Post-release dispersal, habitat selection, and survival will be monitored and correlated with individual physiological profiles. Together, these components form a comprehensive investigation at the intersection of behavioural ecology, veterinary science, and conservation biology. By combining telemetry with microbiome and blood profiling, this study delivers a multidimensional understanding of the health, adaptability, and post-release performance of captive-reared juvenile loggerheads. The findings will inform evidence-based husbandry and release protocols and contribute to global efforts to improve the survival and recovery of this threatened species.

PHYSIOLOGIC EFFECTS OF SUBMERGED RESTRAINT FOR SEA TURTLE UNDERWATER HEARING TESTING

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Assessing physiologic effects of research protocols in animal research is important for ensuring welfare of experimental subjects and weighing the value of information obtained relative to any adverse impacts. During electrophysiological testing of sea turtle hearing, which required turtles to remain still to avoid myogenic artifact and submerged to replicate their natural auditory environment, we measured blood gases, pH, lactate, sodium, potassium, ionized calcium, glucose, packed cell volume and plasma total solids before and after hour-long sessions of physical restraint and carefully monitored intermittent forced submergence. Green turtles (n=14, 2.3 – 7.2 kg) Kemp's ridleys (n=15, 0.9 – 10.4 kg) loggerheads (n=16, 0.8 – 14.1 kg) and hawksbills (n=10, 1.6 – 2.2 kg) were manually restrained with self-adhering elastic tape wrapping the forelimbs to the marginal carapace, swaddling in a cloth bag, and secured to a sliding platform that could be raised and lowered between the hearing test depth and the surface for breathing. A subset of turtles was also lightly sedated to improve compliance while retaining the turtles' voluntary airway control. Turtles were brought to the surface every minute for breaths, or whenever they showed signs of wanting a breath (e.g., head and shoulder movements, raising head, presence of a bubble at the nares). If no breath was taken spontaneously, the turtle's beak was lifted to encourage a breath. If still no breath was taken after the beak-lift assist, the turtle was resubmerged until the next scheduled lift. Surfacing intervals were gradually lengthened or shortened throughout the procedures to find the turtle's natural spontaneous respiratory rate under the test conditions, and interbreath intervals ranged from 0.75–5.0 min. In aggregate, statistically significant but clinically negligible changes were observed in pH (mean decrease of 0.051), lactate (mean increase of 1.06 mmol/L), ionized calcium (mean increase of 0.03 mmol/L) and plasma total solids (mean increase of 0.14 g/dL). Four turtles (3 greens, 1 ridley) experienced lactate increases of >5 mmol/L, which is clinically relevant, though minor compared with the effect of gill net interactions (Snoddy et al., 2010) and even some routine physical exam changes (Mones et al., 2021). Glucose increased significantly (mean 26.9 mg/dL), which is clinically relevant, and represents a classic adrenocortical-mediated stress response, but not concerning on a short-term basis. Results demonstrate that physiologic impacts of serial intermittent forced submergence for sea turtle underwater hearing tests were safely minimized by restricting movement and providing sufficient predictable breathing opportunities. All turtles were successfully released as planned.

INVESTIGATING POTENTIAL HYBRIDIZATION IN UNVIABLE LOGGERHEAD (*CARETTA CARETTA*) AND GREEN (*CHELONIA MYDAS*) SEA TURTLE EGGS IN NORTHWEST FLORIDA

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Six known hybrid combinations between five sea turtle species have been documented, including a combination between loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. Potential hybrid zones may exist in areas where parental species overlap temporally and spatially, such as in the case of loggerhead and green sea turtles in Northwest Florida. The Northwest Florida loggerhead population belongs to a demographically independent cohort and accounts for only 1.3% of the nesting loggerhead population in Florida. Index nesting beach surveys conducted by the Florida Fish and Wildlife Conservation Commission show that the green sea turtle nesting population is smaller than that of loggerheads. Given the small population size of these populations hybridization may have increased effects on reproductive output; however, these effects are poorly studied. As such, the objective of our study is to investigate the presence of hybridization and compare it to nest success rate to determine reproductive success of hybrids compared to non-hybrid parental species. Unviable *Caretta caretta* and *Chelonia mydas* sea turtle eggs were collected from seven sites in Northwest Florida in partnership with the United States Geological Survey and Florida Fish and Wildlife Conservation Commission. Tissue samples from sea turtle embryos labeled as *Caretta caretta* were collected, and 132 samples from four sites were sequenced for the mitochondrial COI gene to confirm maternal species and characterize haplotype structure. Two major haplotypes and two minor haplotypes were found between our samples with some polymorphisms being commonly found in green, Kemp's ridley, and hawksbill sea turtle reference sequences as well as loggerhead references sequences from Kenya, Turkey, and Italy. When haplotype structure was compared to reference sequences there was no indication of hybridization, however, further research will be conducted using species-specific microsatellite markers for a more in-depth analysis.

SEASONAL CHANGES IN BIOMARKERS OF FORAGING AND REPRODUCTION AND THEIR ASSOCIATED BEHAVIORS IN CAPTIVE SEA TURTLES*

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Prior to a successful reproductive season, female sea turtles must accrue sufficient nutritional reserves to support their vitellogenic, migratory, mating, and nesting efforts through ample foraging. Previous research has documented the occurrence of hypophagia in wild sea turtle populations during these reproductive

events as a result of reproductive functions. Certain physiological biomarkers, such as β-hydroxybutyrate (BHB), synthesized from fat stores during ketosis, can be used as a measure of this fasting behavior. Previous studies have measured BHB in several species of sea turtles to infer fasting behavior. Measuring reproductive biomarker concentrations, such as testosterone (T) and vitellogenin (VTG) provide insight to the underlying mechanisms of this hypophagic behavior. Studies utilizing captive sea turtles provide an accessible opportunity to not only document this behavior, but also to gain an improved understanding of the physiological processes that are occurring. The purpose of this study was to test the hypothesis that BHB can be used as an effective biomarker to measure fasting behavior in loggerhead sea turtles. For this study, behavioral data of fasting, oviposition, and mounting were collected from two sea turtles held indoors under permanent human care at the New England Aquarium, along with monthly plasma sampling for the period of May 2022- August 2023 in LOGGER1, and May 2022-April 2023 in LOGGER2. LOGGER1 and LOGGER2 are female loggerhead sea turtles (*Caretta caretta*) with ages estimated at 45 and 30 years, respectively. Egg production in LOGGER1 was first noted in 2017, and has occurred in several years since then, and LOGGER2 has never oviposited. Plasma concentrations of BHB, VTG, and T were measured in each sample, using enzyme-linked immunosorbent assays and colorimetric assays. Fasting behavior was recorded in LOGGER1 between the periods of 3/2/2022-6/17/2022 and 1/20/2023-6/24/2023. LOGGER2 displayed fasting behavior from 2/8/2022-6/25/2022 and 2/16/2023-6/10/2023. Plasma samples collected during periods of fasting were associated with significantly increased concentrations of BHB ($p < 0.005$) in both residents. During months in which LOGGER1 had the highest plasma concentrations of BHB and increasing T concentration, she was periodically observed mounting LOGGER2 in copulatory-like behavior. LOGGER1 oviposited in the water in May, June, and October of 2022, and April and June of 2023. These oviposition events occurred during periods of decreasing BHB concentration, likely due to the animal nearing the end of the reproductive cycle. Using the average values between the residents, BHB and VTG concentrations shared a positive relationship ($R2 = 0.573$), indicating the biomarkers of fasting were increasing concomitantly with reproductive biomarkers. These results support our hypothesis that BHB is a reliable biomarker of fasting behavior in loggerhead sea turtles, and that this behavior is related to underlying hormonal reproductive mechanisms. By confirming the ability to use BHB as a measure of fasting, this study provides tools that can be applied to free ranging populations of sea turtles as an indicator of this behavior. This would allow both conservationists and caretakers of captive turtles to make inferences about the health, foraging activity, and reproductive statuses of these animals.

DOES AMBIENT TEMPERATURE INFLUENCE HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) INTER-NESTING INTERVALS?*

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Understanding the impact of climate change on sea turtles is crucial for predicting population-level responses. Of particular importance is how global warming might affect reproductive success through changes in inter-nesting interval (INI), i.e., the duration between successive clutches. Warmer water temperatures are expected to shorten INI due to accelerated egg maturation rates (the rate at which follicles develop into shelled eggs ready for oviposition). We investigated the effect of mean seawater temperatures on hawksbill turtle (*Eretmochelys imbricata*) INI, recorded by temperature sensors onboard Fastloc-GPS

satellite tags deployed on 10 nesting individuals (n = 19 INI, 2023-24) in the Seychelles and from published datasets (n = 7 INI from the US Virgin Islands). We analysed our Seychelles data using mixed effects models with individual identity and clutch sequence (order of clutch determined through telemetry and beach patrols) as random effects. Data from the Seychelles and US Virgin Islands were analysed using a linear regression model. Seawater temperature did not have a significant effect on hawksbill INI in either analysis ($p > 0.1$), potentially due to limited thermal variation experienced by individuals (<1°C). However, it is unclear whether this reflects local temperature conditions or individual thermal preferences. In our Seychelles dataset, individual variation and clutch sequence in the season explained more variance in INI than temperature, though neither effect was significant. Hawksbill turtles had consistent and relatively high INI of 12-15 days despite high temperatures in the Seychelles, compared to elsewhere and other species. One possible explanation is lower metabolic rates in this species, as evidenced by long dive durations in juvenile hawksbills in the Chagos Archipelago. However, narrow thermal variation and small sample size constrained our ability to detect temperature effects. To understand the broader implications of temperature rises for INI, our findings highlight the need for comparative studies at sites with greater thermal variation due to environmental conditions or depth-related temperature gradients. For example, Hawaiian hawksbill populations have variable INI (13-30 days) compared to the typical range of 12-17 days and may serve as an ideal system to examine whether thermal variation can influence metabolic regulation and INI. Understanding thermal thresholds for successful clutch production is important for predicting how climate change may affect hawksbill reproductive phenology.

VISUALIZATION AND MACHINE LEARNING TO EXAMINE FINE SCALE HEART RATE DYNAMICS IN DIVING TURTLES*

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During long migrations and while resting at sea, turtles perform dives longer than most marine mammals. As air-breathing ectotherms with few adaptations to diving, diving turtles rely on oxygen from the lungs and tight control of their heart rate (HR) to manage perfusion to peripheral tissues. Understanding how HR changes across dive phases and activity states is central to interpreting their energy management, aerobic capacity, and vulnerability to environmental change. In 2019, HR recordings from 8 wild-caught loggerhead turtles (*Caretta caretta*) in shallow tanks demonstrated that HR directly correlates with activity, increasing when loggerheads surface to breathe, but also while feeding and swimming (sometimes to a greater extent than rest at the surface) (Williams et al., 2019). This linear increase in HR at the onset of exercise was also found in green turtles (*Chelonia mydas*) (Okuyama et al., 2020), but in both studies analyses mostly examined dive-scale statistics and did not look at finer scale HR changes paired with respiration and movement. To better link physiology with movement, we leveraged a newly developed open-source database (DiveDB) and visualization software (EcoPhys Video Viewer) to view HR alongside diving and 3D rotation of 4 loggerhead turtles from the previously mentioned study by Williams et al. (2019). Our custom Python workflow, Pyologger, organizes metadata alongside physiological (raw ECG or EEG), motion (IMU, 3D rotation, GPS), and environmental (depth, light, temp) data in a multi-sensor netCDF file format that is reproducible yet customizable through interactive visual interfaces to aid with human-in-the-loop processes like peak detection parameter tuning. We analyzed 72 h of synchronized ECG and motion data from three loggerhead turtles, comprising 103 dives (>4 min, up to 52 min). Instantaneous heart-rate traces were extracted from QRS peaks and compared using dynamic time warping (DTW). Five characteristic patterns emerged: stable bradycardia (~6–7 bpm) during quiescent resting dives, aperiodic elevated HR (~10-20 bpm) during underwater activity, periodic elevated HR (10-20 bpm) linked to

breathing, and two transitional states between tachycardia and bradycardia preceding and following surfacing. By applying unsupervised learning, we can compare these emergent properties of heart rate profiles to those in other diving animals, a lens through which to view the flexible cardiac modulation that supports aerobic efficiency during extended dives. The visualization software allows us to identify and track HR changes associated with individual respirations, along with the release of bradycardia following diving upon movement initiation. Our next steps include this fine scale analysis to examine timeseries patterns surrounding breaths as well as expanding this ecophysiological database to compare physiological parameters across diving vertebrates including penguins, phocid seals, otariids, odontocetes, and mysticetes, revealing convergent solutions to oxygen management underwater. These varied strategies shed light on the ability of endangered species to survive while balancing needs to feed, rest, and sustain vital tissues while they navigate new environmental challenges.

INTER- AND INTRASPECIFIC BLOOD-RELATED BIOMARKERS AND CHEMICAL EXPOSURE IN CONFINED AND FREE-LIVING SEA TURTLES*

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The relevance of recovery centers and head-starting programs for rescue, rehabilitation, rearing, and conservation of sea turtles is recognized worldwide. In addition, these centers contribute to generating biochemical and physiological data needed to identify health markers and provide baseline values. Because of the marine ecosystems' deterioration, biomarker identification is a global priority for sea turtle conservation; nevertheless, information on specific endpoints, such as neurotoxicity and mutagenesis, is still limited in sea turtles. This study aimed to contrast a set of non-invasive blood biomarkers with ecotoxicological and clinical applications in confined (n=17) green sea turtles (*Chelonia mydas*) compared with free-living ones (n=14) from the Mexican Caribbean. Additionally, interspecific (green (n=17), hawksbill (*Eretmochelys imbricata*) (n=4), loggerhead (*Caretta caretta*) (n=6) turtles) differences were also evaluated. Blood samples (7 mL) were taken with vacutainers tubes with and without He/Li as anticoagulant and centrifuged for 15 min (890 x g). Serum and plasma were stored at -80 ºC until processing (<24 mos). Biochemical parameters, hormones, erythrocytic nuclear abnormalities (ENA), oxidative stress indicators, plasmatic organochlorine pesticides (OCs) and polychlorinated biphenyl (PCBs) were determined. All the variables were compared between foraging habitats (free-living *C. mydas*), habitat conditions (*C. mydas*), and species. Matrix correlations between biomarkers and persistent organic pollutants (POPs) were obtained using the Spearman and Pearson correlation coefficients. The results suggest that free-living green turtles along the coast of Quintana Roo in the Mexican Caribbean have adequate health and nutritional status since the biochemical parameters analyzed fell within the ranges reported for healthy green turtle populations. The ranges of uric acid, total proteins, lipids (cholesterol and triglycerides), and thyroxine of confined green turtles fell outside the reference intervals for the species. Additionally, confined green turtles fed with a fish-based protein-rich diet have a higher number of ENA and elevated levels of hemoglobin, lipid peroxidation, and activity of glutathione S-transferase, glutathione

peroxidase, and carboxylesterase (CE), suggesting chronic exposure to persistent organic pollutants. Contrasts among confined species identified hawksbill turtles with the lowest glutathione reductase activity, green turtles with the lowest ENA frequency and CE activity; loggerhead turtles showed the highest levels of OCs, PCBs, and frequency of ENAs, as well as a more pronounced biochemical responses compared to green turtles. Differences in bioaccumulation under the same diet were probably related to digestive metabolism given by trophic niche. These results highlight the relevance of providing sea turtles with an adequate species-specific diet under confined conditions. The information here provided can be used as information in health monitoring programs and for conservation and management policies at regional, national, and international level.

UNCOVERING THE STRUCTURE-FUNCTION RELATIONSHIP OF MARINE TURTLE SHELLS: TRENDS IN SHELL BONE MICRO-ARCHITECTURE OF SEA TURTLES ACROSS BODY SIZES

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Bone functional adaptation describes the process by which bone tissue remodels in response to mechanical forces, allowing the skeleton to maintain strength against the loads it regularly experiences. While this phenomenon has been extensively documented in the appendicular and vertebral skeletons of mammals and birds, far less is known about how these principles extend to reptiles. In aquatic reptiles, particularly those with a highly modified axial skeleton such as the turtle shell, little is known. In turtles, the ribs are expanded and tightly attached to the trunk vertebrae forming the box-like carapace. This structure provides protection, but prevents flexion and undulation. Despite its critical role in protection, the micro-architectural organization of the marine turtle shell, and its relationship to how the shell responds to stresses, remains virtually unexamined. This study investigates how shell bone micro-architecture of marine turtles varies across ontogeny and species to evaluate whether functional adaptation patterns observed in other amniotes extend to the carapace of cheloniids. Green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and Kemp's ridley (*Lepidochelys kempii*) turtles were sampled across a range of straight carapace lengths (SCL) to encompass multiple life stages. High-resolution micro-computed tomography was used to quantify a suite of standard cortical and trabecular bone traits from carapace samples. These traits were analyzed in relation to SCL and compared among species using regression and covariance models to test for both ontogenetic and interspecific differences in bone architecture. We predicted that species with differing evolutionary histories, ecology, and mechanical demands would exhibit distinct micro-architectural profiles reflecting the variation in shells' environments. Based on previous biomechanical work, we expected green turtles to possess dense bone architectures capable of yielding a stiff shell, whereas loggerhead turtles would display looser, more porous micro-structures consistent with their weaker, more flexible shells. We further hypothesized that bone traits would scale allometrically with body size to maintain a lightweight, hydrodynamic carapace, facilitating life in an aquatic environment. Size-dependent traits were found to scale predictably with body size across species, indicating shared allometric trends yet we found species-specific intercepts (starting points). Surprisingly, degree of anisotropy decreased as a function of body size (i.e., trabeculae had no preferred orientation), suggesting that adult turtle shells experience multi-directional stresses. Green turtles consistently exhibited higher bone volume fraction and bone mineral density than loggerheads and ridleys, reflecting a denser, stiffer architecture. Loggerheads displayed the most porous bone architectures (characterized by low bone volume fraction, bone mineral density and wide spacing between trabecular struts). Kemp's ridleys were intermediate. Collectively, as turtles increase in body size, trabecular bone architecture evolves toward a mechanically efficient, load-distributing network that resists multi-directional stresses without excessive

bone mass. These findings reveal species-specific structural strategies and demonstrate that bone functional adaptation operates within the larger framework of the rigid marine turtle shell. Our work extends the paradigm of adaptive bone remodeling to an unconventional, unbending axial skeletal system.

LINKING CONTAMINANT EXPOSURE TO CELLULAR EFFECTS IN LEATHERBACK SEA TURTLES*

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Despite their highly migratory ecology, leatherback sea turtles (*Dermochelys coriacea*) also make substantial use of coastal habitats, placing them at risk of exposure to a wide range of contaminants, including harmful algal bloom (HAB)-associated biotoxins, persistent organic pollutants (POPs), chemical plasticizers, and toxic elements. It is important to characterize chemical exposure in adult leatherbacks, as these contaminants can impact individual health and reproductive success, and thus ultimately affect population dynamics. This study represents a novel effort to link contaminant exposure in nesting leatherbacks to associated effects on individual health and to evaluate the cellular impacts of these contaminants in vitro. This framework utilizes minimally invasive techniques to achieve a robust understanding of contaminant exposure dynamics and health effects in Florida's nesting leatherbacks. During the 2024 nesting season, blood (n = 30) and skin (n = 22) samples were collected from the hind limb of leatherbacks nesting on Juno and Jupiter Beaches, Florida, USA. Blood sample fractions were analyzed for hematology, plasma biochemistry, protein electrophoresis, and contaminant detection and quantification. Serum HAB-associated biotoxin concentrations were determined via ultra-performance liquid chromatograph/tandem mass spectrometry. POPs and chemical plasticizers were detected using gas chromatography-mass spectrometry. Toxic element concentrations were quantified using inductively-coupled plasma mass spectrometry on dried blood spot cards. Skin biopsies were used to establish skin fibroblast primary cultures. Detectible levels of six HAB-associated biotoxins were present in blood samples from 18 of 30 (60%) individuals, while multiple phthalates, PCB congeners, organochlorine pesticides, arsenic, cadmium, lead, and selenium were detected in all blood samples. The majority of detected contaminants declined across the nesting season, which is likely attributable to early season lipid mobilization. POPs and chemical plasticizers were generally positively correlated with one another, suggesting common exposure sources and/or foraging areas. Using Spearman correlation tests, statistically significant positive correlations ($p < 0.05$) between dieldrin and calcium ($R2 = 0.18$), nodularin and chloride ($R2 = 0.13$), and di(2-ethylhexyl) phthalate and magnesium ($R2 = 0.11$) were identified. These correlations suggest potential interactions between contaminant exposure and mineral and electrolyte balance. Based on contaminant concentrations in blood, the most environmentally relevant representatives from five contaminant classes – domoic acid (HAB-associated biotoxin), diethyl phthalate (plasticizer), polychlorinated biphenyl-153 (POP), dieldrin (organochlorine pesticide), and cadmium (toxic element, as cadmium (II) chloride)– were selected for in vitro exposure assays. To determine dose-response curves for each of the selected contaminants, skin fibroblast cultures were exposed to each of these five contaminants for 48 hours using log-scale concentrations relevant to each contaminant. Percent viability compared to vehicle controls was assessed for each treatment using the MTT assay. This work represents a more comprehensive field-and-laboratory assessment of the sublethal effects of contaminants on adult leatherbacks. This approach provides insight into contaminants of greatest concern to Florida's nesting leatherbacks and represents a framework that can be utilized to assess contaminant risk in other leatherback populations globally.

ESTABLISHMENT AND CHARACTERIZATION OF LEATHERBACK (*DERMOCHELYS CORIACEA*) PRIMARY SKIN FIBROBLAST CELL CULTURES

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Reductions in regional and global leatherback sea turtle (*Dermochelys coriacea*) populations necessitate a detailed understanding of the individual- and population-level effects of the stressors associated with these declines. Characterizing these effects on imperilled, taxonomically unique species like the leatherback is especially challenging, as controlled, whole-animal experimentation is impossible, and accessible organisms do not accurately model the species. Because of these challenges, diverse research approaches are necessary. In vitro systems present an opportunity to investigate the impacts of stressors on individual health that largely circumvents the need for whole-animal studies. This study presents a novel effort to establish primary cultures of leatherback skin fibroblasts for eventual use in toxicological studies. Skin biopsies were aseptically collected from the rear limbs of leatherbacks (n = 22) nesting on Juno Beach and Jupiter Beach, Florida, USA during the 2025 nesting season. We compared several protocols; primary cultures were established using either explants (n = 15) or single-cell suspension produced via trypsin digestion (n = 7). Primary cultures were then either maintained with a standard RPMI 1640 growth medium formulation (n =12) or an epidermal growth factor-supplemented medium (n =10). All cultures were maintained in the same incubator at 26oC and 5% humidity. Fibroblasts were morphologically characterized utilizing brightfield microscopy and positively identified using immunostaining for vimentin, a mesenchymal cell marker. Preliminary results indicate the mean time to first passage did not differ significantly between the tested media formulations or establishment methods, with no significant interaction between the two variables (two-way ANOVA; $p>0.05$ for all factors). Thus far, primary skin fibroblast cultures have been successfully established from samples from n = 12 individuals with a mean time to first passage of 82.5 ± 28.17 days (mean ± SD). Successful establishment of leatherback primary skin fibroblast cultures presents a minimally invasive means of conducting controlled leatherback physiology and toxicology experimentation, the results of which can be used to better understand bottom-up mechanisms for population decline. Primary cultures established in this study will be used in future toxicology studies to determine the lethal and sublethal effects of environmentally relevant toxins and toxicants for Florida's nesting leatherbacks.

SHAPING SEA TURTLE CARAPACE: A COMBINATION OF GENOMICS AND ENVIRONMENT*

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Sea turtles' carapace plays an important role in locomotor performance and protection from predation, thus, variation in this morphological aspect can impact evolutionary fitness. In this context, a substantial heritability of carapace shape is expected, allowing adaptive evolution under environmental constraints. However, environmental factors affecting incubation could also play a role on the shaping of morphometric characters. In this study, we aim to evaluate the presence of a genetic basis underlying carapace shape by examining the influence of parental population origin, admixture level, individual relatedness and incubation conditions (natural nest or controlled incubators). To do so, we analysed 452 hatchlings from 17 nests laid along the Spanish Mediterranean coast in 2023. Genetic samples were processed using the 2bRAD genotyping method, and hatchling photographs were analysed through geometric morphometric techniques. We confirmed that there is no sexual dimorphism regarding the carapace shape of hatchling, ensuring no sex-related bias. Significant shape differences were found in 80% of the nest comparisons ($p < 0.005$) and genetically related nests fell under the remaining 12% ($0.004 < p < 0.02$ for half siblings and $p > 0.04$ for full siblings), supporting the heritability of the carapace shape. Redundancy analysis revealed morphometric differentiation linked to genetic origin, particularly evident in individuals from the Levantine region, Greece, and the Northwest Atlantic. In contrast, admixtures within the Mediterranean did not exhibit a predominant shape, and the hatchlings from one nest admixed between the Northwest Atlantic and Mediterranean showed intermediate morphologies. Differences between nests from adults with a Greek and Levantine origin were primarily located in the proximal region and correlated with the amount of marginal scutes. This is because individuals of Levantine origin exhibited wider carapaces and usually had 13 marginal scutes per side, whereas individuals of Greek origin had narrower carapaces and typically presented 12 marginal scutes. Finally, beach incubation resulted in greater shape variance and 44% of the nests exhibited shape differences depending on the incubation method. Nevertheless, asymmetry and the number of marginal scutes remained consistent across both conditions. These findings suggest that carapace shape is influenced by both genomic factors and incubation environment.

INVENTORY OF PACIFIC SAMPLES STORED FOR BIOMONITORING BY THE NIST BIOLOGICAL AND ENVIRONMENTAL MONITORING AND ASSESSMENT OF SEA TURTLE TISSUES (BEMAST) PROJECT FROM 2011-2025*

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The National Institute of Standards and Technology (NIST) began the Biological and Environmental Monitoring and Archival of Sea Turtle Tissues (BEMAST) project in 2011 as a long-term pollution trend monitoring project for sea turtles in the Pacific Ocean. Dedicated annual sample collections paused indefinitely in early 2025. This presentation will summarize the sample inventory from sea turtles that had stranded in Hawaii or were caught in the U.S.-based longline fishery in pelagic waters of the Pacific Ocean. Five out of the seven sea turtle species are represented. Thousands of tissue samples are curated and maintained, including ingested plastic, ingested prey, digestive fluids, scute, fat, liver, bile, follicles, blood, muscle, fibropapilloma lesions, blubber, and skin. These tissues were collected using standardized protocols to ensure minimal contamination of samples and are stored at liquid nitrogen vapor temperatures (~150°C) to preserve biological components and chemical contaminants for future analysis. Aliquots of cryo-homogenized tissues can be accessed through NIST for approved research projects related to pollution or health monitoring. This presentation will provide procedures for requesting aliquots, highlights from completed projects with the samples, and a complete list of sample providers and collaborators. Collaborations and funding are vital to the continuation of assessing sea turtle health and contaminants.

HEART RATE REDUCTION DURING EGG-LAYING IN LOGGERHEAD TURTLES REVEALED BY NON-INVASIVE MONITORING*

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Animals undergo significant physiological demands during reproductive processes, often accompanied by hormonal and neural changes. In sea turtles, nesting occurs on land, where they must support their own body weight without the buoyant assistance of seawater, potentially adding significant physical stress. Heart rate is an important physiological parameter reflecting an animal's internal state. To monitor changes in heart rate throughout nesting activities, non-invasive electrocardiogram (ECG) loggers (ECG400-DT, Little Leonardo Ltd.) and accelerometers (W2000-3MPD3GT, Little Leonardo Ltd.) were deployed on five gravid loggerhead turtles (*Caretta caretta*): two captive turtles nesting on an artificial beach at the Port of Nagoya Public Aquarium and three wild turtles nesting on a natural beach in Minabe, Japan. A set of loggers and electrode pads were attached to the carapace one or two nights prior to egg-laying, with the attachment procedure taking up to 1 hour. After deployment, all turtles promptly returned to the water. After egg-laying was completed, all instruments were retrieved either immediately before return to the sea

(wild turtles) or on the following morning (captive turtles). Upon landing on the beach, heart rate increased to 29.3 ± 5.5 bpm, approximately 1.5 times higher than just before landing, and remained elevated during most of the nesting phases. However, at the onset of egg-laying, heart rate significantly decreased to 16.9 ± 5.0 bpm. This bradycardia was accompanied by increased variability in heart rate intervals and elevated RMSSD (root mean square of successive differences), indicating dominance of parasympathetic nervous activity. Heart rate returned to elevated levels after egg-laying, suggesting a shift in autonomic balance. Our results demonstrate that nesting turtles maintain high heart rates during physically demanding terrestrial activities, except during the egg-laying phase, when parasympathetic regulation likely facilitates successful oviposition. External disturbances, such as artificial light, may disrupt parasympathetic regulation, potentially reducing egg-laying success.

HANDLING PROTOCOLS IN STRAGGLER SEA TURTLE HATCHLINGS: TRADITIONAL BLOOD ANALYSIS AND METABOLOMICS AS TOOLS FOR ASSESSING BEST CONSERVATION MANAGEMENT PRACTICES*

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Sea turtle hatchlings are particularly vulnerable during their early life stages, with straggler hatchlings, those that remain in nests after the mass emergence, requiring temporary holding before nighttime release under current Florida Fish and Wildlife Conservation Commission (FWC) protocols. This study presents a comprehensive assessment of physiological and metabolic responses in sea turtle straggler hatchlings during mandatory holding periods of 5–12 hours, using a complementary multi-species approach. In green turtle hatchlings (*Chelonia mydas*; n=30 Experimental, n=20 Validation), morphometric measurements and blood analytes (including blood chemistry and hematology) were evaluated, with corticosterone analyzed in a subset of individuals (n=18 Experimental, n=11 Validation). Untargeted metabolomic profiling using ultra-high-performance liquid chromatography–high-resolution mass spectrometry (UHPLC-HRMS) was conducted for loggerhead hatchlings (*Caretta caretta*; n=9 Experimental, n=7 Validation). Hatchlings sampled both on intake and release (Experimental group) were compared to single-sampled controls (Validation group; sampled on release only) to distinguish holding effects from potential sampling artifacts. Hatchlings demonstrated measurable physiological responses during holding, including mass loss, declining body condition index, and metabolic changes. Blood chemistry revealed increased β-hydroxybutyrate concentrations, indicating lipid mobilization from residual yolk via ketogenic pathways, and declining lactate, suggesting recovery from emergence stress through lactate clearance and transition to aerobic metabolism. Hematologic analyses showed increased heterophil counts and heterophil:lymphocyte ratios exceeding reference intervals, indicating stress- and/or inflammation-mediated immune responses. Clinical assessment at intake further showed that baseline clinical condition significantly influenced physiological responses to holding: compromised hatchlings had higher heterophil and lymphocyte counts. Corticosterone concentrations remained stable and within ranges indicative of moderate stress. Metabolomic analysis identified significantly altered metabolites in loggerheads, with decreases in pseudouridine, β-pseudouridine, and lactic acid, alongside increases in 4-hydroxybenzaldehyde and 4-acetamidobutyrate, reflecting targeted biochemical adjustments rather than systemic disruption. The selective nature of these responses aligned with findings from traditional biomarkers, demonstrating activated adaptive and compensatory mechanisms across both species. Overall, hatchlings demonstrated physiological tolerance to short-term holding through physiologically adaptive mechanisms, while experiencing measurable energetic costs. This study validates current FWC protocols requiring nighttime release for hatchlings collected after 0900 AM and provides an evidence-based

framework that may be exemplary for other sea turtle conservation and rehabilitation programs worldwide, supporting decision-making that incorporates environmental factors and clinical condition of individual hatchlings to balance conservation effectiveness with animal welfare.

HEALTH ASSESSMENTS OF EAST PACIFIC GREEN TURTLES (*CHELONIA MYDAS*) IN BAJA CALIFORNIA SUR AND REVILLAGIGEDO NATIONAL PARK, MEXICO

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The Ojo de Liebre Lagoon Complex (OLLC), located in Baja California Sur, Mexico, is one of the main feeding and developmental habitats for East Pacific green turtles (*Chelonia mydas*), locally known as black turtles. In contrast, Revillagigedo National Park, particularly Clarion Island, represents one of the most important nesting sites for this same population in the Mexican Pacific. Together, these sites provide complementary habitats that sustain the life cycle of black turtles, with juveniles and subadults aggregating in coastal lagoons to feed and grow, while adults migrate to oceanic islands to reproduce. To assess the health status of this population, health surveys were conducted at each site between 2022 and 2024 (30 surveys at OLLC and 100 night patrols on Clarion Island). In the OLLC, 480 turtles were captured using encirclement gillnets (21.22% recaptures). These individuals measured 75.08 ± 11.85 cm in curved carapace length (mean ± SD) and weighed 50.02 ± 24.34 kg, with a mean body condition index of 1.39 ± 0.17. Based on size, 116 were classified as adults (sex ratio 1 male: 3 females) and 364 as juveniles (sex undetermined). On Clarion Island, 74 nesting females were evaluated, with curved carapace lengths of 90.52 ± 11.47 cm (mean ± SD; range: 68–120 cm). All turtles at both sites underwent clinical examinations, and blood samples were collected for hematological and clinical-pathological analyses. All turtles were released in good condition after examination. Clinical results showed that 480 turtles from the OLLC and 74 from Clarion Island exhibited no signs of health impairment or pathological alterations, and these individuals were considered clinically healthy. However, 10 turtles from the OLLC presented fibropapillomatosis (FP) tumors classified as score 1. These lesions were examined through gross pathology and histopathology, and the presence of Scutavirus chelonidalpha5 was confirmed through conventional PCR. FP-affected individuals exhibited lower hemoglobin and hematocrit values, leukocytosis characterized by lymphocytosis, eosinophilia, and heterophilia, as well as altered heterophil-to-lymphocyte ratios, indicating disease progression. Both the OLLC and RNP provide important habitats for black turtles throughout different life stages—offering shelter and food resources during non-reproductive periods and suitable beaches for successful nesting. Although the OLLC hosts some individuals affected by fibropapillomatosis, the overall population remains healthy. Nevertheless, continued monitoring is essential to track health status, prevent disease spread, and ensure the long-term conservation of turtles in both foraging and nesting areas. Integrating health assessments from these complementary habitats strengthens management strategies and conservation planning for *Chelonia mydas* in the Mexican Pacific.

HEMATOLOGICAL PROFILING OF EAST PACIFIC GREEN TURTLES (*CHELONIA MYDAS*) FROM BAJA CALIFORNIA SUR, MEXICO: COMPARISONS AND CORRELATIONS WITHIN THE POPULATION

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Anthropogenic threats and specific environmental factors have caused declines in global sea turtle populations while contributing to the emergence of various diseases. For this reason, health monitoring of sea turtle populations remains essential for their conservation. Eastern Pacific green sea turtles (*Chelonia mydas*), commonly known as black turtles, feed and reside until sexual maturity in the Ojo de Liebre and Guerrero Negro lagoons of Baja California Sur, Mexico. This study established and characterized hematological values in foraging *C. mydas* from these lagoons and assessed potential variations in these values across age and sex categories. For this purpose, 20 black turtles were captured, which underwent physical examination, and their morphometric data were subsequently recorded: Curved Carapace Length (CCL), Curved Carapace Width (CCW), Straight Carapace Length (SCL), Straight Carapace Width (SCW), Plastron Length (PL), Plastron Width (PW), Body Depth (BD), Total Tail Length (TTL), and body mass. The average Curved Carapace Length measured 74.33 ± 11.45 cm. To distinguish age classes, specimens not exceeding 77.5 cm CCL were classified as juveniles. Based on this criterion, the sample comprised 3 adult males, 7 adult females, and 10 juvenile individuals of undetermined sex. Two Body Condition Index (BCI) values were calculated: the first employing Fulton's K equation (BCI-F), and the second derived from Principal Component Analysis (PCA). The PCA-based BCI more accurately characterized the body condition of the turtles than the Fulton-based BCI. Complete blood counts were conducted on all specimens to establish baseline hematological values for healthy individuals. Hematological evaluation included hemoglobin concentration (HB), hematocrit (HCT), erythrocyte indices (ERI), red blood cell count (RGR), mean corpuscular hemoglobin (HCM), mean corpuscular volume (VCM), mean corpuscular hemoglobin concentration (CHCM), total leukocyte count (LEU), and differential leukocyte counts expressed as absolute values and percentages for heterophils (HET) lymphocytes (LIN) monocytes (MONO) eosinophils (EOS) and basophils (BAS) Descriptive statistics (mean ± SD) were calculated for all hematological parameters and compared with reference values reported for the species. Potential differences in hematological values were evaluated with respect to age class and sex, as well as their relationship with BCI values, using Student's t tests or Mann–Whitney U tests for age-class comparisons, and one-way ANOVA or Kruskal–Wallis tests for sex comparisons, depending on data normality. Relationships among hematological variables were explored using PCA, and associations between hematological values and BCI were assessed using multiple linear regression models. No significant differences were found in any parameter. This outcome demonstrates no relationship between hematological values and either age class or sex. The obtained hematological values are representative of healthy turtles and, consequently, provide reference intervals for future health assessments of black turtles. These findings support conservation strategies by delivering more precise health status data for green turtle populations in the Eastern Pacific.

ENDOCRINE DISRUPTING EFFECTS OF PLASTIC-ASSOCIATED CHEMICALS ON SEA TURTLE REPRODUCTIVE TISSUES

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Plastic is prevalent in the ocean, and sea turtles ingest it to the detriment of their health. The impacts of plastic on sea turtle health are especially concerning due to their status as vulnerable or endangered. Plastic ingestion negatively impacts sea turtles through gut compaction, gut perforation, and pollutant leaching. Chemicals linked to plastics have been found in the tissues and blood of wildlife, including sea turtles, and may act as endocrine disruptors. Endocrine disrupting chemicals (EDCs) are chemicals that act like native hormones or interfere with their functioning, thus affecting the reproductive tissues. This study investigates the effects of chemicals on sea turtles' reproductive steroid pathways, which could have subtle, long-term effects on population viability. We collected turtle gonadal tissues from 8 males, (5 juveniles and 3 adults) and 10 females (5 juveniles, 5 adults)) from freshly euthanized or dead loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtle carcasses. The gonads were prepared for fluorescent microscopy by washing and slicing to prepare slides. Standards of potential EDCs known to be associated with plastics, including (Bisphenol A (BPA), Decabromodiphenyl oxide (DecaBDE), Dibutyl phthalate (DBP), and Bis(2-ethylhexyl) phthalate (DEHP)) were conjugated to a protein (BSA) (Homer-Drummond,2012). We then labeled the steroid, EDC conjugates, and pure BSA using fluorescein isothiocyanate (FITC) and counter-stained cells with 4',6-diamidino-2-phenylindole (DAPI). Treated tissues were imaged on both the blue (DAPI) and green (FITC) settings of the confocal microscope. We conducted three competitive binding tests (steroid first, EDC first, and simultaneous competition) on the ovaries and testes. We used estradiol for competitive binding assays on the ovaries and testosterone with the testes. Allred scoring was used for image analysis (Allred et al.,1993). FITC images were scored against the DAPI pairs. The stain proportion were scored on a scale from 0-5 (where 0 = 0; 1/100 = 1; 1/10 = 2; 1/3 = 3; 2/3 = 4; 1 = 5), and added to the stain intensity score (where negative=0;1=weak; 2=intermediate; 3=strong). Images that score between 3-4 are considered low ligand binding, and above four are considered high ligand binding. The images were analyzed with ImageJ for: area, standard deviation, minimum and maximum gray 78 value, shape descriptors, integrated density, skewness, area fraction, mean gray value, median and stack position. The means of each measurement were calculated for each stain test and tissue type, and used as proxies for binding-affinity since we did not use live tissues or cultures. All putative EDCs showed some binding to the tissues. Some disruption of estrogen and testosterone binding occurred for all 4 EDCs, demonstrating their potential to disrupt normal gonadal function in sea turtles. This study sheds light on a previously unstudied threat of plastics on sea turtles with potential long-term physiological effects, and the techniques can be applied to other organisms.

MATERNALLY TRANSFERRED PHTHALATES EXHIBIT POTENTIAL FEMINIZING EFFECTS ON SEXUAL DIFFERENTIATION IN TURTLE EMBRYOS

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Sea turtles play a vital role in marine ecosystems and contribute to local ecotourism industries in many regions of the world. Like other marine organisms, sea turtles are heavily threatened by plastic consumption. Plastics can cause gut impaction or perforation, and may leach chemicals that are then stored in body tissues. Microplastics (plastics less than 5 mm) have been documented in all life stages of sea turtles and can be passed from mother to offspring through eggs. Phthalates, known endocrine-disrupting compounds (EDCs) across a variety of taxa, are one of the many classes of contaminants that leach from microplastics. EDCs are chemicals similar in structure to natural hormones, that can bind to hormone receptors in the body and either stimulate or block its natural action. Exposure to EDCs during incubation can thus affect the sexual differentiation pathway, including in organisms with temperature-dependent sex determination such as sea turtles. In other vertebrates, feminizing effects of phthalates have been described through mechanisms such as decreasing testosterone levels. To determine if turtle sex determination is affected by exposure to certain congeners of phthalates that are commonly detected in sea turtle eggs, we used the freshwater turtle Trachemys scripta as a model for laboratory experiments. Clutches of T. scripta eggs were incubated at either an all-male-producing temperature (26°C) or at the pivotal temperature (29°C). Doses of three different concentrations of di(2-ethylhexyl)-phthalate (DEHP) and dibutyl phthalate (DBP) were applied topically within several days of being laid. Eggs were dissected when embryos were in the later stages of development, and sex assigned through visual assessment and histological analysis. Egg yolks and embryo livers were harvested and frozen at -80°C for analysis of phthalate concentrations utilizing Gas Chromatography-Mass Spectrometry (GC-MS). Verification of sex assignment through histological analysis and quantification of toxicant concentration through GC-MS is ongoing. Preliminary results of sex assignment from visual assessment show production of female embryos exposed to DEHP and DBP at MPT, differing from the expected sex ratio of 100% male production at this temperature seen in control treatments. Positive controls at both temperatures received the topical application of estradiol, and also produced female embryos. This indicates the potential feminizing effects of phthalates in turtle embryos, though further research is needed. Microplastics are ubiquitous in marine environments, leading to significant exposure of sea turtles and other marine life to the variety of EDCs that leach from microplastics. Rising global temperatures already threaten to feminize sea turtle sex ratios, potentially reaching a point in the future where adult males become limiting. Understanding whether exposure to plastic-associated EDCs compounds this feminizing effect is vital to make informed management decisions for threatened or endangered sea turtle populations.

LINKING FORAGING NICHE TO POLLUTANT CONCENTRATIONS IN JUVENILE HAWKSBILL TURTLES FROM BUCK ISLAND REEF NATIONAL MONUMENT

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Hawksbill sea turtles (*Eretmochelys imbricata*) are critically endangered and face multiple threats including chronic exposure to industrial pollutants, sewage effluent, and coastal runoff in nearshore foraging habitats. Juveniles are particularly susceptible to contaminant accumulation because they reside primarily in these shallow, nearshore environments where exposure to anthropogenic waste is persistent. Despite this vulnerability, few studies have examined how individual foraging ecology influences toxic element burdens. This study integrates trace-element analyses with stable carbon isotope ratios ($\delta^{13}C$) to test whether feeding niches predict contaminant exposure in juvenile hawksbills at Buck Island Reef National Monument, U.S. Virgin Islands. Between 2014 and 2019, juvenile hawksbills were hand-captured during a long-term mark–recapture program. Whole-blood samples (n = 44) were analyzed for 12 elements (As, Fe, Cu, Se, Cd, Co, Pb, Mn, Hg, Mo, Tl, Zn) using inductively coupled plasma mass spectrometry (ICP-MS), and $\delta^{13}C$ values (n = 45) were measured via elemental analyzer–isotope ratio mass spectrometry (EA-IRMS). Elemental concentrations and $\delta^{13}C$ data were assessed for normality assumptions using DHARMa residual diagnostics, and a gamma distribution was selected to accommodate for the right-skewed data. Blood $\delta^{13}C$ values were compared with hawksbill epidermis data from Moorehouse et al. (2023) using correlation and linear regression analyses. Linear mixed-effects models were then applied to test $\delta^{13}C$ as a predictor of element concentrations, with each individual turtle as a random effect. Epidermal $\delta^{13}C$ was enriched by 1.6‰ relative to whole blood ($|z| = 14.46$; $p < 0.001$), and 49% of the variation in epidermal $\delta^{13}C$ was explained by blood $\delta^{13}C$ ($R^2 = 0.49$). $\delta^{13}C$ values showed only minor interannual differences, with significant decreases in 2016, 2018, and 2019 ($p<0.05$). Essential elements (Fe, Cu, Se, Zn) and arsenic occurred at the highest concentrations, while nonessential elements (Cd, Co, Pb, Mn, Hg, Mo, Tl) remained low and stable across years. Generalized linear mixed models verified the relationship between blood $\delta^{13}C$ and each metal concentration, showing that year had negligible influence. $\delta^{13}C$ explained 37% of the variation in thallium concentrations ($R^2 = 0.37$) whereas for all other metals $R^2 < 0.05$. These results indicate that diet strongly influences the uptake of Tl, while other factors may contribute to the accumulation of other toxic elements. Correlation analyses further revealed strong negative relationships between $\delta^{13}C$ and six elements (As, Cd, Co, Cu, Se, and Tl), suggesting that turtles foraging on ^{13}C-enriched resources accumulated lower contaminant loads. This study provides the first evidence that individual foraging niches may drive pollutant bioaccumulation in juvenile hawksbill turtles in the Caribbean. The inverse relationship between $\delta^{13}C$ and contaminants suggests reduced exposure for turtles feeding in carbon-enriched reef habitats. These findings highlight the need for habitat-specific management, targeted contaminant monitoring, and incorporation of isotopic foraging proxies into conservation planning. Future research should integrate additional isotopic markers (e.g., $\delta^{15}N$) and expand across species and life stages to better understand ecological drivers of contaminant uptake in marine turtles.

DISEASE PRESENCE AND DIETARY SHIFTS IN GREEN TURTLES FOLLOWING EXTREME FLOODING EVENTS*

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Climate change is intensifying extreme weather events, increasingly impacting coastal regions and their marine ecosystems. In Hervey Bay, Queensland, severe flooding in 2021 was linked to a marked reduction in seagrass coverage, a surge in green turtle (*Chelonia mydas*) strandings, and the emergence of a previously undocumented condition known as soft shell syndrome. In response, a comprehensive health assessment of the local green turtle population was funded by the Commonwealth-state Disaster Recovery Funding Arrangements (DRFA). A total of 145 individuals were evaluated through physical examinations, blood sampling for health and toxicology, and gastric lavage for dietary analysis. A popular hypothesis prior to the investigation was that the observed health deterioration was linked to a dietary shift from seagrass to alternative forage sources such as mangrove and algae. Findings revealed that sub-adults and adult males were disproportionately in poorer health and body condition, likely due to age-specific dietary patterns. Juvenile turtles, with a more diverse diet, exhibited greater resilience. Lavage samples from sub-adults contained higher proportions of mangrove species *Avicennia marina* and *Rhizophora stylosa*, as well as algae, compared to adults. Notably, juveniles with higher body condition scores frequently consumed the red alga *Catenella nipae*, which was the most prevalent and abundant dietary item across samples. Contrary to initial hypotheses, these results suggest that dietary flexibility, particularly the ability to shift to mangrove and algal resources during seagrass dieback, may mitigate susceptibility to chronic illness and disease, and is not the cause of poor health. However, the lack of baseline data on diet composition and health metrics for this population limits the ability to contextualise these findings. We recommend ongoing, holistic monitoring of the Hervey Bay green turtle population during non-disturbance periods to establish reference conditions. This will enhance conservation strategies and improve resilience planning in the face of increasing anthropogenic pressures and climate-driven extreme weather events.

INTESTINAL MICROBIOME COMPOSITION OF FREE-RANGING GREEN TURTLES (*CHELONIA MYDAS*) FROM GUANABARA BAY, RIO DE JANEIRO, BRAZIL*

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Guanabara Bay, located in the state of Rio de Janeiro, Brazil, is part of the metropolitan region and holds strategic importance due to its facilitation of activities such as fishing, navigation, and tourism. The bay hosts a diverse array of ecologically significant organisms but has suffered for decades from pollution, primarily from sewage discharge. This pollution introduces pathogens that can cause a variety of diseases. One resident species, *Chelonia mydas* (green turtles), is regularly exposed to these anthropogenic factors. Juvenile green turtles in polluted areas often present fibropapillomatosis, a disease characterised by the

development of tumours. As bioindicator species, green turtles provide insights into environmental health, which has implications for human health as well, aligning with the One Health concept. This study aimed to identify bacteria and antimicrobial resistance genes present in the microbiota of free-living green turtles using culture-independent methods. Between 2022 and 2024, more than 200 green turtles were captured across Guanabara Bay (SISBIO License: 71913-4). Metadata such as curvilinear carapace length (CCL, cm), curvilinear carapace width (CCW, cm), weight (kg), and the presence of fibropapillomas (FP) were collected. Cloaca swabs were collected and preserved in DNA stabilisation liquid for metagenomic analyses. We analyzed the microbiota of 63 animals using the 16SrRNA gene metagenome. Using metadata, we divided the samples into animals without tumors, with mild tumors, and with severe tumors. From this analysis, we found that most animals with a CCL greater than 40 cm had some degree of tumors. The metagenomic analyses were performed in CLC Genomics Workbench using SILVA as the reference database. The results showed differences in taxonomic abundance between the groups analyzed. The intestinal microbiome analyses revealed the predominance of the Gammaproteobacteria class in all groups analyzed, with enrichment of Desulfobacteria in turtles with severe fibropapillomatosis score (FPS). This bacterial group is commonly associated with seagrasses, which are one of the main food sources for green turtles. These findings suggest that larger individuals with more severe tumors may be staying for prolonged periods in Guanabara Bay, possibly due to their loyalty to feeding areas already described for the species. Continued exposure to polluted environments can compromise the immune system of these animals, promoting or aggravating the development of tumors. In this context, the results reinforce the importance of conserving and restoring coastal areas used as feeding grounds, since environmental degradation can have direct effects on the health of green turtles and pose an additional threat to the conservation of the species.

EXAMINING THE RELATIONSHIP BETWEEN FIBROPAPILLOMATOSIS TUMOR LOCATION AND PLASTIC INGESTION IN GREEN SEA TURTLES (*CHELONIA MYDAS*)

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Plastic pollution remains a major threat to marine ecosystems, with sea turtles among the species most at risk. These reptiles, which range from Vulnerable to Endangered on the IUCN Red List, often ingest marine debris, resulting in physiological harm such as gut impaction, perforation, and chemical exposure. This study explores the potential relationship between Fibropapillomatosis (FP) tumor location and plastic ingestion in green sea turtles (*Chelonia mydas*). Specifically, it examines whether the distribution of tumors, external, internal, or both, affects the frequency or type of plastics ingested. Necropsies were performed on 46 green sea turtles, and gastrointestinal tracts were processed using 10% KOH digestion to isolate debris larger than 2 mm, which was then identified and quantified using ImageJ software. Preliminary results indicate that plastic ingestion occurred across all tumor-location categories, with 81% of FP-afflicted turtles (17 of 21) and 63% of non-FP turtles (15 of 24) showing evidence of plastic consumption. A total of 742 debris items were recovered, with polyamide, polyethylene, and polypropylene as the dominant polymers. Filaments were the most common form of debris (69% in FP turtles and 72% in non-FP turtles), and black and white were the most frequently observed colors. While tumor presence alone did not significantly predict ingestion rate, further investigation into tumor location and severity may clarify whether localized internal growths influence feeding behavior or debris retention. These findings contribute to a broader understanding of how disease pathology and plastic exposure intersect in marine turtles, with implications for conservation and rehabilitation efforts.

LONG-TERM GREEN TURTLE FIBROPAILLOMATOSIS TRENDS AT AN EAST-COAST FLORIDA FORAGING AREA

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Fibropapillomatosis (FP) is a multifactorial disease associated with Chelonid herpesvirus 5 (ChHV5) and is most frequently observed in juvenile green sea turtles (*Chelonia mydas*). FP manifests as internal and external tumors and can impede movement and feeding but may regress partially or fully. The focus of this study was to examine long-term trends in FP prevalence in the Trident Basin (TB) in Port Canaveral, Florida, USA. The University of Central Florida's Marine Turtle Research Group (UCFMTRG) began monitoring TB in 1993, and FP was not observed in this turtle aggregation until 2005. These long-term data provide an opportunity to investigate disease emergence and dynamics in a juvenile development habitat in Florida. The UCFMTRG sampled TB biannually from 1995 to 2024. Green turtles (n=2,248, straight carapace length: 20.0 - 71.5cm, mean: 31.4cm ± 5.48cm) were captured using tangle and dip nets, and FP presence was determined by visual assessment of external tumors. Of those turtles, ~4% (n = 86) showed signs of FP and ~96% (n = 2,224) did not. We used generalized linear mixed-effect models to examine temporal trends in FP prevalence across years and between seasons while accounting for interannual variability. FP infection in TB was first recorded in 2005 and was observed annually through 2024. We found a significant and consistent upward trajectory in FP prevalence from 2005 to 2024, suggesting that the proportion of turtles with FP within the population is increasing over the years. The random effect for year indicated some variation among years beyond the general upward trend. These annual fluctuations could reflect changing environmental conditions (e.g., water quality or pollution), FP expression and regression dynamics, or shifts in population demographics. FP prevalence was not significantly different between summer and winter, but prevalence tended to be higher in winter (~5-6%), compared to summer (~3-4%). This may reflect environmental or host-related factors like cooler water temperatures or varying seasonal aggregation patterns. The rise of FP prevalence in a formerly unaffected site suggests changing environmental conditions or inter-population connectivity. These results underscore the importance of long-term monitoring efforts for detecting emerging disease patterns.

STANDARDIZATION OF A COST-EFFECTIVE PROTOCOL FOR ASSESSING SEA TURTLE HEALTH: A SYSTEMATIC REVIEW

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The health status of sea turtle populations is a key component for determining their conservation outlook. There is a broad array of parameters that can be considered in sea turtle health assessment, and their selection is not only driven by the research question (e.g., prevalence of a disease) but also by economic and/or logistical constraints. The aim of this work was to develop a cost-effective protocol that maximizes data collection while minimizing costs and sampling effort – a particularly advantageous setting for economically or logistically limited scenarios (e.g., onboard/remote sampling). We followed the PRISMA methodology to conduct a systematic review of the literature that assessed the health of all sea turtle species

worldwide. We selected a total of 246 peer-reviewed publications spanning the period 1977-2025. These studies examined sea turtles obtained from bycatch, field studies (capture-release at sea or nesting beach) or strandings; and assessments were conducted either in the field or at research or rehabilitation facilities. Research effort was uneven across the globe, with a much higher number of publications from coastal regions of the US or northeastern Australia. Bias was also found in taxonomic coverage, with over 60% of the records belonging to green and loggerhead sea turtles (*Chelonia mydas* and *Caretta caretta*, respectively). Health parameters were recorded and classified into greater categories and, for each one, we identified the most informative and frequently used health parameters. Based on this evidence, we designed a basic health assessment protocol intended to be applied to any sea turtle species and sampling context. It includes (i) basic sampling data (species, sex, date, locality, sampling setting, presence of tags, photographs), (ii) morphometric data (weight and several body measurements, including curved and straight carapace length at minimum), (iii) physical examination (activity level, subjective body condition, external conditions – e.g., injuries, tumours, entanglement –, epibiont diversity and load), (iv) clinical examination (body temperature, hydration level, reflex response, respiratory frequency), and, whenever possible, (v) blood analyses (biochemistry, hematology, and blood gases). This work aims to open the conversation for protocol standardization to ensure reproducibility and the determination of long-term trends in health, as well as encourages the use of this cost-effective protocol particularly in challenging field conditions, e.g. monitoring bycaught animals aboard fishing vessels.

INVESTIGATING THE USE OF EPIBIONTS AS INDICATORS OF SEA TURTLE HEALTH: A METHODOLOGICAL FRAMEWORK

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Sea turtles harbor a remarkable diversity of epibiotic fauna and algae, with nearly 400 epifaunal taxa from seven phyla reported to date. Several studies have used epibiont load (typically abundance), along with other health parameters (e.g., external injuries, body condition), to classify sea turtles as clinically healthy or ill. However, in reviewing the literature, we found that the link between epibionts and sea turtle health is uncertain. Some studies, but not others, reveal significant relationships between epibiont presence or abundance and external injuries, poor body condition, or some blood analytes (e.g., positive with white blood cell count and cholesterol levels, or negative with hemoglobin concentration). These inconsistencies may arise, at least in part, from differences in study design and analysis. First, some studies measure 'epibiont' or 'barnacle' loads regardless of taxonomic composition, despite the vast diversity of epibionts concerning life cycle or host specificity, hence their potential as health indicators. Second, few studies account for the potential effects of confounding variables (e.g., seasonality). Third, many studies deal only with clinically healthy turtles. We propose a methodological framework to assess the usefulness of epibionts as health indicators that includes (1) independent data collection and analysis of distinct epibiont taxa, (2) multivariate analyses that control for the effect of environmental and biological covariates, and for the negative binomial distribution in epibiont intensity); and (3) balanced sampling of clinically healthy and ill sea turtles, as well as (4) turtles with low and very high epibiont loads. We applied this framework to identify the determinants of the presence and abundance of the barnacles *Chelonibia testudinaria*, *Platylepas hexastylos*, *Lepas hillii*, and *Conchoderma virgatum* on 293 loggerhead sea turtles (*Caretta caretta*) caught accidentally in fisheries or found stranded along the Valencian region of Spain (western

Mediterranean). Of these, 226 loggerheads were admitted to a rehabilitation center, and 67 were found dead and necropsied. The presence and abundance of each barnacle species was modeled using Generalized Linear Models (GLMs) - with a binomial and negative binomial error distribution, respectively - based on 4 predictors, i.e., sex, season, curved carapace length (21-84 cm) and Body Condition Index (BCI). For turtles in rehabilitation, an additional health score indicating a debilitating condition (based on biochemical and hematological markers) was also included. No significant effects of BCI or debilitating condition were detected on the probability of barnacle occurrence or abundance. However, our study met conditions (1) and (2) of the framework above, but not conditions (3-4) since the sample was mainly composed of turtles accidentally captured in fisheries, including only two turtles with BCI < 1 and 8.4% of debilitated individuals, and barnacle prevalence ≤15% and mean intensity < 45 individuals/turtle for all species. Therefore, whether the selected epibionts are useful health indicators for loggerhead sea turtles in the study area remains an open question. Coordinated, multi-institutional efforts and data sharing will facilitate the implementation of this framework.

DIFFERENT STROKES FOR DIFFERENT FOLKS: ONTOGENETIC SHIFTS IN MORPHOLOGY AND EARLY SEA TURTLE DISPERSAL

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As hatchling sea turtles emerge from nests, they exhibit an innate hyperactive state: rapidly crawling to the water, followed by almost continuous swimming for 24-48 hours. This “frenzy” is dominated by powerstroking – characterized by bilateral “flapping” of wing-like flippers. The flippers are hydrofoil-shaped in cross-section and produce the thrust required to move forward in the water, as the rigid vertebrae of turtles make it impossible to undulate like other impressive swimmers. Once distanced from shore and in the open ocean, most sea turtles continue using the powerstroke, however less vigorously. And yet, not all sea turtle species are alike. Loggerheads (*Caretta caretta*) find refuge in floating mats of seaweed, opportunistically feeding and hiding from predators, while leatherbacks (*Dermochelys coriacea*) prefer the true openness of the open ocean in nearly constant search of gelatinous prey. Beyond the phylogenetic differences, we hypothesize that these different types of behavior correspond with species-specific morphometrics and kinematics of the flippers. To test these hypotheses, loggerhead and leatherback hatchlings were collected on the day of emergence, measured, and allowed to swim in a sea water-filled tank. Turtles were on tethers that permitted swimming in any direction and prevented contact with the tank sides or bottom. Swimming video and force data were collected synchronously to measure thrust in concert with flipper motions as hatchlings and after 4-16 weeks of growth. Corresponding morphometrics were taken at both time points. Our results demonstrate that leatherbacks and loggerheads exhibit similar growth patterns between hatchling and neonate life stages. Overall, body length increases significantly faster than flipper length (allometric growth). Additionally, flipper aspect ratio and mean peak force per stroke increase as both species reach larger sizes, while thickness percentage of the flippers decrease. Just like the specialization of bird wings for different modes of flight, these ontogenetic changes reflect a behavioral shift from the sprinting frenzy to the less vigorous post-frenzy swimming exhibited by both species. Despite these similar growth patterns, leatherbacks and loggerheads differ significantly in morphometrics and thrust production forms when compared to each other. Leatherbacks have a significantly higher flipper aspect ratio and a smaller hydrofoil thickness percentage at both life stages compared to loggerheads. Additionally, although leatherbacks exhibit a higher mean peak force per stroke than loggerheads as hatchlings, loggerheads exhibit a higher mean peak force per stroke as neonates. We propose these species-specific differences are best explained by their differing post-frenzy dispersal behaviors and microhabitat preferences during that time. Leatherbacks swim almost constantly with slow, but steady, marathon-like

characteristics, while loggerheads can exhibit quicker bursts of swimming when not hiding or foraging in sargassum mats. The comparison of leatherback and loggerhead sea turtles' size, shape, and swimming exemplify how form informs function.

OVARIAN DYNAMICS IN CAPTIVE LOGGERHEAD SEA TURTLES*

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Reproduction is a critical aspect of the life history of animals and plants. Understanding the physiological underpinnings that control reproduction is essential to designing and implementing effective conservation measures in imperiled species such as sea turtles. Because all sea turtle species are highly migratory, it is exceedingly difficult to obtain blood samples across the year to allow us to fully describe the associated hormonal correlates of ovarian recrudescence and regression in these ancient marine reptiles. To address this, we obtained monthly heparinized blood samples from two female adult loggerheads maintained in captivity at Mote Marine Lab, Florida under artificial conditions across an entire year. Samples were kept frozen at -80°C until analysis was performed. Using commercial enzyme immunosorbent assays (ELISAs) we measured testosterone and estradiol in all samples. Additionally, we measured vitellogenin (VTG) using an in-house ELISA. Both reproductive steroids are secreted from ovarian follicles, whereas VTG is secreted by the liver upon induction by endogenous estradiol. As a reference, the nesting season for loggerheads in Florida runs from May through October. Our results show that estradiol rose in July-September, reaching a peak of 570 pg/mL in January, and then decreased to a nadir of 45.14 pg/mL in June. VTG and testosterone exhibited a similar trend. VTG rose in October to reach a maximum circulating concentration of ~13 mg/mL in December through February and gradually decreased to a nadir in June and July, when it was undetectable. Lastly, testosterone rose gradually from 1,287 pg/mL September to a maximum circulating concentration in April with 9,998.85 pg/mL. After that, testosterone decreased gradually to its nadir at 798.79 pg/mL in June. Following this sequence of reproductive biomarkers, the ovaries should have begun to enlarge in November and reached maximum development between February and April, just in time for what would be the nesting season. Full gonadal regression should have then been reached between June and September for these captive loggerheads. Although this study included a sample size of only two animals the consistency in the concentration and dynamics of the biomarker's profiles of the two animals suggest that the data are representative of the loggerhead wild populations in the southeastern United States. This timeline of events can be applied to wild populations to inform managers and scientists about the most likely time when ovarian development in loggerheads is underway at foraging grounds.

MYOGLOBIN QUANTIFICATION IN JUVENILE *CHELONIA MYDAS* AND *LEPIDOCHELYS KEMPII*

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As an oxygen-binding hemoprotein, myoglobin facilitates diffusion and storage of oxygen in skeletal muscle tissues of diving vertebrates. High concentrations of myoglobin within locomotor muscle tissues illustrate an enhanced capacity for onboard oxygen storage to support extended dive durations. Previous studies with marine mammals emphasize that higher myoglobin concentrations are found in the skeletal muscle compared to the cardiac tissue due to the heavy reliance on skeletal muscle tissue oxygen stores to support breath-hold diving; however, this comparison between tissues has yet to be made in marine reptiles. This study aims to quantify myoglobin concentrations in the skeletal and cardiac tissues of green sea turtles (*Chelonia mydas*) and Kemp's ridley sea turtles (*Lepidochelys kempii*). Results will be placed in the context of dive capacity and the relative importance of muscle tissue oxygen stores. Tissues were obtained from cold-stunned juvenile *C. mydas* and *L. kempii* through the North Carolina Sea Turtle Stranding Network. The central pectoralis muscle and cavum arteriosum of the ventricle of each individual was sampled and myoglobin concentration quantified via spectrophotometric methods described in Reynafarje (1969). With a generalized linear mixed modelling approach, we found no difference between species but the average myoglobin concentration within skeletal tissues (*C. mydas* (N = 7): 1.08 mg·g-1 ± 0.58, *L. kempii* (N = 4): 0.87 mg·g-1 ± 0.40) was significantly lower than that of the cardiac muscle (*C. mydas*: 2.94 mg·g-1 ± 0.93; *L.kempii:* 2.26 mg·g-1 ± 1.84). Myoglobin concentration in sea turtle muscle tissue was similar to the range reported for terrestrial reptiles (1.20 to 6.04 mg·g-1 , Bennett et al., 1983; Weber et al., 1980). The difference in myoglobin concentration between skeletal and cardiac muscle tissue in these chelonid species indicates that skeletal muscle is not as significant for oxygen storage as in marine mammals (up to 120 mg·g-1, Burns et al., 2007; Kooyman, 1989). Additionally, other species of sea turtles, such as the loggerhead sea turtle (*Caretta caretta*, 2.9 mg·g-1, Lutz et al., 1985) and the leatherback sea turtle (*Dermochelys coriacea*, 4.9 mg·g-1, Lutcavage et al., 1990), have higher observed myoglobin concentrations in their muscle tissues than *C. mydas* and *L. kempii*. Distribution of oxygen stores between lung, blood and muscles may vary depending on interspecific differences in diving behavior and ecology. Future investigations will incorporate opportunistic tissue collection from our specific sampling sites in the central pectoral muscle and cardiac muscle of *C. caretta* and *D. coriacea* for additional interspecies comparisons. Additional investigations of myoglobin within other locomotor skeletal muscle groups that play different roles in the upstroke/recovery phase (posterior supracoracoideus, latissimus dorsi) or downstroke/power phase (pectoralis, coracobrachialis) of swimming could further our understanding of the energetics of locomotion and how sea turtles manage oxygen stores during breath-hold diving.

IMPLEMENTING THE ONE ENVIRONMENTAL HEALTH APPROACH: BLOOD METAL PROFILES OF NESTING LEATHERBACK AND LOGGERHEAD SEA TURTLES FROM SOUTHEASTERN FLORIDA, USA

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Ocean pollution is a global problem that impacts human, animal, and ecosystem health, all of which are interconnected. In fact, the One Health initiative considers there to be only "one" health shared by humans, animals, and the ecosystem and what impacts one impacts all three. Using the One Environmental Health research approach, a subspecialty of the One Health initiative that focuses on toxic chemicals, we can obtain a deeper understanding of the health impacts of ocean pollution. Of particular concern is metal pollution, which has been found in all of the world's oceans. Sea turtles are key species in the ocean that are long-lived and consequently can bioaccumulate metals, making them excellent bioindicators for monitoring local and regional metal concentrations, providing valuable insight into the health of marine ecosystems and sea turtle populations. For this study we focus on the endangered leatherback (*Dermochelys coriacea*) sea turtle and the threatened loggerhead (*Caretta caretta*) sea turtle. Some of their densest nesting grounds in the continental United States are on or near Juno and Jupiter Beaches in Florida. We assessed metal profiles in blood samples of nesting leatherbacks and loggerheads from this area to better understand how metal concentrations change across time. Blood samples were collected from 60 nesting sea turtles between 2020 and 2024. Blood was collected from the dorsal popliteal sinus in leatherbacks and from the external jugular vein in loggerheads using either Vacutainer collection systems or syringe and needle after disinfection with 70% isopropyl alcohol. Blood samples were digested using trace metal grade concentrated nitric acid prior to analysis of 25 metals using inductively coupled plasma mass spectrometry. We compared metal profiles within species and across the sampling periods. Essential metal concentrations fell into three ranges: (1) 250–2500 ug/g: iron, potassium and sodium; (2) 1–100 ug/g: copper, selenium, magnesium, zinc and calcium; (3) 0.001–0.01 ug/g: cobalt, molybdenum and manganese. When comparing species, loggerheads had more potassium and calcium in their blood than leatherbacks. Conversely, leatherbacks had more magnesium and sodium in their blood. While these essential metal concentrations remained relatively constant in leatherbacks, sodium and magnesium concentrations decreased with time in loggerheads while calcium concentrations increased. Nonessential metal concentrations were generally much lower. Arsenic had the highest mean concentrations of 1.2 and 2.7 ug/g in leatherbacks and loggerheads, respectively. Notably, blood arsenic concentrations in both species decreased over time. Tungsten, uranium, nickel, aluminum, vanadium, antimony, lead, cadmium, thorium, and barium were detected at much lower concentrations (0.01–0.1 ug/g) while beryllium and chromium were even lower (0.001–0.003 ug/g). These results provide valuable insights into essential and nonessential metals in two imperiled sea turtle species. Ongoing work includes assessing how these concentrations change over time as well as establishing genotoxicity measures with blood chromosome aberration analysis.

BREATHING WITHOUT A DIAPHRAGM*

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All turtles must breathe using mechanisms that do not rely on pressure changes in lungs via movements of a diaphragm, as mammals do. Fundamentally, inspiration occurs when the lung's volume increases, creating a lower pressure environment that induces the entry of air. Expiration occurs when the lungs compress, either via elastic recoil or by forced compression. Turtles ventilate sporadically, undergoing prolonged breath-holds, regardless of their location on land or in water. Turtle lungs are dorsally positioned and attach to the carapace's vertebrae and anterior pleural bones via a pulmo-carapacial mesentery. Other reptiles such as lizards and snakes rely on rib rotations for lung volume changes. Turtles cannot rotate the ribs. They also lack a visceral piston-pump system, like in alligators. How do turtles inflate and deflate their lungs? In non-marine turtles, a "muscular sling" surrounding the lung ventrally and laterally serves this function, along with volume changes due to appendicular motion. Sea turtles lack a muscular sling around the lungs. Unlike terrestrial and freshwater species, marine turtles routinely experience pressure changes associated with moderate to deep dives. Flexible joints between their lateral plastron (hyo- and hypoplastron bones) and peripheral bones of the carapace contribute to their ability to accommodate pressure shifts. Similarly, outward flexion and recoil of the shell occur during routine ventilation (breathing). When sea turtles inspire, the carapace appears to elevate, then depresses on expiration. This role of the axial skeleton of turtles is novel. How can these movements occur? Our aim is to investigate anatomically how these shell shape changes can occur during ventilation. Dissection of fresh dead cheloniid sea turtles (*Caretta caretta*, *Chelonia mydas*, *Natator depressus*) identified three muscle sets that can accomplish the necessary actions of the shell. The Latissimus dorsi (dorsally) and Serratus magnus (ventral) together can flex the carapace and plastron during contraction by pulling the shell margins medially, while simultaneously stretching the pulmo-carapacial mesentery as the carapace bows slightly outward. The medial movement of peripheral bones also flexes the hyo- and hypoplastron bones contributing to shell elevation and lung volume increase. Increased lung volume results in low internal pressure and thus inhalation. The lungs deflate by elastic recoil when the Latissimus dorsi and Serratus magnus are relaxed, allowing the carapace to unflex and the carapace margin to return to their neutral positions. Movements of the inguinal fossae muscles (Transverse abdominis and Abdominis oblique) may contribute to posterior lung collapse, yet their activity appears to be irregular with the ventilatory movements. Understanding the fundamental structure-function relationships underlying breathing in marine turtles contributes to our understanding of normal behavior during swimming and resting. This understanding provides insights into normal vs. abnormal turtle health and clarifies the adaptations that have occurred in air-breathing that accompany land-to-water shifts in turtle evolutionary history.

SEXUAL SKULL DIMORPHISM ON LOGGERHEAD SEA TURTLE FROM JAPAN

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The Loggerhead Sea Turtle inhabits the seas surrounding the Japanese archipelago, with the only nesting site known in the North Pacific. Mature males are distinguished from females by a longer tail, more curved claws of forelimb and a more concave plastron than females, but sexual dimorphism has not been reported for other characters. Dead loggerhead sea turtles sometimes strand ashore on the Japanese coast. However, sexing these carcasses is difficult due to their bad morphological condition. Sex information of such stranded sea turtles are necessary to understand sex ratios, population dynamics, and mortality. In this study, 40 skull samples, 26 females (SCL:±SD=786±65mm) and 14 males (760±88mm), were collected from carcasses along the coast of Japan. All individuals were classified as subadults or adults based on SCL size and sex was determined by direct observation of the gonads. We checked for sexual dimorphism in cranium shape by 3D geometric morphometrics. The 3D models were created using photogrammetry and analyzed with principal component analysis (PCA), canonical variate analysis (CVA) and regression analysis. Females and males were clearly separated in both PCA and CVA, with Procrustes ANOVA ($p<0.001$) and Procrustes distance ($d=0.0286$, $p<0.001$) supporting significant differences. The shape of the anterior cranium, parietal bone, supraoccipital bone, and quadrate bone were sexually differentiated. Males had a longer snout and flatter skull, whereas females had a shorter snout and a taller skull. From the regression analysis, centroid size only explained a small part of whole skull shape change (3.78%) and allometry was not significant between sexes ($p=0.067$). The intercept (i.e. centroid size-corrected mean shape) was different between sexes ($p<0.001$). These results suggested the existence of sexual dimorphism in the cranium of loggerhead sea turtles, which were previously thought not to be significant. Male skull shape is thought to be related to courtship behavior and male-to-male competition, whereas the female skull is more robust than the male skull, possibly to increase bite force for eating harder food. However, as the present sample size was small, future studies will look into the ontogenetic development of these sexual differences by increasing the sample size for both sexes, including juveniles and hatchlings.

REFERENCE VALUES FOR HEMATOLOGY AND BLOOD BIOCHEMISTRY IN THE EASTERN PACIFIC GREEN TURTLE OF NORTHERN SINALOA

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Hematological and blood biochemical markers represent a valuable tool for wildlife health monitoring. The foraging areas of northern Sinaloa lack reference values for blood biochemical markers; therefore, the objective of this study is to establish these values in the Eastern Pacific green turtle in order to contribute to the protection of the species through markers that allow for the evaluation and monitoring of its health status. From 2017 to 2021, 77 sea turtles were captured, 45 in the Navachiste Lagoon System and 32 in Topolobampo Lagoon System. Based on the sizes obtained, the population structure of the NLS is mainly composed of subadult and juvenile specimens, while the TLS is mainly composed of subadults and adults. The biochemistry of 40 samples was analyzed. In general, the values were within the range established by other authors in different foraging areas. Statistical differences were observed between lagoon systems in uric acid and potassium levels. Based on apparent health indicators, size, hematological markers, and blood biochemistry, these turtle populations can be considered healthy and can be used as reference ranges for their populations within the region.

Conservation, Management, and Policy

VESSEL AVOIDANCE BEHAVIOR IN GREEN TURTLES OFF THE GULF COAST OF FLORIDA*

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Vessel strikes have become a concerning source of mortality for sea turtles due to increased turtle and vessel abundance in shared areas. For effective management strategies to be established, this threat to sea turtles must be thoroughly understood. To aid in this effort, we observed how green turtles (*Chelonia mydas*) reacted to oncoming vessels at varying speeds. We conducted observational boat surveys to measure turtle flight responses and flight initiation distances (distance from the bow of the vessel an animal begins flight behavior) and then compared behaviors of turtles of differing size classes (greater or less than 60 cm estimated carapace length). We found that green turtles' average flight initiation distance was significantly driven by the speed of the oncoming vessel, with the average flight initiation distance reducing from a high of 7.7m in ideal conditions at 4 km to a high of only 5m in ideal conditions at higher speeds of 9 and 14 km. There was no correlation between flight initiation distance and the turtles' size. Green turtles did show a preference of flight behavior, fleeing directly away from the trajectory of the oncoming vessel in 51% of interactions (n = 78). Green turtle populations are beginning to rebound, and the number of recreational vessels is increasing in coastal waters, meaning a likely increase in vessel/turtle interactions. This research looks to improve the available information on a threat for sea turtles in coastal waters and will be useful for management organizations to help reduce vessel related mortality.

INTRODUCING OCEAN CONSERVANCY'S WILDLIFE IMPACT CALCULATOR AND PLASTIC-WILDLIFE IMPACT DATABASE*

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Cleaning up plastic pollution is one of three interventions scientists agree are necessary to address our global plastic pollution crisis and help protect marine life, including sea turtles. There is much work to be done to curb plastic production and improve waste management, but how can we effectively bolster public participation in cleanups to achieve this lofty goal? Powered by robust scientific models, Ocean Conservancy's new Wildlife Impact Calculator tool illuminates the real-life positive impacts of individual coastal cleanups on sea turtles, seabirds and marine mammals. This tool makes powerful science on the mortality risks of macroplastic ingestion publicly accessible and understandable, whereby the positive ocean impacts of even small-scale, individual plastic cleanups can be calculated with the simple click of a button. Ocean Conservancy's Wildlife Impact Calculator quantifies and demonstrates the direct impact individuals can have on helping protect wildlife when partaking in plastic pollution cleanup efforts. We

believe public engagement with our novel tool will both deepen personal connections to the issue, and ultimately unleash broader engagement in the fight to reduce ocean plastic pollution. Additionally, with over 10,000 entries, our publicly-available Plastic-Wildlife Impact Database contains all the research on macroplastic ingestion that informed this model. Together, our new resources can be used by conservationists and decision makers alike to evaluate the benefits of different interventions to evaluate the benefits of different interventions to prevent or remove plastic pollution and help inform management and reduction policies.

ARTIFICIAL IRRIGATION TO COMBAT WARMING OF SEA TURTLE NEST ENVIRONMENTS: DAMPENED SAND CAN INCREASE HEAT TRANSFER TO NEST DEPTH*

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Artificial irrigation of sea turtle nests is being rapidly adopted as a climate change intervention strategy, with large-scale projects proposed at nesting sites including Raine Island, Australia. Over the last decade, artificial irrigation has been tested at nesting sites globally with approaches ranging widely in application volume, frequency, water source (freshwater or seawater), and depth at which thermal effects are measured. This has led to variable thermal responses to irrigation, requiring controlled experimentation to understand underlying mechanisms and establish best practices. We investigated nest irrigation as a potential mitigation strategy using controlled laboratory trials and field validation at Dalyan beach, Türkiye, an important Mediterranean loggerhead turtle (*Caretta caretta*) nesting site. Laboratory experiments used ten sand chambers within a temperature and humidity controlled room to test five different irrigation regimes under standardized conditions, measuring water movement, temperature, and salinity changes throughout the sand column and at nest depth. Selected regimes were then tested at Dalyan beach under natural environmental conditions. Both laboratory and field trials demonstrated that thermal and saline responses to irrigation depended critically on irrigation regime and environmental conditions. Daily irrigation achieved net cooling: moderate applications (20 mm seawater) reduced mean temperatures by 0.96°C at 35 cm depth but increased diel thermal variability by up to 1.5°C and salinity up to 50-fold natural levels. Low-volume (10 mm) daily irrigation achieved comparable cooling (0.81°C) without percolating to nest depth, avoiding increases to thermal variability and salinity at nest depth. In contrast, one-off large-volume irrigation (100 mm) increased maximum temperatures under controlled laboratory conditions and by 0.22°C above control temperatures at Dalyan beach, with elevated temperatures persisting for 12 days after irrigation ceased. Initial sand water content prior to large volume irrigation strongly influenced this warming effect; during the hottest day of the field trial (air temperature >50°C), the difference between 5% and 20% initial sand water content resulted in an order of magnitude difference in warming (0.77°C versus 0.07°C above control temperatures). All irrigation regimes that percolated to nest depth increased diel thermal variance in dry sand, with these effects most pronounced during hotter periods and at shallower depths. For populations facing extreme developmental temperatures, conservative irrigation approaches using low-volume daily applications offer meaningful temperature reduction while minimizing risks. Implementation should proceed only after site-specific testing, particularly during hotter periods when both the need for intervention and the risk of adverse effects is greatest. Our findings demonstrate that nest irrigation could be a valuable conservation tool but also carries risks if not implemented carefully.

RAS BARIDI TURTLE CONSERVATION INITIATIVE: LONG-STANDING CONSERVATION PROGRAM, SAUDI ARABIA*

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Ras Baridi, located near Yanbu on the Saudi Red Sea coast, is recognized as the most important nesting site for green turtles (*Chelonia mydas*) in the Saudi Red Sea coast since 1980's, with occasional nesting by the critically endangered hawksbill (*Eretmochelys imbricata*). However, this key rookery has long faced threats from industrial activity, beach erosion, artificial lighting, and marine debris. In response, the Ras Baridi Turtle Conservation Initiative (RBTCI) was established by KAUST Beacon Development to develop and implement a Saudi-led, science-based program to ensure the long-term survival of marine turtles and the resilience of their habitats in the Red Sea. This work aligns directly with Saudi Arabia's Vision 2030, which emphasizes the preservation of the Kingdom's biodiversity and environmental stewardship. During its initial years, RBTCI prioritized urgent mitigation and capacity-building actions. These included regulating beach driving, removing plastic debris, and engaging local communities through environmental education. Since 2021, dedicated Saudi Environmental Wardens were regularly patrolling the beaches, documenting nesting events, rescuing disoriented hatchlings, and tagging nesting females, generating the foundation for one of the first long-term, standardized turtle monitoring programs in the region. Now in its fifth year, RBTCI has become a cornerstone of turtle conservation in Saudi Arabia. To date, the team has tagged more than 735 nesting females, rescued over 3,500 hatchlings, and removed approximately 850 kg of marine debris from nesting habitats. More than 120 people have participated in outreach sessions and guided visits at the Ras Baridi Turtle Visitor Center, fostering national awareness and stewardship. The research component has expanded to include genetic connectivity analyses, mark-recapture assessments, drone-based topographic mapping, and microclimate monitoring to assess how climate change and beach morphology affect nesting success. Several notable recaptures, including individuals originally tagged more than three decades ago, underscore the exceptional site fidelity and longevity of the Ras Baridi turtle population. Building upon these achievements, RBTCI is evolving into a long-term, data-driven conservation platform integrating climate resilience modeling, population dynamics, and community participation. Future objectives include strengthening regional collaborations, and translating research outcomes into adaptive management plans that protect both turtles and the coastal ecosystems they represent. Through the integration of hands-on conservation, local capacity building, and cutting-edge research, the Ras Baridi Turtle Conservation Initiative exemplifies a scalable model for safeguarding marine biodiversity and advancing Saudi Arabia's leadership in Red Sea conservation under the Vision 2030 framework.

BEYOND BORDERS: BUILDING AWARENESS AND CONSERVATION CAPACITY FOR SEA TURTLES IN GHANA AND SARDINIA

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The ongoing collaboration between Okra Projects and the Sardinian Regional Network (SRN) continues to advance the conservation and management of sea turtle nests in Ghana, integrating education, scientific monitoring, and community engagement. Building on the foundation established last year, new initiatives have been implemented to further optimize marine turtle protection in this critical region. Okra Projects, a Ghanaian NGO active for over 15 years in small communities projects, environmental education, and turtle conservation, has strengthened its partnership with SRN. Operating primarily in the Jomoro District (Western Region). Okra involves local schools and coastal communities in awareness campaigns addressing plastic pollution and marine turtle protection. All seven sea turtle species are globally threatened by human activities and habitat degradation. In Sardinia (Italy), the loggerhead turtle (*Caretta caretta*) remains the main species under SRN protection. Since 2000, nearly 1000 turtles have been rescued by seven regional rescue and emergency centers, SRN's primary partners, mostly due to by-catch in fishing gears, litter ingestion and entanglement. In recent years, SRN has expanded its work to nesting management, monitoring over 80 nests, and to the analysis of marine litter discarded in the environment and ingested by turtles. Its collaborative network extends to North Africa, through projects such as INDICIT I/II, REMEDIES, and TURTLENEST, enhancing cross-regional conservation capacity. In the current phase, new activities have been introduced to strengthen outcomes. The number of participating villages has increased to 9, covering approximately 25 km of coastline, reflecting greater community involvement. In March 2025, an in-person training course was organized by CNR researchers (scientific partner of SRN) both in Sardinia and Ghana to build technical capacity among conservation practitioners. Standardized guidelines and protocols for nests management were developed and implemented, and data loggers were installed in two protected hatcheries (Beyin 1 and Beyin 2) from March to October 2025 to continuously monitor sand temperature, a key factor influencing hatchling sex ratios and reproductive success. Data recorded in 2025 revealed the most recorded nesting species (*Lepidochelys olivacea* and with lower values also *C. caretta*), with 6943 eggs relocated from 72 nests across seven locations (Beyin, Ngelekazo, Twenen, Agyeza and Bonyere, Egbazo, Ekabaku) and 3392 hatchlings released in the wild, a very higher value respect data from 2024 with only 1915 eggs protected and 574 hatchling released. In the last year, average temperatures recorded in the two hatcheries were respectively 28.51 ± 0.03 (B1) and 29.10 ± 0.02 (B2) (mean T° ± SE). Results show variability in hatching success among sites. Although analyses are ongoing, early findings suggest that targeted nest relocation can enhance hatchling survival, while temperature monitoring provides essential data for adaptive management under climate change scenarios. This integrated approach, combining scientific monitoring, capacity building, and community participation, represents a model for effective marine turtle conservation in Ghana and other regions facing similar ecological challenges. The partnership, sustained by a continuous exchange of expertise and resources between Sardinian and Ghanaian teams, ensures the sustainability, scalability, and long-term impact of joint conservation actions.

A MULTI AGENCY AND COMMUNITY FOCUSSED APPROACH TO REDUCING SEA TURTLE BYCATCH MORTALITY ALONG THE TAMIL NADU COAST, INDIA

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This paper elucidates the mitigation methods followed in Tamil Nadu, India, to reduce the bycatch mortality of the Olive Ridley sea turtles by engaging multiple agencies including the coastal fisher community. The coast of Tamil Nadu serves as a vital foraging, breeding and nesting habitat for the Olive Ridleys (*Lepidochelys olivacea*), a globally vulnerable species (IUCN). The beaches from Kanyakumari to Thiruvallur districts in Tamil Nadu, are natal nesting sites for thousands of turtles and the offshore waters are the migratory route to hundreds of thousands turtles that migrate annually from Gulf of Mannar, a rich foraging habitat off the southern cost of Tamil Nadu, toward their solitary nesting beaches along north Tamil Nadu, Andhra Pradesh and Odisha's mass nesting (arribada) beaches. However, this important coastline faces escalating threats, particularly from bycatch mortality caused by mechanized fishing, the use of prohibited fishing gear and illegal nearshore trawling. During the breeding season (December to March), Olive Ridley turtles are highly susceptible to entanglement in trawl nets, gillnets, and nets set for ray fish. These accidental captures often result in drowning. Despite clear revised guidelines under the Tamil Nadu Marine Fishing (Regulation) Act, 2020 (MFRA), illegal trawler/commercial fishing operations continue to operate within the restricted 8 nautical miles zone, causing large scale turtle mortality. Since 2002, TREE Foundation has been working with the enforcement departments on an 'Integrated Community Based Sea Turtle Conservation Program'. This presentation will outline specifically how the conservation challenges were addressed since January 2025 (i.e. comtemporary developments), working jointly with the enforcement departments. A multi-pronged collaborative strategy integrating enforcement departments, fishing communities, awareness, and technology-driven monitoring has been created as outlined below: (1) Dedicated Patrol Boats: Wet-leased trawlers operated jointly by the Forest, Fisheries, and Marine Police Departments. These sea patrols were conducted randomly from strategic fishing harbours. Hefty penalties were levied on the violators which deterred most illegal fishing and enforced MFRA provisions; (2) Enhanced Awareness and Capacity Building: Intensive outreach in fishing villages and awareness campaigns on turtle-friendly fishing practices and new penalty structures; (3) Empowering the Indian Coast Guard: Temporary empowerment under the MFRA and the Wildlife Protection Act (1972) to apprehend violators during turtle season, mirroring Odisha's successful enforcement model; (4) Prohibition of Harmful Gear: Banning ray fish nets, and use of squid nets (at night time) during the nesting season. This integrated strategy emphasizes cross-sectoral coordination, community participation, and technological enforcement tools such as 'Vessel Communication and Support System (VCSS)' transponders for tracking compliance. By combining proactive sea patrols, strict legal enforcement, and grassroots education, it is envisaged that bycatch-related mortality will drastically reduce and thereby help secure the survival of Olive Ridleys along India's east coast. The Olive Ridley turtles are flagship species of marine biodiversity and ecological resilience. Their conservation demands unified action bridging government agencies, enforcement authorities, and coastal communities. Continuing this strategy will not only safeguard nesting populations but also strengthen sustainable fisheries management and marine ecosystem health in the Bay of Bengal region.

INTEGRATING ADAPTIVE PREDATOR CONTROL TO PROTECT CRITICALLY ENDANGERED HAWKSBILL NESTS*

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The Hawai'i Island Hawksbill Project, a program of the Pacific Cooperative Studies Unit in collaboration with the National Park Service, has monitored nesting activity of the endangered hawksbill sea turtle (*Eretmochelys imbricata*, honu'ea) for over 30 years. Nest predation by non-native species – including rats (*Rattus spp*.), cats (*Felis catus*), and mongooses (*Herpestes javanicus*) – continues to pose a significant threat to sea turtle populations. Since 1989, the project has relied primarily on rudimentary traps, with little modification to trapping protocols. Between 2018 and 2020, no predator trapping was conducted due to staffing and resource limitations. Critically, Hawai'i Island's primary hawksbill nesting beach, Kamehame, had no trapping from 2016 to 2020. During the 2021 nesting season, following an unprecedented 91% nest predation rate at Kamehame, it became evident that predator management strategies required substantial refinement. Historically, the project relied solely on live traps and conducted trapping only when staff were present on the beach during nesting season from May to December. Beginning in 2021, we diversified our trapping approach by adding four additional trap types: Trapinator DOC250, an instant-kill trap, and the Goodnature A24 and A18s, an instant-kill and automatically resetting trap, and AT220 traps, resulting in the use of five distinct trap types. The automatic self-resetting traps have helped maintain consistent predator control during staffing gaps, non-nesting season, while also increasing the number of active trapping days and overall coverage. Additionally, a trap line barrier was established around the island's four most active hawkbill nesting beaches, creating a defensive perimeter to reduce predator access to nesting sites. Effective and adaptive predator control is essential for supporting long term viability and recovery of hawksbill turtles in Hawai'i. These enhanced and diversified predator control efforts protect nests and help secure future generations. Our goals demonstrate that targeted, adaptive predator management can deliver measurable conservation outcomes and underscore the importance of sharing methodologies, results, and challenges. We aim to support other sea turtle conservation programs facing similar threats and highlight the importance of collaboration to strengthen predator control efforts across the region and beyond.

EFFECT OF ARTIFICIAL LIGHT ON THE ORIENTATION ABILITY OF GREEN TURTLE HATCHLINGS ON TORTUGUERO BEACH, COSTA RICA*

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On nesting beaches, the survival of hatchlings is influenced by anthropogenic effects. Light pollution, generated by the exposure of artificial light on the beaches at night, can affect the hatchlings' orientation, as they search for the brightest spot in the sky to find their way to the ocean. In March 2023, the Costa Rican Electricity Institute (ICE) replaced the public lighting in Tortuguero with 71 red-spectrum lamps. Previously, the conventional white LED lights (80 W) emitted broad-spectrum radiation between 380 and 780 nm, overlapping with the most sensitive visual range of sea turtle hatchlings. After the replacement, amber/red LED lamps were installed, with emissions restricted to narrow wavelength bands of 450–650 nm, which are less disruptive to hatchling orientation. The purpose of this study was to test the hypothesis that hatchlings exposed to the new red lights show significantly lower misorientation compared to those exposed to white artificial light, suggesting that red-spectrum lighting could serve as a mitigation strategy to reduce the impact of light pollution on nesting beaches. Using standard circular arena experiments, we simulated hatchling dispersion events evaluating the directional movement of hatchlings, we examined the tracks left in the sand during hatchling dispersal to assess the directional preference of green turtle hatchlings exposed to white and red light during different lunar phases. Each arena consisted of a circle 6 m in diameter, divided into 24 segments of 15°. Segments between 165° and 195° faced inland artificial light sources. We evaluated the dispersal of hatchlings by implementing a Rayleigh test. Using a V test we assessed the expected distribution and of hatchlings under both treatments. Finally, using the Watson U2 test, we compared the distribution of hatchlings under white and red light. We conducted 135 arena experiments over two different nesting seasons, releasing 2700 hatchlings. Our results indicated that the trajectories of turtles exposed to white and red light were not uniformly distributed on their way to the sea, as there was a statistically significant directional clustering (Rayleigh test = $P \leq 0.05$). The V test showed a grouping of hatchlings in direction of $\pi/2$ (the most direct direction toward the sea), where 15% of the arenas exposed to white light showed a statistically significant misorientation, with hatchlings heading towards the artificial light sources. For the arenas exposed to red light, 5% showed misorientation. The result indicated a statistically significant difference in the distribution of the hatchlings (Watson U2 = 11.8611, $P < 0.001$). White light attracted the hatchlings because green turtle hatchlings are highly attracted to wavelengths in the range of 350 to 450 nm, resulting in disoriented behavior in their search for the sea. The influence of artificial lights from human settlements significantly affects the orientation ability of green turtles. Hatchlings exposed to white light show noticeable misorientation. However, artificial red lights have a lower impact on the correct orientation of green turtle hatchlings. This initiative to shift public lighting toward red/amber wavelengths represents an effective mitigation strategy to facilitate the successful seaward orientation of hatchlings.

OLIVE RIDLEY, *LEPIDOCHELYS OLIVACEA*, STRANDINGS ALONG SOUTHERN BRAZIL

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The olive ridley (*Lepidochelys olivacea*) is currently listed as Vulnerable to the risk of extinction in the Southwest Atlantic Regional Management Unit. Public policies aimed at reversing its threatened status indicate research priorities for more effective impact mitigation and conservation actions. Considering these priorities, we evaluate a comprehensive olive ridley strandings dataset along the southern Brazilian coast to better understand their population parameters, mortality and stranding patterns. Since 2015, the Santos Basin Beach Monitoring Program (PMP-BS) conducts daily standardized surveys along ~1,400km of coastline covering four Brazilian states (Rio de Janeiro, São Paulo, Paraná and Santa Catarina) to recover all stranded animals. Over the past ~9 years, 1,399 *L. olivacea* have been recorded, of which ~96% were already deceased. Most stranded animals were adults (n = 798; juveniles = 269), with a mean curved carapace length of 66.8 cm ± 4.99 SD. Sex ratio was biased towards females (2.6:1). In total, evidence of interaction with anthropogenic activities was detected in 12.8% of strandings, most frequently related to fisheries bycatch (n = 125), marine debris ingestion/entanglement (n = 35), aggression (n = 24) and boat collision (n = 20). When considering only fresh carcasses, however, the proportion of individuals with evidence of fisheries bycatch was ~40%. Annual stranding events remained consistent at 150-200 olive ridleys across all 9 years, except in 2016 (n=~50) and 2023 (n=~100). Negative binomial GLMMs identified significant seasonal stranding patterns—increased during spring, decreased during autumn. There was also spatial variability when accounting for standardized effort: there was higher stranding rates in a particular state (Paraná), followed by two others with the highest absolute number of recovered individuals (São Paulo, then Rio de Janeiro). Binomial GLMMs for spatio-temporal variability within development stages detected lower rates of juveniles during winter than during summer, and in São Paulo than in Rio de Janeiro state. Binomial GLMMs also identified that advanced decomposition decreases detectability of interactions by ~5 times significantly higher rates of anthropogenic interactions in Paraná and Santa Catarina states, with lower levels in Rio de Janeiro state. The observed predominance of adults, increased stranding rates during spring, and high bycatch frequency on fresh carcasses are consistent with a known overlap between inter-nesting SWA-RMU olive ridleys and shrimp trawling, longline fisheries and vessel traffic. The mortality of individuals in this mixed-stock aggregation in Brazilian foraging grounds urges local monitoring of threatening anthropogenic activities and enforcement of bycatch mitigation measures, including spatio-temporal coastal management and extensive Turtle Excluder Devices' implementation. Collaborative efforts are then essential to the long-term management of *L. olivacea* within the SWA-RMU.

COMPREHENSIVE COMMUNITY CONSERVATION OF COASTAL ECOSYSTEMS IN THE MORRO AYUTA BEACH SANCTUARY*

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The Morro Ayuta Beach Sanctuary (SPMA) in Oaxaca, Mexico, covering 90 hectares and stretching 15 km, is one of the world's primary nesting sites for the olive ridley sea turtle (*Lepidochelys olivacea*). Recent records (2016–2025) estimate an annual average of 1,233,715 nests. Threats at this site include real estate development, poaching, and nest predation; therefore, since 2016, management actions have been implemented to ensure the conservation of species and coastal ecosystems in the SPMA through a comprehensive approach involving the National Commission of Natural Protected Areas (CONANP) and COSTASALVAJE, with the active participation of the region's indigenous Chontal communities. In response to growing pressure from real estate development, joint management actions between COSTASALVAJE and CONANP led to the establishment of a federal conservation concession through a "destination agreement" in 2018. This legal instrument laid the foundation for the site's official designation in 2024 as a federal Natural Protected Area under the Sanctuary category, ensuring long-term protection for one of the most important olive ridley nesting beaches in the world. To mitigate nest predation, a permanent canine sterilization program was implemented within the Sanctuary and surrounding communities. Over a five-year period, 270 dogs were sterilized, reducing the population of free-ranging dogs present in the Sanctuary from 138 individuals in 2022 to 65 in 2025, potentially decreasing nest predation rates, as studies suggest a single dog can destroy up to 30 nests in a single night. This action was complemented by wildlife monitoring through camera traps installed in the coastal dunes. Consequently, records moved from sporadic sightings to documenting the presence of 14 species in 2025, including medium-sized carnivores such as the ocelot (Leopardus pardalis) and the jaguarundi (*Herpailurus yagouaroundi*). These findings provide essential information to guide the Sanctuary's adaptive management. To address the poaching of eggs, an integrated strategy was implemented, combining environmental education and community monitoring. Environmental education programs reached more than 4,000 children from neighboring communities, utilizing culturally appropriate materials translated into the Chontal language. Simultaneously, more than 110 community members were trained in arribada monitoring, enabling continuous data collection over a ten-year period (2016–2025). This long-term monitoring recorded 11,103,437 nests, with an average emergence success of 20.61%, generating robust population data and reinforcing community ownership as a key conservation outcome. Conservation in the SPMA is possible thanks to the collaboration among COSTASALVAJE, CONANP, and the Chontal communities, whose traditional knowledge and commitment have been fundamental in safeguarding one of the most important nesting sites for the olive ridley sea turtle worldwide.

FROM TAGGING TO POLICY: BUILDING A COLLABORATIVE FRAMEWORK FOR SEA TURTLE RECOVERY IN THE BRITISH VIRGIN ISLANDS*

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The British Virgin Islands (BVI) hosts one of the longest-running sea turtle programmes in the Eastern Caribbean, with over 35 years of nesting-beach surveys and more than 20 years of in-water tagging. The Sustaining Turtles, Environments, Economies and Livelihoods (STEEL) project (2020-2024), funded through the United Kingdom's Darwin Plus programme, laid the groundwork to develop an updated Virgin Islands Sea Turtle Recovery Action Plan (STRAP 2025-2030). This plan combines long-term monitoring, local knowledge, and stakeholder engagement to create a more effective recovery framework. At key foraging sites across four island groups, 721 green turtles (*Chelonia mydas*) and 595 hawksbills (*Eretmochelys imbricata*) were tagged; catch-per-unit-effort (CPUE), size-class distributions, and recapture analyses reveal a 5.4-fold increase in green turtles across the territory, stable juvenile recruitment, and high site fidelity for both species. In contrast, hawksbill foraging stocks declined 20-fold after 2010, with near-absence from historical hotspots after 2017, while leatherback (*Dermochelys coriacea*) nesting decreased significantly since 2008, a similar pattern seen across the region. Threat assessments link these trends to five key stressors, including inadequate regulatory frameworks, coastal development and tourism, climate change, environmental pollution, and invasive species. Using the Community Voice Method (CVM) engagement during the STEEL project revealed deep cultural ties to artisanal turtle fishing and strong public support for collaborative conservation. The STRAP channels these insights into five strategic actions: (1) science-based legislative reform; (2) building resilience and climate adaptation; (3) strengthening monitoring and research efforts; (4) developing strategic partnerships with resorts and marine police; and (4) ensuring a sustainable financing mechanism. With an ambitious but measurable goal of increasing the population tenfold from 2024 baselines, the BVI model demonstrates how sustained science, threat prioritisation, and stakeholder partnerships can drive recovery across small-island Caribbean contexts.

THE ROLE OF LIGHTING CERTIFICATION IN SEA TURTLE CONSERVATION*

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Light pollution is a well-known threat to wildlife worldwide. In sea turtle conservation, we know it not only negatively affects nesting behavior, but it also interferes with both nesting adults and hatchling's ability to navigate to the ocean. Sea turtles are often misdirected by artificial light sources which prevent them from quickly reaching the ocean or sometimes from reaching the ocean at all, posing a serious threat to sea turtle conservation. To mitigate the artificial lighting impacts from coastal development, the state of Florida requires new coastal developments to utilize sea turtle "friendly" lighting. Florida Fish and Wildlife Conservation Commission (FWC) and U.S. Fish and Wildlife Service (USFWS) created the Wildlife

Lighting Certification Program in 2005 to help property owners, developers, and lighting designers identify sea turtle lighting options. The Wildlife Lighting Certification Program identified several criteria that light fixtures and lamps must meet which are known to reduce impacts from artificial lights on sea turtles and certifies fixtures and lamps that meet those criteria for use in coastal development. The program has not only helped identify appropriate sea turtle lighting options, but it has also increased the number and availability of lighting options that can be used to reduce impacts to sea turtles and other wildlife. This past year over 300 fixtures were submitted for review. Every year new manufacturers join the growing list of lighting companies offering Wildlife Lighting Certified products. The partnerships that have formed between FWC and USFWS with the lighting manufacturers and distributors though this program have helped to increase awareness of the need for sea turtle lighting while also increasing awareness that sea turtle lighting can also meet human lighting requirements. The success of this program can be used as a template for other U.S. states and countries to minimize impacts of artificial lighting on sea turtles and other wildlife.

SEA TURTLE CONSERVATION THROUGH THE MANAGEMENT OF ARTIFICIAL LIGHTS*

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Artificial lights at night (ALAN) is a well-known, detrimental threat to sea turtles worldwide. It not only negatively effects nesting behavior, potentially deterring adult females from coming on shore to nest but it also interferes with both nesting adults and hatchling's ability to navigate to the ocean, posing a serious threat to sea turtle conservation. Managing ALAN requires not only rules and regulations from Federal, State, and local authorities, but partnerships with stakeholders to balance lighting requirements for human safety while minimizing lighting impacts to sea turtles. These management actions and partnerships work in conjunction with each other to have a greater impact on sea turtle conservation. Florida adopted a state statute in the 50's, The Marine Turtle Protection Act, which reinforces the protection of the Endangered Species Act and also authorizes the state agencies to review and condition state permits for projects on or near the beach to prevent adverse impacts to sea turtles and their nesting habitat. This has allowed the state to review projects for potential lighting impacts and require the use of sea turtle "friendly" lighting. To educate coastal developers about appropriate sea turtle lighting, FWC developed Sea Turtle Lighting Guidelines which identifies appropriate lighting for different applications to meet lighting requirements for human safety while reducing potential impacts to sea turtle nesting beaches. In coordination with U.S. Fish and Wildlife Service (USFWS), the Wildlife Lighting Certification Program was created to identify light fixtures that meet the Sea Turtle Lighting Guidelines providing further assistance to coastal developers. To empower local governments to help manage artificial lighting on the coast through beach nourishment permits, FWC required many local governments to adopt local lighting ordinances for sea turtle protection. Today, 22 of 26 coastal counties in Florida have sea turtle lighting ordinances and several cities in the four counties without ordinances have adopted an ordinance. This helps to regulate lighting on properties that the state cannot. Since managing ALAN requires more than just rules and regulations, FWC works with federal partners at USFWS, state partners such as the Florida Department of Environmental Protection and Florida Department of Transportation , utility companies, and with other stake holders such as lighting manufacturers and distributors to ensure sea turtle lighting criteria do not conflict with lighting requirements for human safety and that appropriate fixtures are available to meet the lighting requirements. These partnerships have helped to develop solutions for minimizing the impacts of artificial lighting on sea turtles and other wildlife and resulted in successful projects throughout the state that meet the sea turtle lighting guidelines and human safety lighting requirements. It is important for other regions that aim to

develop management practices for reducing the impacts of lighting on sea turtles to identify the appropriate partners necessary and build those relationships early in the process to ensure success. Florida serves as an example of where to begin by identifying the partnerships to pursue and provides guidance on effective management techniques.

FAUNA-FRIENDLY LIGHTING IN MAJOR COASTAL INDUSTRIAL DEVELOPMENTS*

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Fauna-friendly lighting can play a critical role in major facility developments by reducing the risk of behavioural impacts to fauna. Without the appropriate safeguards in place, artificial lighting is shown to significantly alter animal behaviours, affecting feeding, navigation, mating, and migration, and increasing predation risks by exposing fauna to unnatural illumination. The Chevron-operated Gorgon Project, located on Barrow Island—a Class A Nature Reserve off the northwest coast of Western Australia with 24 endemic species and regionally significant turtle rookeries—serves as a case study in proactive and effective lighting design. The natural gas development, which includes an onshore liquified natural gas (LNG) facility and a domestic gas plant, has implemented a range of safeguards including fauna-sensitive lighting, and light 'zoning' to minimise ecological impacts in higher risk areas. In addition, a robust Management of Change process ensures that any lighting modifications undertake environmental assessment, while ongoing monitoring confirms compliance with internal lighting standards. Regulatory guidance, including the Australian 2023 National Light Pollution Guidelines for Wildlife, underpins best practices in lighting design. These guidelines emphasise preserving natural darkness, adaptive controls, and species-specific mitigation. The Gorgon Project is highlighted within the Guidelines as a case study in applying these principles. The Chevron-operated Wheatstone Project is located in a strategic industrial area near Onslow, Western Australia. In contrast to the Gorgon Project, the Wheatstone Project operations pose significantly lower risks to fauna, which meant the lighting design and safeguards implemented from construction were a different standard. Wheatstone is now in the process of retrofitting existing lighting systems, in order to align with evolving best practice and the 2023 guidelines. The retrofit aims to reduce sky glow and light spill, with technical and operational hurdles such as infrastructure compatibility and maintenance of safety standards. Continuous monitoring and adaptive management are essential to further reduce any risks to fauna and document the efficacy of retrofitted systems. A comparative analysis has shown that early, proactive lighting design—exemplified by the Gorgon Project — delivers substantial ecological benefits and risk reduction. In contrast, the complex retrofitting process for Wheatstone highlights the many challenges associated with updating legacy systems. In addition to physical lighting controls, both projects now prioritise audits, inspections, and adaptive management as fauna safeguards. Key success factors identified include early integration of lighting considerations, stakeholder collaboration, and evidence-based decision-making.

THE VALUE OF LONG-TERM STUDIES TO INFORM CONSERVATION*

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It might be asked that if turtle biologists have been measuring x, y or z for some time, then is there value to continuing to make these measurements into the future, given the time, cost, and sometimes ethical, constraints of fieldwork? From our emerging results with green and hawksbill turtles in the western Indian Ocean, we highlight the value of a broad range of long-term sea turtle studies. (i) For green turtles we show how satellite tracking nesting turtles from one site across years has value as there may be inter-annual differences in migration destinations, so important areas for conservation may be missed in single-year tracking studies. As part of this work, we identify how green turtles nesting on one beach may have foraging sites spread across 10+ countries and so their tracks can broadly inform conservation planning, for example, within the Kunming–Montreal Global Biodiversity Framework (the 30x30 agreement). Further, we show how satellite tracking can show the use of key areas beyond national jurisdiction (ABNJs) and hence inform ongoing conservation planning in these areas, for example as part of the United Nations High Sea Treaty. Further we show an evolution of studies across years first using location-only devices, then depth enabled tags and more recently tags that record and relay compass heading (SCOUT NAV tags). (ii) We show how drone surveys across years can detect changes in the numbers of turtles at sea and so be used for assessing trends in numbers for those life history stages (e.g. juveniles and males) that are traditionally under-studied. (iii) We show how simple weight and length measurements of juveniles allow both growth rates as well as long-term changes in body condition to be identified and linked, for example, to foraging conditions and/or climate change. Such studies are revealing, for example, the implications of high packing densities (density dependence) on foraging grounds resulting from successful long-term conservation. Density dependence may slow growth rates and impact the body condition of turtles. Through these ongoing case studies we highlight the value of long-term studies to inform conservation planning.

17 YEARS OF COLLABORATIVE HAWKSBILL RECOVERY IN EL SALVADOR*

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This study presents the outcomes of a 17-year collaborative conservation of the critically endangered hawksbill sea turtles (*Eretmochelys imbricata*) in El Salvador. The program, led by ProCosta in closer collaboration with local communities and governmental institutions, integrates multiple conservation approaches including nesting protection, bycatch mitigation, habitat restoration, and community engagement. The initiative operates under a dual mission to conserve hawksbill turtles and their habitats while supporting sustainable coastal communities. The program engages communities by fostering participatory governance and institutional strengthening. The program is transforming local communities from historical egg collectors to active conservation stewards. Conservation strategies include year-round nesting monitoring, bycatch reduction in Punta Amapala and Los Cóbanos, support for Marine Protected Area establishment, and education efforts. The 17- year conservation effort has achieved significant

positive outcomes. Protection rates increased from nearly 100% of nests consumed in 2007 to 99% of nests protected in 2024, with 4,755 clutches safeguarded between 2008 and 2024. Hatchling production grew from 10,039 released in 2008 to 38,623 in 2004, resulting in a cumulative release of 387,130 hatchlings. Nesting activity increased from an average of 241 nests per season during 2008-2010 to 509 nests per season during 2022-2024. In addition, bycatch mitigation efforts engaged more than 18 fishers across five communities, integrating safer fishing practices into local fisheries. These trends suggest a positive impact of early protection efforts. Considering that hawksbill turtles require 15-20 years to mature and return to nest, hatchlings protected during the program´s early years are probably returning as reproductive adults. This success has been deeply connected to social transformation within local communities. On average, the conservation program annually engages 150 egg collectors and fishermen in monitoring and protection activities. Communities completely changed their relationship with sea turtles, shifting from selling turtle eggs to becoming stewards who actively protect nests through daily monitoring and year-round beach patrols. Our collaboration with local fishers enabled the testing of bycatch-reduction technologies, including LED lights, which reduced sea turtle bycatch by up to 60% without affecting target fisheries, and supported the identification of critical habitats informing the establishment of a new marine protected area in El Salvador. This sustained community engagement over nearly two decades has been essential to creating the conditions necessary for long-term population recovery. Even during difficult times, the program demonstrated resilience by adapting its approaches and maintaining strong connections with communities, ensuring continuity of conservation efforts across challenging circumstances. The long-term commitment demonstrates that close and committed collaboration for conservation, coupled with consistent protection efforts over multiple generations, can effectively contribute to the recovery of slow-maturing species and create lasting biological and social impacts. Building on seventeen years of success, ProCosta is moving beyond nesting protection toward a more comprehensive vision of marine conservation. The next phase focuses on habitat protection, identifying potential Marine Protected Areas, and integrating other endangered species into conservation and management plans. Continued collaboration with coastal communities and fishermen remains central to effective, community-driven conservation while maintaining strong links between local people and institutions.

UNDERSTANDING TEMPORAL ECOLOGY OF BASKING TURTLES

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This study examines ten years of basking behavior data for a known population of Hawaiian green sea turtles (*Chelonia mydas*) at Laniakea Beach, O‘ahu. Data were collected through standardized daily observational surveys by trained monitors, recording the frequency and duration of basking events for individuals identified by name. We employed exploratory data analysis (EDA) to identify underlying patterns and inter-sexual comparative analysis to explore differences between male and female turtles in basking occurrence and duration. Time-series analysis was used to evaluate inter-annual and seasonal variation, while diurnal distribution analysis characterized shifts in behavior potentially reflecting environmental changes or site-specific factors. This decade-long assessment provides a robust behavioral baseline, enabling managers to identify critical high-use periods and assess how population-level shifts align with local environmental changes. These findings offer direct support for the spatial and temporal refinement of existing protective measures and the strategic allocation of monitoring resources to minimize human-wildlife interaction and address potential behavioral shifts due to social-ecological conflict.

FLATBACK TURTLES AND THE POWER OF COMMUNITY: TWO DECADES OF COMMUNITY-LED CONSERVATION IN PORT HEDLAND, WESTERN AUSTRALIA*

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Port Hedland, situated 1,800 km north of Perth in Western Australia's Pilbara region, is a town shaped by both ancient cultural heritage and modern industrial transformation. Aboriginal rock carvings depicting sea turtles, dated to approximately 12,000 years attest to the enduring connection between sea turtles and the Kariyarra people, traditional custodians of Cemetery Beach and surrounding Port Hedland coastal areas. Today, Port Hedland's beaches are bordered by the largest bulk tonnage export port in Australia, with a population of 15,000 and a coastline under pressure from its urban population, dredging, lighting, development, and recreational use. Prior to 2003, little was known or documented about flatback turtle (*Natator depressus*) nesting activity on local town beaches. In response, the Care For Hedland Environmental Association initiated a community-led monitoring and conservation program in 2004. Now on the cusp of its 23rd season, the program monitors three urban beaches using track identification, mark-recapture, and nest success excavation methods. These techniques have enabled the documentation of nesting seasonality, population size, population structure, inter-nesting intervals, recruitment rates, hatchling emergence, hatchling orientation, and disturbance impacts. Cemetery Beach, a 1,440m stretch within the heart of the town, has emerged as a regionally significant rookery within the WA North West Shelf flatback population. Longitudinal data indicates a relatively stable medium-sized female population (200–450 per season), with annual recruitment rates of 14% and 25% of tagged females returning to nest the following year, evidence of annual nesting migration. Genetic analysis has linked Port Hedland turtles to populations on Barrow Island and Mundabullangana, with a small percentage of tagged individuals nesting across other regional beaches. However, despite its resilience the population faces mounting challenges. Declining adult numbers, significant hatchling mis-orientation and nest success rates that fluctuate widely (20–64%), often correlating with extreme weather events and high sand temperatures. Port Hedland beaches are among the warmest in the region, and Cemetery Beach records some of the lowest hatch success rates. Threats include feral animal predation, artificial lighting, off-road vehicle use, tourism, and coastal infrastructure development. These pressures underscore the vulnerability of urban flatback turtle rookeries, the need for adaptive management and adoption of climate change resilience works. Over two decades, data collected by volunteers and analysed by experts, has informed local decision-making, shaping dredging schedules, lighting mitigation, predator control, and coastal landside and portside development planning. The program's success is rooted in community pride, scientific rigor, and the maintenance of long-term strategic partnerships, with relevant agencies and funding partners. It is widely believed locally that without Care For Hedland's intervention, sea turtles would no longer nest on Port Hedland beaches. Sharing lessons from Port Hedland's grassroots conservation journey, highlighting the intersection of science, culture, and community. Reflecting on the importance of place-based stewardship and the role of regional leadership in sustaining long-term ecological outcomes. As pressures intensify, Port Hedland's experience offers a model for inclusive, data-driven conservation, ensuring that flatback turtles continue their ancient relationship with this town, community and coastline for the next 12,000 years and beyond.

COMMUNITY-BASED SEA TURTLE BYCATCH MITIGATION IN SOUTHWEST CAMBODIA, 2017 TO 2025

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Along Cambodia's southwest coast, green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles forage and rest in regionally important coral reefs and the largest seagrass meadows in mainland southeast Asia. These populations are highly diminished relative to historic levels and face continued pressures from habitat degradation and fisheries, particularly illegal bottom trawling. Urgent protection of sea turtles and their foraging habitats is needed to ensure they remain in Cambodia's seas. Since 2017, Wild Earth Allies has documented and responded to sea turtle bycatch in collaboration with coastal communities in Kampot province. This project is part of our overall program to strengthen co-management of Marine Protected Areas (MPAs) and fisheries. Our collaboration with coastal communities centers on strengthening the capacity of Community Fisheries (CFis) to manage marine resources and protect at-risk biodiversity, including sea turtles. CFis are recognized under Cambodian Fisheries Law and comprise communities or groups of small-scale fishers who are granted management and use rights of resources within a marine area, including setting boundaries and permissible fishing gear and practices. There are now 45 CFis across four coastal provinces playing a central role in managing Cambodia's coastal and marine areas. This community-based approach improves equity in access to marine resource management and protection. The CFi model has also provided an opportunity for developing collaborative, community-based sea turtle conservation efforts. Together with 10 CFis, we have launched community-led patrols to mitigate threats to sea turtles, namely trawling and other forms of IUU fishing. We have also developed a community-based response system in Kampot province for sea turtle bycatch incidents. Wild Earth Allies trained response teams in safely handling sea turtles and applying external flipper tags. Response teams are composed of CFi committee members and Fisheries Administration officers at the provincial level. Our team and CFi committees use signage, in-person meetings, and digital communications (e.g., Telegram groups) to raise awareness about the program and how to contact the response team if a sea turtle is accidentally captured. Non-monetary incentives are used to encourage fishers to report bycatch incidents, such as t-shirts and certificates honoring their service. This has resulted in increased reporting of sea turtle bycatch in Kampot province, with a nearly 100% increase in the average reported incidents in the 2022-2025 period versus the 2017-2019 period. In total, the team successfully released 61 green turtles and 5 hawksbills between 2017 and 2025. The team also documented five dead green turtles, bringing the total bycatch record to 71 incidents over the 8-year period in Kampot province, Cambodia. Results are input into the national sea turtle database, which is managed by the Fisheries Administration. While these bycatch rates are low at a global scale, sea turtle bycatch and sightings are higher in Kampot relative to other provinces in Cambodia. Our results demonstrate the importance of engaging coastal communities in the protection of sea turtles and vital foraging habitats in southwest Cambodia. As a next step, we are improving community patrol effectiveness and data collection with SMART technology (Spatial Monitoring and Reporting Tool).

CONSERVATION AND MANAGEMENT OF SEA TURTLES IN SRI LANKA*

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Turtle Conservation Project, Sri Lanka

Sri Lanka is an island nation situated at the Southern point of India, separated from the mainland by the shallow seas of the Gulf of Mannar. The island has a 1,585 Km coastline and is 353 km from north to south and 183 Km at its widest point, covering a land area of 65,610 Km². Five species of sea turtles (Green, Olive ridley, Leatherback, Hawksbill and Loggerhead) are found nesting in Sri Lanka. Green turtle is the most common nesting turtle species in Sri Lanka. Although the nestings are reported throughout the year, peak nesting season is between March and June. Key nesting sites are located at Benthota, Induruwa, Kosgoda, Rekawa, Kalametiya and Bundala (Kapurusinghe, 2006). Olive ridley is the second common nesting turtle in Sri Lanka based on TCP beach surveys and long-term nesting data. Nesting season is between December and April and the main nesting sites are located at Benthota, Induruwa, Kosgoda and Panama areas. The Leatherback is the third common nesting turtle species found in Sri Lanka. Peak nesting season is between April and July. Ussangoda-godawaya, Rekawa, Tangalle and Bundala are the main nesting sites for leatherbacks. The Hawksbill turtle is not a common nesting turtle species in Sri Lanka. Benthota, Induruwa and Kosgoda are the key nesting sites. The species Loggerhead is probably the rarest of all marine turtle species found in Sri Lanka. Although the loggerhead turtles are quite common and widely distributed in the global context, morphological differences (mainly the colouration) suggest that the Sri Lankan loggerhead population can be a distinct and unique population that must be considered as a separate management unit. Despite the legal protection, marine turtles in Sri Lanka are still being exploited for their eggs and meat. In addition, turtle nesting beaches are being disturbed by tourism development activities and foraging habitats, such as sea grass beds and coral reefs are being destroyed by destructive harvesting practices and marine pollution. Thousands of marine turtles are accidentally caught and drowned in fishing gear around the island and this can be considered as the most negatively affecting threat for the survival of marine turtles in Sri Lanka. Although the nesting turtles are protected in National Parks (NP) such as Yala NP, Kumana NP, Wilpattu NP etc., natural predators such as wild boars, jackals, water monitors and land monitors consume the eggs and hatchlings in National Parks. In addition, dogs have been reported attacking nesting turtles and eating turtle eggs and hatchlings. In-situ sea turtle conservation programme is conducted at Rekawa turtle sanctuary by TCP, NFR and the department of Wildlife Conservation as a collaborative project. Educational programmes are being conducted enhancing the community knowledge on sea turtles. Ex-situ conservation practices are implemented by the turtle hatcheries which are mainly located along the southern coastal areas. NARA, Wildlife department and the Coast Guard department are the key government institutions in Sri Lanka which carry out turtle research and conservation activities. TCP and NFR are the main NGOs involved in turtle conservation activities.

CONSERVATION STATUS AND CULTURAL VALUES OF SEA TURTLES LEADING TO (UN)WRITTEN PARALLEL MANAGEMENT SYSTEMS IN FIJI

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Fiji hosts four of the world's seven sea turtle species: the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and leatherback (*Dermochelys coriacea*). Of these, the green and hawksbill turtles nest and forage locally, making them vital to local ecosystems and deeply woven into iTaukei traditions, where they are honored as chiefly tributes, totems, and sacred beings. This study examined how communities manage turtles under parallel systems: written national legislation and unwritten customary rules. Researchers used six methods, including interviews with elder fishermen, questionnaires, talanoa storytelling sessions, an online survey, semi-structured interviews, and focal group discussions with men, women, and youth. In total, 229 participants provided insights into historical practices, cultural values, and responses to conservation laws. Two case study villages were central: Qoma, on Viti Levu's northeastern coast, and Denimanu, on Yadua Island. Qoma continues to rely on customary rules, with turtle harvests requiring chiefly permission and adherence to strict rituals and taboos. Each sub-clan contributes turtles for feasts and ceremonies, often regardless of government permits, showing the persistence of cultural obligations. Denimanu, however, has shifted toward conservation. Once reliant on egg collection and turtle hunting, the village has shifted its focus to protecting turtles through nest monitoring and research. In 2009, the chief declared turtle harvest taboo, with exceptions requiring both government permits and chiefly approval. The key findings show that while both villages traditionally targeted green and hawksbill turtles, their responses diverged: Qoma continues customary harvests, while Denimanu achieved an 80% reduction in captures. The study concluded that integrating customary practices into formal governance could harmonize cultural values with conservation goals, ensuring sustainable management of Fiji's sea turtle populations.

EXPANDING COMMUNITY ENGAGEMENT AND RESEARCH: INSIGHTS FROM THE LEATHERBACK TURTLE PROJECT "TINGLAR DORADO"IN PUERTO RICO

Emanuel Martinez Urbina, Jeriliz Ortiz Laboy, Deborah Feliciano, Julimar Nevarez Melendez, Irmaury Serrano Robes

Chelonia Investigacion y Conservacion de Tortugas Marinas, Puerto Rico (U.S.)

Chelonia, Investigación y Conservación de Tortugas Marinas (CICTM) is a non-governmental organization dedicated to sea turtle research and conservation for over thirty years. Its primary projects are based in Dorado and Mona Island, Puerto Rico, focusing on the nesting and foraging activities of leatherback, green, and hawksbill sea turtles. Since 2012, the leatherback nesting project "Tinglar Dorado" has served as a platform to expand community outreach and research collaboration in Playa Grande El Paraiso Natural Reserve (PEGP), one of the main leatherback nesting beaches in Puerto Rico. In its fourteen years, the project has documented 216 female leatherbacks and an average of 320 nests per season, with an average hatching success rate of 60%. Community outreach efforts have impacted an average of 7,000

people a year through in-person activities and social media. During the 2023-2025 seasons, CICTM collaborated with the New England Aquarium in the deployment of 12 satellite transmitters on nesting leatherback females in Dorado, contributing to nesting, foraging, habitat use, and migratory behavior data. Recent initiatives within the project include research on the inter-nesting period of female leatherbacks and the use of Geographic Information System (GIS) mobile apps for on-site nesting data collection, viewing, and analysis. Integrating GIS in the project has enhanced management and outreach efforts by allowing real time data sharing, easy access and quicker response to nest location risks such as flooding and erosion.

A PATHWAY TO IMPORTANT MARINE TURTLE AREAS: THE NEED FOR REGIONAL EFFORTS TO SIT WITHIN A COORDINATED GLOBAL FRAMEWORK*

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Taxon-specific "Important Areas" have been established for a wide array of marine species, including birds (Important Bird and Biodiversity Areas; IBAs), marine mammals (IMMAs), and sharks and rays (ISRAs). Through delineating these areas, the science community formally ascribed ecological value to certain locations, thereby providing standardized, consensus-backed products with direct utility for conservation and policy outcomes such as those related to the Global Biodiversity Framework's 30x30 initiative. The pathways that scientific communities have taken to establish taxon-specific Important Areas vary considerably, from processes playing out over more than a decade to an accelerated exercise taking less than two years. Yet, what unites these "Important Area processes" are: 1) a central coordinating framework guiding assessment, proposal, and designation; 2) a replicable approach following common guidelines; and 3) an iterative process—often playing out via regional workshops—driven by a repository of data. Initial guidelines for Important Marine Turtle Areas (IMTAs) were developed and published by the IUCN-SSC Marine Turtle Specialist Group (MTSG) in 2021, offering a crucial starting point. Yet, despite progress in some regions, no IMTAs have been formally established to date, leaving marine turtles without the representation that other species have in global policy forums, while at the same time, deadlines approach (e.g., the target to protect 30% of the world by 2030). The marine turtle conservation community clearly possesses the knowledge and data to drive an "IMTA process;" however, we make the case that what our community needs now is a catalyst. In that context, we present a year-1 update for the Blue Corridors for Turtles project, which aims to catalyze a turtle-community-driven IMTA process with coordination through an MTSG "Task Force," cooperation across region-specific workshops, and empirical backing from a central data repository to be used to identify IMTAs. We provide an update on the mission and architecture of the project and progress made to date. We then explain the vision of Blue Corridors for Turtles moving

forward, building out from MTSG guidance and drawing on lessons from other Important Area processes to describe how the IMTA process might unfold. We discuss potential timelines, what IMTA products might look like, what researcher engagement with the process may entail, and what we still need to do as a community to prepare. Most importantly, we ask for your participation.

STATE OF SEA TURTLE NESTING IN NIGERIA: AN EVALUATION OF COASTAL AREAS IN LAGOS STATE

Chinedu Mogbo

Greenfingers Wildlife Initiative, Nigeria

Sea turtles are globally recognized as keystone species in marine ecosystems, yet their survival is increasingly threatened by anthropogenic pressures. Nigeria's 850 km coastline hosts five species of conservation concern: hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*). All are listed as Vulnerable, Endangered, or Critically Endangered by the International Union for Conservation of Nature (IUCN). While Nigeria's Niger Delta and southwestern states have historically been studied, Lagos's Eleko to Victoria Island stretch of coast has emerged as an important but under-researched nesting and foraging zone. Rapid urbanization, unregulated coastal development, light pollution, plastic debris, artisanal fisheries, and persistent poaching now converge to undermine nesting success in this region. This study conducts an evidence-based assessment of sea turtle nesting challenges in Lagos State. It integrates literature and global conservation benchmarks with ongoing fieldwork, including preliminary 2025 survey responses from local fishers. Early insights from these interviews reveal high encounter rates with turtles, widespread incidental capture in fishing nets, and frequent egg consumption, alongside perceptions that turtle numbers are declining. Economic motivations remain strong, with many respondents admitting to killing turtles or harvesting eggs for food or income, yet some indicated willingness to release turtles if compensated with fishing gear. This highlights opportunities for incentive-based conservation. Drawing on international comparisons such as Gabon's legally protected nesting parks, Seychelles' 500% turtle recovery under strict enforcement, India's Odisha community patrols, and Costa Rica's integration of ecotourism, the study identifies scalable practices relevant to Lagos. It proposes a multi-pronged conservation framework that includes designating marine turtle protected beaches, reducing fisheries bycatch through gear modifications, incentivizing local fishers to safeguard turtles, and strengthening law enforcement and waste management. By situating Lagos within global and regional conservation trends while incorporating local evidence, this research underscores both the urgency and the potential for reversing sea turtle decline in Nigeria's most urbanized coastal state.

BEYOND POPULATION RECOVERY: TOWARD COEXISTENCE BETWEEN GREEN TURTLES AND SEAGRASSS MEADOW ECOSYSTEMS IN THE OKINAWA ISLANDS, JAPAN*

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Green turtles (*Chelonia mydas*) have reportedly recovered in abundance in several populations worldwide over the past few decades. In Japan, major nesting populations have shown an increasing trend, and foraging aggregations in seagrass meadows have likewise been reported to increase. Concurrent with this rise in green turtle abundance, many seagrass meadows in the Ryukyu Archipelago, Japan, have suffered collapse or severe degradation. To promote coexistence between green turtles and seagrass meadow ecosystems, we have initiated comprehensive research projects. These include assessments of foraging population abundance, determination of natal origins using genetic information, analyses of home range and grazing impact of green turtles, as well as evaluations of biomass and net primary production in current seagrass meadows and the development of restoration techniques. We also have social studies to explore the local perceptions, potential challenges, and communication strategies for supporting decision making on each island. This presentation outlines the various components of our project and introduces conservation efforts aimed at protecting seagrass meadow ecosystems to achieve coexistence with green turtles.

THE PACIFIC LEATHERBACK HUB: A DECISION-SUPPORT TOOL FOR THE RECOVERY OF CRITICALLY ENDANGERED LEATHERBACKS*

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Conservation planning for endangered species like Pacific leatherback sea turtles requires data-driven tools to guide stakeholders in assessing the effectiveness of different conservation actions. Here we present a publicly accessible decision-support tool that integrates data on leatherback threats, past conservation efforts, and population models to support innovative approaches to future conservation. The Pacific Leatherback Hub was built upon a multi-language systematic review of grey and academic literature to quantify leatherback mortality in Pacific fisheries. We assigned risk to specific fisheries based on fishery characteristics, potential estimated mortality, and fisheries behavior. This tool enables users to view spatial and temporal maps of fisheries risk, in relation to known areas of critical foraging and nesting habitat for Pacific leatherbacks. These findings inform population viability analysis models for two populations (East,

West) and five subpopulations (Mexico, Costa Rica, Nicaragua, Indonesia (Jamursba-Medi, Wermon), Papua New Guinea). These individual-based population models run in the IUCN-hosted Vortex software – allowing users to predict population trajectories under current conditions or in response to different conservation actions (bycatch reduction and short-term captive rearing (headstarting)). The outputs include population size and probability of population survival over time, with plans to incorporate a cost component to allow for more comprehensive evaluations. Additionally, the literature review compiled numerous studies on bycatch mitigation strategies, enabling a bycatch mitigation quiz with tailored suggestions for specific gear types or within certain regions. Future work includes creating a platform for shared learning between conservation and fisheries stakeholders to understand what barriers to success may exist in certain fisheries or governments. The Pacific Leatherback Hub provides data to empower stakeholders to effectively evaluate conservation actions for Pacific leatherbacks across multiple scales, while simultaneously offering a model that is easily adaptable for other endangered species.

BUILDING BRIDGES FOR CONSERVATION: STRENGTHENING COMMUNITY PARTICIPATION OF A NEW MARINE PROTECTED AREA IN EL SALVADOR: LESSONS FROM PUNTA AMAPALA*

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Community participation in Marine Protected Area (MPA) governance is essential for achieving ecological, social, and cultural goals, but putting it into practice can be difficult. Local communities may lack resources or experience, and government agencies or NGOs may unintentionally hinder participation. Thus, despite agreement on the value of participatory governance, practitioners still seek effective ways to foster meaningful collaboration among diverse groups. This presentation examines these dynamics through a case study in Punta Amapala, located along El Salvador's southern coast within the Gulf of Fonseca. El Salvador hosts one of the largest aggregations of the Critically Endangered hawksbill sea turtle (*Eretmochelys imbricata*) in the eastern Pacific, with nearly half of the recorded nesting in the region. Punta Amapala is a critical foraging and nesting habitat for this species. Despite reduced egg consumption, research has documented persistently high bycatch mortality in local fisheries, with approximately bycatch of 0.0022 individual/100 m set and 0.74 mortality—significantly hindering species recovery. Over the past decade, the national NGO ProCosta has collaborated with local fishers to reduce bycatch, working collaboratively with local communities. Building on these relationships, both fishers and practitioners recognized the need for spatial management tools to protect hawksbills and their habitats. In 2023, El Salvador's Ministry of Environment and Natural Resources (MARN) initiated the legal process to establish a new 27 km² MPA in Punta Amapala, which was formally approved in late 2024. Although both government and community actors sought better fisheries management and biodiversity protection, locals initially viewed the protected area as a threat to their livelihoods, creating potential tensions and risks to collaboration. In this context, ProCosta is implementing a participatory process to strengthen community engagement in the establishment and early management of the MPA. Since 2024, ProCosta organized a three-day workshop on MPA governance and conflict resolution with 31 participants from six institutions and six communities, followed by seven community meetings and six focus groups that engaged over 130 residents. These workshops aim to improve communication between communities and the government,

clarify governance expectations, and address concerns related to fishing access and livelihoods. A third activity, currently underway, focuses on a participatory fisheries diagnosis involving the mapping of fishing zones and coastal sites with nearly 100 participants. Our objective was to improve understanding of local fishing dynamics and identify areas of higher bycatch risk. Through this experience, we have drawn several lessons that have also been seen and documented in similar cases globally. Working with coastal communities is dynamic and adaptative. Assuming that years of collaboration automatically translate into a complete understanding of community dynamics can be misleading. Social structures, priorities, and interests change over time, which calls for continuous learning, listening, and adaptation on our part. Meaningful community involvement throughout all phases of a project strengthens outcomes in different levels—not only by encouraging broader participation, but by enriching the process through the diverse knowledge, perspectives, and contributions of community members.

COMMUNITY BASED MARINE ECOSYSTEM CONSERVATION WITH A FOCUS ON SEA TURTLES ALONG THE GOAN COAST, INDIA

Anil Kumar Singh Panwar, Supraja Dharini

Tree Foundation, India

The poster presents the community-based marine ecosystem conservation program along the Goa coastline (April 2024–March 2025) to safeguard sea turtles and marine megafauna through fisher engagement, capacity building, and ghost net retrieval. The project implemented by TREE Foundation was conducted in collaboration with the Goa Department of Fisheries, the Forest Department, Marine Police and the Indian Coast Guard. Key activities include orientation and empowerment meetings for the new Sea Turtle Protection Force (STPF), composed of artisanal fishers from coastal villages. The sessions equip STPF members with the skills to conduct awareness programs on how to retrieve ghost nets and safely release entangled marine fauna. A total of 20 awareness programs reached over 2,700 artisanal fishers across 20 villages, fostering stewardship and responsible fishing practices. The poster will also outline the workshops on "Strengthening Community in Conserving and Releasing Entangled Marine Megafauna" where over 200 participants were trained, including officials and fishers, on protocols for safe rescue and release of turtles, dolphins, and whale sharks. Data recorded from these initiatives which directly resulted in the rescue and release of 11 Olive Ridley (*Lepidochelys olivacea*) turtles, 4 Green (*Chelonia mydas*) turtles, 2 Hawksbill (Eretmochelys imbricate) turtles and 1 Finless Porpoise (*Neophocaena phocaenoides*) will be depicted through a graph. Also, outlining how through community-based ghost net retrieval, 3,542 kg of derelict nets were removed from the sea, with 16 fishers incentivized for their active participation. The Foundations program also extended outreach through events such as 'International Coastal Cleanup Day' and the 'Aqua Goa Mega Fish Festival 2025', promoting public awareness on marine conservation. This poster will clearly demonstrate how multi-stakeholder partnerships and community ownership can effectively reduce bycatch mortality, restore marine habitats, and strengthen long-term conservation of sea turtles and associated marine biodiversity along the Goan coast.

USING THERMAL IMAGERY TO MONITOR AND PROTECT ENDANGERED HAWAIIAN HAWKSBILL TURTLES*

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Hawksbill turtles (*Eretmochelys imbricata*) inhabiting the Hawaiian Islands are critically endangered and considered one of the smallest hawksbill populations in the world. The majority of confirmed hawksbill nests in the state have occurred at remote beaches in the district of Ka'ū along the coast of Hawai'i Island. Monitoring and protecting Hawai'i hawksbill turtles and their nests are challenging given their small population size, coupled with nesting across extremely remote and dispersed beaches over a 10-month nesting season. During the 2024 nesting season, we conducted a pilot study to determine whether hawksbill turtles could be detected at nesting beaches using thermal imagery. We found that female turtles could be detected clearly in thermal imagery when arriving and departing a nesting beach, and hatchlings were visible in thermal imagery when they were near the high-water line on the beach. In addition, non-native predators (rats, mongoose, cats, ghost crabs) that predate turtle eggs and hatchlings were also easily distinguished in the thermal imagery. Having demonstrated the use of thermal imagery to monitor hawksbill nesting activities we are expanding the use of thermal cameras to monitor nesting activities at beaches that differ in composition (e.g., white sand, black sand, and cobblestone beaches). Moreover, we are developing a data management workflow that in future seasons will allow for remote upload and automated analysis of the thermal imagery using computer vision algorithms. The use of thermal cameras to remotely monitor nesting beaches and the development of a data management workflow for the thermal imagery will allow for near real-time, continuous documentation of the timing and number of nesting females utilizing a beach, providing critical information for accurate population estimates. Identifying when a female has nested at a beach will allow for prioritization of what beaches personnel should visit, and lead to more cost-effective use of limited funds and personnel. In addition, knowing the timing of nesting activity will ultimately lead to more immediate protection of nests from non-native predators with nest cages, maximizing nest success. Additionally, identifying the type and density of predators at a beach is key to assessing the effectiveness of ongoing predator trapping and will help with the development of more targeted trapping efforts based on the type and distribution of predators documented.

HAWKSBILL TURTLE CONSERVATION IN LOS CÓBANOS, EL SALVADOR: LONG-TERM OUTCOMES OF A COLLABORATIVE PROGRAM

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Los Cóbanos is El Salvador's first marine–coastal protected area and a Ramsar site, supporting diverse habitats and four sea turtle species. In 2007, it was identified as a key hawksbill nesting site, prompting targeted conservation efforts after the species was considered nearly extirpated nationally. This decline was driven largely by egg overharvesting and fisheries bycatch. This study describes and evaluates the outcomes of an 18 year collaborative conservation program aimed at recovering hawksbill turtles in Los Cóbanos, El Salvador, with a focus on nesting protection, community engagement, and responses to ongoing environmental and fisheries-related threats. Since 2008 Asociación ProCosta—formerly the Eastern Pacific Hawksbill Initiative (ICAPO-El Salvador)— conducted efforts to restore hawksbill populations within the Los Cóbanos Protected Area. The conservation program integrates multiple complementary components, including year-round beach monitoring, an incentive-based system for clutch protection, the operation of two sea turtle hatcheries, fisheries bycatch monitoring and mitigation efforts, and targeted environmental education activities. The program is grounded in a conservation approach that places local community engagement at its core, recognizing the importance of respecting local contexts and integrating local knowledge and experience into conservation practice. It directly involves local communities as protectors and key participants in safeguarding hawksbill nests and eggs. During the initial phase of the program in 2008, only the 25.5% of nesting events were documented, whereas during continuous implementation, cumulative protection reached more than 95%. This expansion improved efficiency, reduced illegal egg trade, shortened transport time, and increased hatching success. By the end of 2024, the program had protected 533 nests, incubated over 73,000 eggs, and released more than 51,000 hatchlings, achieving a 70% hatching success rate. Despite these positive results, the program has faced and addressed several natural and human-related challenges relevant to other conservation efforts. Building trust with local communities was essential and was achieved through the sustained engagement of local residents as project staff and leaders. Practices of egg collection for sale or consumption have gradually shifted promoting protection instead of extraction. Environmental threats, including rising sand temperatures, predators, and pests, were reduced through practical measures such as shaded, enclosed incubation areas that improved hatching success. However, hawksbill turtles remain at risk. Since 2018, more than 20 individuals, mostly juveniles have been accidentally caught in the local lobster fishery. These experiences highlight the importance of community participation, adaptive management, and collaboration among partners to address ongoing conservation challenges. Conservation programs in the Los Cóbanos Protected Area, led jointly by ProCosta and local communities, represent a source of hope for the recovery of hawksbill turtles and the protection of the region's ocean, coastal, and land environments. Although the area faces multiple challenges, the collaborative work among local communities, government agencies, non-governmental organizations, and private partners continues to strengthen effective conservation efforts.

STRENGTHENING LOCAL CAPACITIES TO REDUCE SEA TURTLE MORTALITY IN PELAGIC LONGLINES FISHERIES IN PERU*

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In Peru, sea turtles face significant threats from incidental capture in pelagic longline fisheries. In response, the Reglamento de Ordenamiento Pesquero (ROP, Fishery Management Regulation) for mahi mahi *Coryphaena hippurus* (ROP-Perico) establishes best practices for the safe release of sea turtles and other protected species. To support this regulation, the Peru-based NGO ProDelphinus, in collaboration with FONDEPES (National Fund for Fisheries Development), implemented a capacity-building program aimed at strengthening fishers' knowledge and skills to reduce bycatch and improve compliance with conservation measures. The program provides theoretical knowledge on sea turtle biology and conservation status, practical training in safe handling and release techniques (e.g., using dehookers) and other bycatch mitigation tools, and guidance on relevant legal frameworks. Training sessions were developed using participatory workshops, standardized educational materials, and practical demonstrations. From May 2024 to March 2025, the program conducted 102 training sessions in 30 ports along the Peruvian coast, reaching 3096 fishers (283 women and 2813 men), representing approximately 60% of the estimated 5000 fishers operating in this fishery. During these sessions, 171 "J"-type sea turtle dehookers were distributed to participants reinforcing the practical application of the safe handling and releases techniques taught. To maintain communication between fishers and the project team, a WhatsApp group was established, to facilitate reporting of sea turtle interactions, share best practices, and receive feedback on gear use and release events. Program outcomes were evaluated through structured follow-up interviews with 163 trained and certified fishers who completed both theoretical and practical components, representing 5% of total participants and ensuring at least one trained crew member on 163 vessels. Among respondents, 35% reported already owning a "J"-type dehooker for releasing sea turtles. Certified fishers have reported and documented the safe release of 7 loggerheads, 3 leatherbacks, and 1 green turtle, demonstrating the practical impact of the training program. These preliminary results indicate both adoption of safer handling practices and active reporting of bycatch events. Additional monitoring is ongoing to assess long term behavioral changes and broader adoption of the ROP Perico guidelines. This program highlights the effectiveness of combining regulatory frameworks with hands-on capacity building. By providing formal training and certification, fishers gain both the knowledge and tools necessary to reduce sea turtle bycatch, fostering a sense of responsibility and increasing awareness about the impacts of fishing practices on the marine ecosystem. The program also emphasizes the importance of ongoing engagement, practical skill reinforcement, and continuous monitoring to ensure compliance and promote sustainable fishing practices. Continuing efforts will increase the proportion of certified fishers and evaluate the effectiveness and implementation of training methods. By combining policy, education, and direct engagement, this initiative offers a promising model for conservation strategies in artisanal fisheries and represents an important step to contribute to the long-term health of both marine ecosystems and the communities that depend on them.

ILLUMINATING A PATH TO CONSISTENT, SCIENCE-BASED COASTAL LIGHTING FOR SEA TURTLE CONSERVATION*

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Outdoor lighting remains one of the biggest challenges for developed areas with sea turtle nesting habitat. Effective management of light to reduce adult and hatchling disorientation remains inconsistent and confusing for all stakeholders. Despite clear evidence that light trespass disrupts hatchling orientation and nesting behavior, the path from ecological science to enforceable lighting practice remains fragmented. Many coastal jurisdictions attempt to mitigate lighting impacts through spectrum-based guidelines, emphasizing "amber" or "turtle-safe" lighting. However, this narrow focus often overlooks other critical factors, namely light intensity, controllability, and directionality, that determine how lighting illuminates sensitive coastal environments. Recent experiences in Hawai'i illustrate the consequences of this partial understanding. In 2023, honu (Hawaiian green turtle, *Chelonia mydas*) hatchlings from eight nests were misoriented at a popular beach on Oahu, Hawai'i after a high correlated color temperature (CCT) LED retrofit. Following the nesting activity, the LED fixtures were first switched off and then replaced with amber LED fixtures, which addressed spectral requirements, but failed to appropriately limit intensity and distribution. Continued over-illumination and light spill on the beach contribute to the continued risk of hatchling misorientation, even though there were no confirmed nests in 2024, and one nest in 2025. Such cases demonstrate that even well-intentioned lighting retrofits can fall short when policy and procurement lack the tools to operationalize the right lighting. This complexity is compounded by trade-offs between ecological protection and energy efficiency. Narrowband amber LEDs, which minimize short-wavelength light that disorients honu, are among the least energy-efficient options. Municipalities thus face difficult decisions between ecological and energy efficiency goals and costs, particularly in island and coastal contexts where resources are constrained. To bridge the gap between ecological research, lighting technology, and enforceable practice, the DesignLights Consortium (DLC) has developed a dedicated Turtle Lighting specification within its LUNA V2.0 requirements. The intent is to translate scientific understanding into a consistent, policy-ready lighting framework that communities can adopt through ordinances, permits, and procurement standards. LUNA's Turtle Lighting criteria combine requirements for spectrum, output, and distribution, offering a comprehensive approach to mitigating ecological impacts. Key provisions include: All Turtle Lighting luminaires must be energy efficient; All Turtle Lighting luminaires must use narrowband Amber LEDs; White LED luminaires with amber filters are disallowed to avoid filter removal that would introduce short-wavelength content; Limits on high-angle light and zero uplight ensure that compliant products minimize skyglow and target the majority of their light downwards; A maximum light output cap ensures that compliant products are less likely to create skyglow and overlight surfaces; All pole-mounted roadway and area lighting products must be available with a shield to curb beachward spill; Products can only be leveled at a maximum of ten-degree tilt to align with the pavement or roadway surfaces. Each of these requirements will be mapped to conservation mechanisms and we will outline compliance requirements for plan reviewers and contractors.

COMMUNITY-BASED CONSERVATION OF THE LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*) AT THE PLAYA CHACAHUA SANCTUARY, MEXICO*

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The Chacahua Beach Sanctuary (SPCH) in Oaxaca, Mexico, is a critical nesting site for the East Pacific leatherback turtle. Historically, SPCH has faced limited management capacities; during the 2022-23 season, it was estimated that only 50% of nests were protected, and female tagging had been suspended for five years. To reverse this trend, during the 2024-2025 season, CONANP, COSTASALVAJE, and local Mixtec and Afro-Mexican communities implemented a comprehensive conservation program with an adaptive management approach. The methodology consisted of night patrols conducted under the NOM-162-SEMARNAT-2013 standard for nest collection and relocation into four temporary incubation corrals managed by community brigades. A total of 80.5% (91) of all nests were protected, achieving an emergence success of 46.14% and the release of 2,617 hatchlings. This result is significant compared to the near-total loss observed in natural nests exposed to critical predation. To mitigate the impact of climate change, a thermal management protocol was implemented using 90% shade cloth. Monitoring of representative nests revealed an average temperature of 30.39°C, validating the need for these interventions to maintain nests within optimal ranges and ensure embryonic viability. Twenty-four females were identified (19 with PIT and metal tags). Of these, 75% were recorded as probable neophytes, suggesting positive recruitment of new adult females, while 25% were remigrants, confirming site fidelity. Additionally, the program strengthened community engagement by raising awareness among 242 children from surrounding communities. Leatherback conservation requires coordinated and cross-cutting efforts among various stakeholders. The success at the Chacahua Beach Sanctuary demonstrates that by securing the necessary resources and consolidating strategic alliances among authorities and organizations, it is possible to link scientific rigor with community participation. This working model will be implemented over the coming years to maintain its robustness, allowing for data comparison across at least three continuous seasons. This continuity is essential to establish a statistical baseline and ensure the ultimate success of this methodology, guaranteeing that species protection is biologically viable and socially sustainable in the long term.

HURRICANES THREATEN LOGGERHEAD SEA TURTLE NEST SUCCESS IN SOUTHWEST FLORIDA*

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Tropical storms and hurricanes pose a major threat to sea turtle nest success, particularly for loggerhead sea turtles (*Caretta caretta*) nesting along the Gulf Coast of Florida. These severe weather events are becoming more frequent and intense, overlapping directly with late sea turtle nesting season when many nests are still incubating. Developing embryos at this stage are vulnerable to storm surge and flooding, which can lead to the complete loss of a clutch, while sand accretion traps emerging hatchlings. In 2023

and 2024, Hurricanes Idalia and Debby made landfall mid-nesting season in Sarasota County, one of the highest-density loggerhead nesting areas along Florida's Gulf Coast. To mitigate storm impacts and prevent complete loss, emergency relocations were approved for 40 nests prior to hurricane landfall. Research-focused nests were at least two-thirds through the average incubation duration (~40 days) and at-risk of loss if not relocated. Monitoring data from nests exposed to storm conditions during the same period provides an opportunity to compare relocated clutches to those that remained in-situ. In-situ nest fate was significantly associated with nest location, with open-beach nests more frequently washed out than nests located at vegetation. Emergence success of all in-situ nests was significantly lower than the long-term loggerhead Casey Key average of 57.7%. These findings show that intense storm events drastically alter nest outcomes and reduce reproductive success. While emergency relocation can be an effective management tool under certain storm conditions, its risk and benefit should be considered. In an era of intensifying storms, this study strengthens our understanding of how hurricanes affect loggerhead sea turtle nest success in Central West Florida.

SEA TURTLE NEST RELOCATION: IS IT A VIABLE MANAGEMENT TOOL? ASSESSING THE SUCCESS OF RELOCATED LOGGERHEAD TURTLE (*CARETTA CARETTA*) NESTS IN MON REPOS, QLD

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Southern Queensland supports the largest rookeries for the South Pacific subpopulation of Loggerhead Sea Turtles (*Caretta caretta*), which is listed as "Critically Endangered" under the IUCN Red List. This population has experienced a greater than 80% decline since the mid-1970s and continues to be dependent on conservation actions due to persistent threats. Clutch relocation is a commonly used management tool at many of Queensland's loggerhead rookeries, as many clutches face tidal inundation, predation, and high incubation temperatures, and would otherwise be at risk of embryonic death. While clutch relocation is known to improve hatching success amid human-induced impacts, it can be time-consuming and is most effective when there is intensive monitoring of the nesting beach to ensure suitable numbers are protected. Also, while guidelines exist, current information on inadvertent sublethal impacts on hatchlings is not well-known. As this genetic population is critically endangered, understanding the costs and benefits of clutch relocation, and if needed, updating clutch relocation procedures, is critical to ensure best practice management. This project examines long-term monitoring data to evaluate the overall success of relocated clutches and identify factors that influence hatching outcomes, such as hatchling and emergence success in immediate versus late relocations, relocations of different durations, and spatial variations in relocations. In addition, experimental manipulations are used to compare hatching success and hatchling locomotor performance across different relocation methods used to mitigate threats such as high sand temperatures, tidal inundation, and predation. Leveraging Queensland's unique long-term dataset, this project applies a novel and innovative lens to multi-season nesting dynamics. Together, these approaches provide evidence-based recommendations to refine management and relocation protocols, leading to improved conservation outcomes.

IS DYNAMIC PLACED-BASED MANAGEMENT AS EASY AS MAKE A MAP? NO*

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Most marine megafauna, including sea turtles, are managed in a single-species framework. Placed-based management, such as protecting nesting beaches or marine protected areas, can provide some umbrella effects across multiple sea turtle species. However, sea turtles spend the majority of their lives outside of these areas. Dynamic place-based management in neritic and pelagic environments has been proposed as means to further protect sea turtles from detrimental impacts. We present three case studies from the adoption of dynamic place-based management in the Pacific. The first is an evaluation of one of the earliest Dynamic Ocean Management-styled information products to reduce loggerhead bycatch in pelagic longlines, TurtleWatch. We highlight how, despite the consistent support that TurtleWatch identifies high bycatch risk areas the incentive structure to the fishery was insufficient to galvanize fleet-wide voluntary use of the product. Instead, it appears some derby fishing was occurring as the fleet reached its shared bycatch cap. The second case study highlights challenges when developing a TurtleWatch-esque product for reducing bycatch in a New Zealand longline fishery encountering leatherback sea turtles. Despite the relative ease of designing a dynamic area, the effective area encompassed the majority of the fishing grounds for roughly 1/3 of the year. As such, the product was not adopted and, instead, quitting rules were recommended. These would allow fishing but facilitate dynamic reactions to the relatively rare, but ecologically risk significant, of encountering a leatherback. The third case study is a different dynamic place-based, but more common, management scheme involving a no-fishing zone triggered in response to excess mortality or injury to a protected species. The “Southern Exclusion Zone” triggers in response to mortality or injury to False Killer Whales (Pseudorca crassidens) and shuts down the U.S. EEZ around the main Hawaiian islands to longline fishing. Unsurprisingly, this spatial closure shunts considerable fishing effort to the high seas. Despite the gargantuan size of the closure, covering over 300,000 km2, we observed intense effort concentration along the edge of the boundary so called “fishing the line”. This, in turn, concentrated the bycatch risk of many sea turtle species including leatherback sea turtles. This “out of the frying pan into the fire” form of single-species management is likely more prevalent than assessed. Even within sea turtles, bycatch hotspots of one species do not align perfectly with others. With redistributing fishery effort, one closure or avoidance area designed for single species could very well negatively impact another. In summary, we have the tools and means to develop dynamic place-based management schemes. But, ignoring the context of how these schemes are incentivized or their attendant consequences may result in jeopardy with very little benefits for the species initially intended to be protected.

STRENGTHENING CAPABILITIES AND CAPACITIES FOR SEA TURTLE CONSERVATION IN INDONESIA THROUGH ORGANIZATIONAL DEVELOPMENT

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The Indonesian archipelago and its surrounding waters host 6 out of 7 species of sea turtles. However, Indonesia's conservation efforts are undermined by limited organizational capacity and outdated methodologies. Furthermore, the prevalence of illegal take by the coastal communities-driven largely by persistent poverty - continues to hinder conservation efforts. To address these challenges, a collaborative project between Turtle Foundation (TF) and Yayasan Penyu Indonesia (YPI) was established to strengthen local capacity in sea turtle conservation management. This project, supported by the UK government through the "Darwin Initiative" over a 2 year-grant period, aimed to enhance the operational and organisational effectiveness of the local NGO YPI. YPI is a non-profit organization established in 2018 that focuses solely on sea turtle conservation in Indonesia. It operates in Berau (East Kalimantan), Mentawai (West Sumatera), Simeulue (Aceh), Nias (North Sumatera), and Bali (as head office). YPI carries out four core programs, including species and habitat protection, monitoring and research, awareness raising, and community empowerment. The project delivered a targeted package of interventions, including the development of a user-friendly ranger handbook and Training of Trainers (ToT) programmes to equip 10 local ranger trainers. It also facilitated the recruitment of a Fundraising Officer and a Communications & Campaigns Officer – to strengthen YPI's structure and outreach efforts. Additionally, an exchange visit between YPI and LPPM UNIPA (Papua) enabled mutual learning about sea turtle conservation practices. Further organizational development included tailored training for head office staff members in financial management, organizational standards, team building and gender equality, and lastly to develop a concept of sea turtle education centre to replace the current sea turtle head-starting "ecotourism" practices. Moreover, community-based action plans for poverty alleviation in Berau and Simeulue were jointly prepared with the local governments, partners and local communities. During 1.5 year of project implementation, 79 people including 11 women (comprising 19 YPI staff members, 36 local rangers and 24 members of local conservation groups in Simeulue) strengthened their capabilities in key areas including sea turtle conservation management, leadership, finance, biodiversity project management, and organizational policy standards. Furthermore, YPI's reciprocal visit to Jeen Womom (Papua)- the largest leatherback turtle nesting beach managed by LPPM UNIPA, provided valuable lessons on long-term monitoring, research strategies, and strategies to foster the stewardship of local communities in safeguarding the world's largest sea turtle species. All these efforts are highly relevant for both biodiversity and human development. Indonesia's sea turtles continue to face escalating threats from poaching, illegal trade, unregulated tourism, and habitat loss. Meanwhile, rural coastal communities, where many of these nesting sites are located, often struggle with poverty and limited livelihood opportunities. By empowering YPI, a locally rooted NGO, the project ensures culturally appropriate, long-term conservation efforts that integrate community wellbeing. Ultimately, YPI and TF share a common vision for a future where sea turtles and local communities can coexist and flourish together.

CONSERVATION OF SEA TURTLE IN GHANA, ANLOGA

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The Anloga coastline, within the Keta Lagoon Complex Ramsar Site in Ghana, encompasses approximately 40 km of uninterrupted sandy beach that provides important nesting habitat for three marine turtle species: the leatherback, *Dermochelys coriacea* (Vulnerable), olive ridley, *Lepidochelys olivacea* (Vulnerable), and green turtle, *Chelonia mydas* (Endangered). During the 2024–2025 nesting season, our monitoring efforts documented 18 leatherback nests, 60 olive ridley nests, and one green turtle nest. Sea turtles nesting in Anloga are increasingly threatened by anthropogenic pressures, particularly direct harvesting of nesting females and eggs, as well as the growing risks posed by unregulated ecotourism. The Wildlife Division of Ghana's Forestry Commission implements a multi-pronged conservation strategy, including nightly patrols to safeguard nesting females and hatchlings, community-based education and awareness campaigns, law enforcement, and alternative livelihoods support for communities. Additionally, stakeholder engagement, research, training, and policy advocacy are integrated to strengthen long-term conservation outcomes.

TURNING THE TIDE ON GHOST NETS: COMMUNITY BASED MONITORING AND RETRIEVAL INITATIVE ALONG CHENNAI & CHENGALPATTU COAST, INDIA

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TREE Foundation, India

Ghost nets - abandoned, lost, or discarded fishing gear have emerged as a major threat to marine ecosystems and marine megafauna particularly to sea turtles along the Chennai and Chengalpattu coastline of Tamil Nadu, India. These drifting nets entangle marine fauna, damage coral reefs, and contribute to persistent ocean pollution. Recognizing the urgent need for intervention, TREE Foundation launched the community based Ghost Net Retrieval Programme, titled "Hunting the Ghosts that Haunt Our Oceans." The Foundation incentivises fishermen for the ghost nets retrieved and handed over. The poster will outline the initiative that mobilizes local coastal communities, mainly artisanal fishers, coordinated through the 'Sea Turtle Protection Force' (STPF) members of TREE Foundation who regularly create awareness, systematically survey, map, record, retrieve, and document ghost nets in both nearshore and offshore waters. Through coordinated retrieval efforts, numerous megafaunas including: Olive Ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*) and leatherback turtles (*Dermochelys coriacea*) have been rescued from entanglement many suffering from flipper amputations, abrasions, or stress-induced trauma. Beyond direct removal, the programme emphasizes awareness creation and capacity building among fishing communities to reduce net loss, encourage timely reporting of derelict gear, and promote environmentally responsible disposal and recycling practices. The collected data from the 186 tons of ghost nets retrieved to date, retrieval sites, net collected, gear types and fauna entangled are being used to develop spatial maps that identify high-risk entanglement zones and inform policy recommendations for sustainable fishing gear management and marine waste regulation. This poster demonstrates how a locally driven, science supported, and alternative income generating community empowered initiative can significantly mitigate sea turtle mortality while enhancing the ecological resilience of coastal waters. By integrating conservation action with fisher participation and data

based policy input, the poster will clearly outline how TREE Foundation's ghost net programme provides a replicable and scalable model for addressing marine debris and safeguarding vulnerable sea turtle populations along India's eastern coastline.

CO-CREATING WIN-WIN SOLUTIONS THAT EMPOWER FISHERS AND REDUCE LEATHERBACK BYCATCH IN A GLOBAL BYCATCH HOTSPOT*

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Bycatch reduction projects often focus narrowly on turtle-centric goals and techniques while overlooking social, economic, and political factors that can catalyze or hinder success. Such approaches oversimplify the complex fisheries systems in which these interventions are intended to act, leading to unstable or short-lived gains. A new paradigm is needed—one that integrates fisheries sustainability and conservation goals, and treats community empowerment and conservation not as opposing aims but as mutually reinforcing. Such a paradigm embraces the complex interactions among human, ecological, and institutional dynamics that influence conservation outcomes. The twin-island republic of Trinidad and Tobago (TT) is home to the highest remaining leatherback nesting abundance in the Wider Caribbean region. However, leatherback abundance has been declining regionally and in TT, due in part to high levels of incidental capture in artisanal gillnet fisheries along Trinidad's northeast coast. Despite previous efforts in the 2000s to develop bycatch reduction measures in TT, this bycatch remains unsustainably high, posing threats both to Caribbean leatherbacks and to the livelihoods and safety of fishers who must deal with entangled turtles during their fishing activities. In response to these challenges, a multi-stakeholder partnership—including government agencies, NGOs, universities, and local fishing communities— has collaboratively and simultaneously undertaken numerous complementary activities to promote improved fishing practices that sustain small-scale fishing through reduction of leatherback bycatch in Northeast Trinidad. Together, we have co-developed a 'menu' of potential win–win solutions informed by fisher input and participation that both reduce leatherback bycatch and support improved fishing livelihoods. Primary activities include: 1) experimental gear trials to examine the potential efficacy of net illumination as a viable bycatch reduction technique; 2) provision of improved gear and expert training in alternative fishing methods; 3) a nationwide marine megafauna bycatch survey documenting small-scale fishing practices and fisher perspectives of causes and potential solutions to bycatch; 4) and support for national-scale efforts to enhance fishing sustainability through a growing cooperative, fishing competitions, safety-at-sea trainings, and other activities. Our collective goal is to develop a holistic, community-centered strategy that enhances fishing livelihoods while reducing leatherback bycatch. In this presentation, we will key insights and lessons learned from our multi-pronged approach to show how developing community-centered, holistic bycatch reduction strategies can reduce bycatch while supporting resilient small-scale fisheries.

THE MAUI AREA SEA TURTLE ATLAS: MAUI OCEAN CENTER MARINE INSTITUTE'S FIELD GUIDE

Bruce Weyermann, Alan Espiritu, Ylenia Mayen St-Louis, Dustin Paradis, Cheryl King

Maui Ocean Center Marine Institute

The Maui Ocean Center Marine Institute (MOCMI) is a nonprofit organization incorporated in 2016 that is based on the island of Maui, Hawai'i (USA). MOCMI's mission is to inspire lifelong environmental stewardship and ensure the survival of sea turtles and coral reefs in Hawai'i through science-based conservation efforts, education, and outreach. As part of this mission, MOCMI is responsible for operating the sea turtle stranding network for all of Maui; leading land-based and in-water responses to turtles that need assistance. MOCMI opened the first sea turtle rehabilitation facility in the state, treating patients from neighboring Hawaiian Islands as well as Maui. Through 2025, our team logged the 1,638th case of our assistance of sea turtles in need (on land and in-water). With a current volunteer list of over 160 people, management, training and coordination can be a challenge. The Maui Area Sea Turtle Atlas (MASTA) serves as a master document to provide valuable insight and quick reference for specific in-water/shoreline geographical areas to assist the MOCMI team in executing prompt, efficient responses. This internal-only living digital document (104 pages and growing) includes a wealth of local knowledge on sea turtle basking, resting, cleaning, and foraging habitats that are pinned on Google Earth images. Geographical areas are divided into three coastal regions around Maui: West Shore, North Shore, and South Shore. Links let you "fly" to each location. Hawaiian place names are included when available with modern and local names with GPS points. There are detailed descriptions about parking suggestions, coastal access points, ocean entry spots, environmental factors, and notes about other local knowledge that may aid in rescue efforts. Useful links to webcams for checking current ocean conditions and property addresses with the appropriate contact information for gaining access/permission are also included. This information is especially helpful to our new team members. Every minute counts when response efforts are underway, and the MASTA has proven to be a critical tool that enhances team coordination, site familiarity, and safety. Although it is specific to Maui, the MASTA framework could be utilized by other stranding response efforts worldwide.

NAVIGATING THE INTERNATIONAL LIGHT POLLUTION GUIDELINES FOR MIGRATORY SPECIES: AN ENVIRONMENTAL PRACTITIONERS VIEW

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The Convention on the Conservation of Migratory Species (CMS) International Light Pollution Guidelines for Migratory Species (the Guidelines) provide a framework for assessing and managing the impacts of artificial light on sensitive species, including marine turtles. The Guidelines aim to establish consistent, standardised, and transparent processes for best-practice management of artificial lighting visible near sensitive habitats. For marine turtles, the Guidelines recommend that an environmental impact assessment (EIA) be undertaken for any action or activity involving artificial lighting within 20 km of important nesting habitat. The EIA should include detailed information on the local turtle population and behaviour and species-specific behaviours, such as annual nester abundance, regional importance, nesting and hatching seasonality, productivity, and orientation of hatchlings and adult turtles. The Guidelines also

specify the minimum biological information required to support the assessment and outline the development of a Light Management Plan, including requirements for biological monitoring during different phases of the action e.g. construction, operations, and the establishment of trigger parameters to detect changes in turtle behaviour. In this presentation, we share our experience in applying the Guidelines as environmental practitioners across several large-scale resource projects in Western Australia. We discuss the practical challenges of collecting biological data in remote coastal regions, modelling light emissions from proposed developments as viewed from sensitive habitats, and integrating these outputs into a risk assessment framework. , our approach to determining regional importance, and how we measure and detect change in both adult and hatchling behaviour. Our approach to determining regional importance and detecting changes in adult and hatchling behaviour is described, along with outcomes from recent projects where this methodology has been implemented to successfully mitigate the impacts of artificial light on marine turtles.

ASSESSING HUNTING DYNAMIC AND CONSERVATION IMPACTS ON PACIFIC LEATHERBACK TURTLE IN KEI ISLAND, MALUKU INDONESIA BETWEEN 2017-2024*

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The Pacific leatherback turtle (*Dermochelys coriacea*) remains among the most endangered sea turtle populations globally, with an estimated population decline exceeding 78%. In Kei Islands Maluku, direct hunting has been a persistent threat, deeply rooted in customary practices. This study quantifies the trends of leatherback turtle hunting from 2017 to 2024 and evaluates the impacts of community engagement and policy interventions on reducing the threats of hunting. A total of 191 individual Pacific leatherback turtles were recorded as hunted across 11 coastal villages in the Kei Islands between 2017 and 2024. Hunting was at a peak in 2017 with 103 individuals, but declined sharply to three individuals in 2024, representing a 97.1% reduction over eight years. The villages of Somlain (n=60 turtles), Ohoidertutu (n=59 turtles), and Ohoiren (n=18 turtles) accounted for most hunting events, while Tanimbar Kei and Ur Pulau demonstrated notable declines following 2021. Seasonal patterns revealed that hunting activity was most intense between August and December, particularly during October–November, coinciding with the leatherback turtle's coastal migration period. Data on sex composition were collected starting in November 2019, comprising 11 males (9.6%), 43 females (37.4%), and 53% individuals of unidentified sex. The sharp decline in hunting corresponded with extensive outreach and engagement involving over 1,500 people through collaboration with customary councils, youth networks, and both Catholic and Protestant churches. Conservation messages were integrated into local religious and cultural frameworks, fostering behavioral shifts away from hunting. Additionally, the 2023–2030 Maluku Sea Turtle Conservation Action Plan established a formal legal framework for regional conservation, integrating research, education, enforcement, and habitat protection. The results demonstrate that the combination of community participation, faith-based engagement, spatial management, and policy implementation effectively reduced direct hunting. These findings highlight a successful conservation model for mitigating human-induced mortality in critically endangered leatherback turtles.

Education, Outreach, and Advocacy

SEA SCHOLARS: CONNECTING WITH THE COMMUNITY THROUGH SCIENCE, EDUCATION, AND ARTS*

Chelsea Bennice, Jeanette Wyneken

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The mission of the Florida Atlantic University Marine Science Laboratory (FAU Marine Lab) is to conduct novel and necessary scientific studies on sea turtles, train the next generation of scientists, and share discoveries with the community to increase conservation awareness and ocean stewardship. This commitment to bridging scientific discovery and educational outreach sparked the formation of the lab's first cross-disciplinary program, the Glenn W. and Cornelia T. Bailey Marine SEA (Science, Education, and Arts) Scholars program to engage undergraduate and graduate students to "dive in" by participating in sea turtle research, engaging in public education and outreach activities, and becoming effective science communicators to broad audiences. This program benefits from the students' diverse backgrounds and talents gained from expertise in science, education, and arts. Students in this program use/share their skills and interests to develop interactives and content that relays science in fun, creative new ways at the FAU Marine Lab's visitors' gallery and marine life conservation events – reaching over 200,000 community members in the past year. To share a day-in-the-life of a scientist, a "sea" of free resources for "marine science explorers" of all ages has been created by the Glenn W. and Cornelia T. Bailey Marine SEA Scholars. Sea turtle coloring fact sheets, 3D turtle models, and interactive lessons featuring important sea turtle research topics including "From Nest to Sea", "Turtle Vision", and temperature dependent sex ratios "Hot Chicks, Cool Dudes" are available. The interactive lessons have added value in providing pre- and post-assessments to identify if SEA Scholars are clearly communicating FAU Marine Lab research outcomes and what the participant knows/learns from the lessons. These scientists-in-training are the next generation of ocean ambassadors and gain valuable experience as they help bridge the gap between scientists and the community. Those SEA Scholars who completed their time in the program highly ranked this program as progressing their science communication skills and preparation for STEM-related career paths.

ENHANCING MARINE TURTLE CONSERVATION IN THE JORDANIAN GULF OF AQABA: PHASE II - FOSTERING INTERNATIONAL COOPERATION FOR BYCATCH REDUCTION AND CAPACITY BUILDING*

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The Gulf of Aqaba hosts five sea turtle species: Hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), and olive ridley (*Lepidochelys olivacea*). Green and hawksbill turtles are the most frequently encountered, particularly in shallow coral reef habitats that serve as critical feeding and nesting grounds. However, the Gulf's role as a hub for fishing, shipping, tourism, and recreational diving creates significant anthropogenic pressures, emphasizing the urgent need for effective conservation measures. In response to threats from bycatch and other human-induced risks, the Jordan Society for the Conservation of Turtles and Tortoises (JSCT) launched in 2024 a multi-phase initiative to enhance marine turtle conservation and reduce bycatch in the region's fisheries. The initiative focuses on reducing turtle injuries and mortality from fishing operations and vessel strikes, through awareness campaigns and capacity-building programs targeting fishers and marine personnel. The project's second phase includes surveys with key stakeholders such as the Royal Jordanian Navy, Marine Reserve staff, local fishermen, and representatives of the diving and tourism sectors to evaluate their awareness and practices regarding marine turtle conservation. These are followed by workshops designed to strengthen participants' understanding of sea turtles, their ecological roles, and the risks associated with fishing activities. Training sessions include demonstrations of safe rescue and rehabilitation techniques for accidentally captured turtles, and rescue kits will be distributed to naval vessels, marine reserve staff, fishers and diving teams to support these efforts. This phase benefits from partnerships with international organizations, including TurtleWatch Egypt 2.0 (TWE) and the Inwater Research Group (IRG, USA), which contribute to cross-border collaboration in monitoring, education, and bycatch reduction. Together, these partnerships aim to enhance regional data sharing and unify conservation practices across the Red Sea and Gulf of Aqaba. TurtleWatch Egypt, active since 2011, is a citizen science initiative engaging divers, snorkelers, and marine personnel in photo-identification monitoring of green and hawksbill turtles along the Egyptian Red Sea. With a database of over 11,000 reported sightings, TWE demonstrates the value of community-based monitoring. Building on this experience, TWE will support the introduction of a similar photo-ID program in Jordan, engaging local dive operators and conservation partners in data collection and reporting. Inwater Research Group (IRG) brings extensive experience in sea turtle research and conservation, particularly through its International Sea Turtle Ambassadors (ISTA) program, which develops educational materials for schools and communities. JSCT is adopting the ISTA program to expand marine conservation awareness and youth engagement across Jordan, complementing ongoing training for fishers, divers, and naval staff while promoting sustainable, community-driven stewardship. Through theoretical and practical sessions, approximately 45 Royal Jordanian Navy members, 80 fishers, 15 Marine Reserve & related stakeholders staff, and 30 dive professionals will gain skills in bycatch reduction and turtle monitoring. The project is ongoing, and the outcomes of its second phase will be presented at the 44th International Sea Turtle Symposium (ISTS). JSCT ultimately aims to strengthen national collaboration, enhance knowledge of sea turtle populations, and increase awareness among local communities and stakeholders involved in turtle conservation.

PIONEERS IN BAJA CALIFORNIA SUR: SUCCESSES, CHALLENGES AND LESSONS LEARNED AFTER 30 YEARS OF SEA TURTLE CONSERVATION IN LOS CABOS, MEXICO*

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The permanent ban on sea turtle hunting in Mexico was implemented in 1990, leading to the first conservation programs. In Baja California Sur, the pioneering sea turtle camp was established by members of the local community in Los Cabos and was later formalized as the civil association "ASUPMATOMA" in 1995. The beaches monitored by ASUPMATOMA are located on the Pacific coast and are among the areas with the highest nesting density in the state for olive ridley sea turtles (*L. olivacea*), with leatherbacks (*D. coriacea*) and black (*C. mydas*) also nesting there, but less frequently. Over the course of 30 years, ASUPMATOMA sea turtle camp has led three main programs: 1) Biological monitoring of the olive ridley turtle nesting colony, managing to increase the number of nests per season, from <100 nests in the 1995-96 season to >1,000 nests in the 2024-25 season; likewise, a cumulative total of 1,800,000 hatchlings have been released into the sea, maintaining hatching percentages above 75% in most seasons. 2) Scientific research, providing valuable information on the species that nest in the area; for the leatherback turtle, a successful greenhouse startup method was developed, eliminating the negative impact of low temperatures on nests incubated during winter; likewise for the olive ridley turtle, we now know that we produce one of the highest proportions of male hatchlings in Mexico, due to our geographic location. 3) Environmental education and community engagement, reaching dozens of local groups from Los Cabos community, 65% of whom are elementary school children and young people between 6-15 years. ASUPMATOMA has served as an incubator for approximately 300 students and professionals who began their training as turtle conservationists at our camp and have directly or indirectly conducted scientific research. We highlight key attributes of our camp, such as the continuity of our work for 30 uninterrupted years and the fact that in every challenge (hurricanes, the Covid-19 pandemic, the loss of our main camp) we have accumulated lessons in perseverance and resilience, which we have shared with other camps. As pioneers in the region, we are proud to have been a seedbed for laying the foundations of other camps in neighboring communities (e.g., Todos Santos, El Pescadero), which have also successfully integrated as civil associations. A distinguishing characteristic of our community, Los Cabos, is that it is made up of non-native residents who came from different parts of Mexico (and the world) and, over time, adopted it as home. In highly touristic and migratory areas, the diversity of lifestyles often diminishes the sense of belonging; we strongly believe that one of our most significant lessons over these 30 years has been the value of a sea turtle camp as a recreational and educational space for connection, which simultaneously fosters identity, purpose, and pride in a multicultural community, thanks to sea turtles as a local symbol of conservation.

TEN YEARS OF COORDINATED MONITORING AND MANAGEMENT OF GUAM'S SEA TURTLES*

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Community involvement plays a critical role in effective sea turtle research and conservation, particularly in regions where long-term monitoring depends on sustained local engagement and stewardship. Outreach-driven programs can expand monitoring capacity, improve data collection, and foster public investment in conservation outcomes. On Guam, the Guam Division of Aquatic and Wildlife Resources (DAWR) has implemented community-based initiatives that integrate education, outreach, and advocacy directly into sea turtle management and research. Programs such as Haggan Watch and Haggan Huddle exemplify this approach by engaging community members, students, and volunteers in sea turtle conservation through hands-on participation, education, and public awareness. These programs operate within networks of federal, local, and community partnerships developed over the past decade to strengthen Guam's capacity to monitor and protect sea turtles. Through sustained support from federal partners, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS), as well as cooperation from the Department of Defense and local agencies, DAWR has established an integrated, data-driven framework for sea turtle research and management. Standardized monitoring protocols have generated valuable long-term data on Guam's two most commonly observed species, the green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles, across the Western Pacific. By embedding outreach and education within DAWR's monitoring efforts, Haggan Watch and Haggan Huddle have expanded field capacity, strengthened community stewardship, and enhanced conservation outcomes.

BEYOND THE NEST: STORIES OF GRASSROOTS CONSERVATION, BROUGHT INTO THE PUBLIC EYE TO INSPIRE ENGAGEMENT, CHANGE, AND GLOBAL ACTION

Scott Handy

Mamatuga Limited

Sea turtle conservation is often discussed in terms of science, data and ecological outcomes for global populations. Yet behind the statistics lie real stories — of danger, courage, connection and community. Narrative storytelling, particularly through published books, can deepen public understanding, inspire behavioural change, and strengthen stewardship with wildlife conservation efforts on a global scale. On the Frontline of Saving Sea Turtles chronicles over a decade of work in coastal areas blighted by wildlife exploitation, poverty, violence and narcotrafficking. As a young conservationist, I, like many others, faced not only natural threats like adverse weather, natural disasters, and disease, but also direct confrontations with poachers and criminal networks. These threats, alongside the devastating realities of physical and sexual assault, kidnappings, and even murder, illustrate the high-stakes effort required to conserve an endangered species. Despite these risks, our work continued, fuelled by passion, a sense of urgency, and an unwavering desire to make a difference. In the midst of these challenges, where saving sea turtles meant risking human lives, strong relationships were forged with the local communities, where empathy and

perseverance made long-lasting change possible. Using a collaborative approach — combining scientific research with grassroots engagement — we built enduring local partnerships, improved hatchery practices, formulated a national strategy plan, and ultimately enhanced conservation outcomes across the region. Firsthand narratives from the field do more than inspire — they bring conservation to life. They highlight the risks and resilience required to drive change, while identifying the achievements, and celebrating the victories of those working tirelessly to protect our planet's threatened wildlife. By translating complex conservation challenges into human terms, they influence a shift in behaviour, spark global advocacy, and help reshape policy. The result is real, measurable, and lasting impact — from increased funding and the creation of protected areas, to long-term ecological recovery. These stories remind us that science alone cannot save a species, but when brought into the public eye, stories can rally the world to do so. Wildlife conservation storytelling is more than raising awareness — it's a catalyst for action.

THE CROSSROADS OF CONSERVATION: EDUCATION THAT SUPPORTS THE NOTION OF COEXISTENCE

Lisa Harrington, Deborah Kay Herrera

Malama i na Honu, United States of America

Hawaiian green sea turtles, or Honu in Hawaiian, have been revered on the islands over the centuries, as depicted in the hieroglyphics, sacred writings, hula, and chants. The indigenous peoples of Hawaii often refer to the Honu as their 'Aumakua, or ancestral spirit. Prior to the Endangered Species Act (ESA) of 1973, Honu, once thought only for the Ali'i (royalty) were frequently hunted for survival, as their meat is rich in nutrients and was plentiful. On Kauai, there exists a phenomenon where large numbers of Honu (approximately 100) haul out on shore during the evening to bask on the busiest beach on the island. Basking, in this context, is the act of a marine animal coming on shore to thermoregulate, digest food, and rest. Sea turtles (all species) are designed for life in the water, yet throughout the Hawaiian Islands, both male and female engage in this atypical basking behavior. While there is no conclusive research to show why this adaptation began, this behavior has created a concern about the coexistence of people and Honu on this beach. Docents or "citizen scientists" spend each evening educating visitors and keeping careful watch over these federally protected creatures (Endangered Species Act, 1973). They hand out bookmarks that visitors can learn from aligned to the information the docents are sharing. There is also signage on 9 cones and 4 sandwich boards stationed 20ft. from the Honu with educational information to help visitors enrich their viewing experience. A team of docents conduct outreach for schools either at their site or on the beach as a field trip, and hold weekly Honu talks at a neighboring resort. In the hope of understanding their behavior, this team of volunteers has engaged in nightly data collection for the past two years. The purpose of this mixed-methods study was to determine if relationships exist between the number of Honu that haul out to bask and observable environmental factors: number of people on the beach, number of people in the water, the phases of the moon, air temperature, the time of sunset, and other events involving human presence. Findings suggest there are adverse relationships among the categories studied and how they impact the number of Honu that bask throughout the year, including the number of people on the beach. The implications of these findings lead the researchers to understand both the importance of volunteer presence during peak basking times and the approximately 135,000 people who visit annually. Using these findings, the organization's aim is to provide education so that Honu and people can safely coexist on this beach and similar beaches around the Hawaiian Archipelago.

WHEN THE COAST FROZE, WE DIDN'T: HOW SEA TURTLE INC ORCHESTRATED A RECORD-BREAKING COLD-STUN RESPONSE*

Wendy Knight, Amy Bonka

Sea Turtle Inc, United States of America

When freezing temperatures swept across the Texas coast, thousands of sea turtles were paralyzed in the water — cold-stunned, immobile, and moments from death. In February 2021, Sea Turtle Inc found itself at the epicenter of the largest sea turtle rescue in recorded history, saving 5,556 turtles in just days. Three years later an unprecedented triple wave of cold-stunnings in early 2025 that tested every limit of our facility, staff, and community. What unfolded wasn't just a rescue—it was a masterclass in crisis leadership, community engagement, and operational agility. Within hours, Sea Turtle Inc transformed from a small coastal nonprofit into an emergency command center. Local boat captains, Coast Guard crews, and volunteers worked shoulder-to-shoulder with our team, turning pickup trucks into transport fleets and warehouses into temporary triage units. Every heater, towel, and water tank became part of a coordinated system to save lives. Behind the scenes, strategic communication proved as critical as science. Using real-time social media updates, live videos, and transparent storytelling, Sea Turtle Inc turned passive followers into active participants. Each Facebook Live—whether showing the arrival of hundreds of cold, stunned turtles or their first successful swim test—ignited thousands of responses, donations, and volunteer mobilizations. Community members opened homes, hotels offered free rooms, and restaurants delivered food to responders. Conservation became contagious. These back-to-back emergencies revealed that resilience in wildlife conservation isn't built solely on biology—it's built on leadership, logistics, and the ability to inspire action under pressure. The lessons learned from Sea Turtle Inc's experience offer a replicable model for how organizations can respond to large-scale environmental disasters by blending emergency management principles, digital communication strategy, and community empowerment. This presentation will share how one small nonprofit scaled overnight into a regional response hub capable of saving thousands of endangered animals. We'll explore the operational frameworks that allowed rapid mobilization, the partnerships that made it possible (including NOAA, TPWD, and the U.S. Coast Guard), and the social media strategies that transformed crisis communication into community activation. At its core, this story is not only about saving sea turtles—it's about what happens when leadership meets purpose, when science meets storytelling, and when an entire community refuses to stand still as the coast freezes.

PLAY, LEARN, CONSERVE: GAMIFYING PHOTO-IDENTIFICATION TO ENGAGE THE PUBLIC IN SEA TURTLE CONSERVATION

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Gamification represents a novel approach to enhancing engagement and understanding in marine conservation by transforming scientific techniques into interactive learning experiences. The TurtleTurtle project (https://www.turtleturtle.fun) applies this concept to sea turtle photo-identification (photo-ID), converting real research data into an accessible digital game that educates and trains participants in individual turtles recognition and conservation principles. The game combines scientific accuracy with entertainment to increase public appreciation of sea turtle biology and research techniques. The first version of the game was launched in August 2025 and was funded by the Centre for Public Engagement of Queen Mary University of London. It uses thousands of curated photographs from the SeaTurtleID2022 dataset, which contains images from a 25-year spanned photo-database of the loggerhead turtle (*Caretta caretta*) population of Zakynthos Island, Greece. The SeaTurtleID2022 dataset was originally developed to train and test automated photo-ID algorithms. Players are invited to match turtles based on their facial scale patterns, following the same method applied by researchers. The image metadata of SeaTurtleID2022 include timestamps, head orientations as well as clarity (image quality) scores, thus allowing the design of several difficulty levels for the game from "easy" to "expert". Successful matches reward the player with details about each individual's life history, such as site fidelity, and behavioural traits, while also presenting sea turtle biology trivia as well as conservation messages about threats including bycatch, boat strikes, climate change and habitat degradation. In the first 3 months after the game's launch, more than 200 game sessions were played and more than 350 persons visited the game platform. To encourage adoption of the game by other sea turtle photo-ID projects, its backend code was released as open source. Building on this success, the concept was adapted in 2025 for the Egyptian Red Sea in collaboration with TurtleWatch Egypt 2.0 (TWE) and with support from a 2025 ISTS Innovation Grant. The new version, TurtleTurtle-RedSea, focuses on green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles identified through nearly two decades of data gathered by TWE's citizen science network and over ten years of regular field monitoring. It introduces players to local conservation challenges such as tourism pressure, marine debris, and speedboat collisions, using genuine photographs and individual stories collected from Red Sea dive sites. Similar to the original TurtleTurtle, it features multiple difficulty levels determined by scute pattern distinctiveness, image quality, and turtle orientation, engaging audiences that range from students to divers and researchers. Both platforms are freely accessible online without registration, encouraging inclusive global participation. Beyond outreach, they serve as effective tools to raise awareness, foster empathy, and train volunteers, interns, and new team members in individual turtle identification. They help citizen scientists understand the value of their photos, motivating careful data collection and improving submission quality. This approach shows how digital tools bridge science and public involvement, strengthening education and data reliability. The TurtleTurtle initiative turns real data into an engaging experience, inspiring conservation and offering a scalable model for global citizen science.

PROMOTING OCEAN LITERACY WITH SEA TURTLE THROUGH INTEGRATION OF HISTORY, ART AND SCIENCE IN THE SWIRE MARINE DISCOVERY CENTRE AT THE HONG KONG MARITIME MUSEUM*

Connie Ka Yan Ng

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Hong Kong—a coastal city in China with more than 1,100 kilometres of shoreline and over 200 islands—is a hotspot for marine biodiversity. Its waters support nearly 6,000 documented marine species, representing approximately 25% of China's national marine biodiversity. Yet despite the ocean's profound ecological, cultural and economic importance, much of the public remains "sea blind." As human activities such as overfishing, pollution, and climate change intensify, raising ocean awareness across all sectors of society has never been more urgent. The Hong Kong Maritime Museum (HKMM), located beside the cultural icon Victoria Harbour, showcases a rich collection of exhibits centred on human interactions within the maritime world to foster public engagement in maritime culture and appreciation for our connection to the ocean. In 2025, HKMM launched the Swire Marine Discovery Centre (SMDC)—a new multi-purpose learning hub designed to advance ocean literacy and highlight the richness yet the vulnerability of marine ecosystems. Guided by the principle that ocean literacy is understanding how the ocean affects you, and how you affect the ocean, SMDC inspires public engagement in marine conservation by "exploring human-ocean interaction with the community through History, Art, and Science". Our interactive marine science education programme includes the Marine Science Gallery, thematic exhibitions, guided tours, public talks, workshops, and online learning resources that empower youth, children, and the public to appreciate and protect marine biodiversity. As a sea turtle scientist and educator, Dr. Connie (Head of the Marine Discovery Centre) has positioned sea turtles as a central ambassador throughout the programme. Drawing on her own origin story, she integrates the magnificent life history of and the challenges faced by sea turtles into educational materials, outreach activities, and multimedia platforms to cultivate emotional connection, spark curiosity, and motivate young people to pursue marine conservation and ocean-related careers. Collaboration is at the heart of SMDC's mission. Partnerships with stakeholders such as the governments, NGOs, universities, and educators have strengthened our impact. Flagship events such as the Swire Family Fun Day brought together more than 3,000 participants from families and stakeholders, offering hands-on learning experiences and inspiring conservation pledges. In 2025, SMDC engaged over 98,700 visitors and students in the Marine Science Gallery and more than 4,700 participants in 210 marine science activities. By nurturing appreciation and stewardship, SMDC aims to inspire individual conservation action that collectively contributes to a sustainable future for generations to come. In this presentation, Dr. Connie will share key challenges, lessons, and opportunities from the development and implementation of SMDC. She invites fellow sea turtle educators to explore creative, collaborative strategies for advancing ocean literacy through the powerful storytelling and scientific significance of sea turtles, that motivate our communities towards a common goal of protecting the ocean and the species of our interest. Dr. Connie will also pioneer a new concept: featuring an "ancient sea turtle" as a narrative guide in an ocean literacy story to deepen humans' connection to the ocean and hence prompt our conservation awareness and action.

OCEAN LITERACY AND FUNDAÇÃO PROJETO TAMAR: A COMMITMENT TO MARINE CONSERVATION*

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The United Nations' Ocean Science Decade for Sustainable Development (2021–2030) aims to transform our relationship with the ocean by promoting Ocean Literacy, which has been integrated into Brazil's school curriculum. Fundação Projeto Tamar, created in the 1980ss, has combined scientific research, social inclusion, and environmental education aiming to recover sea turtle species in the Southwestern Atlantic. Since 2008, the Tamar at School program has engaged around 18,000 students from schools in environmental awareness activities. Every year, Fundação Projeto Tamar's open-air museums welcome over one thousand school groups, with ~50,000 students and ~6,000 educators. Here, we present the development and implementation of a new version of the educational resource for teachers, integrating Ocean Literacy principles with sea turtle conservation efforts and scientific literacy. Based on accumulated experience from long-term school programs, the "Guide for Educators – Ocean Literacy & Sea Turtle Conservation" was created, featuring content and activities to foster understanding of the ocean as a global system, its physical and biological characteristics, sea turtle life cycle habitats, and conservation actions. The guide includes content and activities designed to foster understanding of the ocean as a global system, addressing its physical and biological characteristics, the marine ecosystems used by turtles throughout their life cycle, and conservation efforts in place. The guide seeks to integrate theory and practice, promoting teacher leadership and hands-on learning experiences for students. The guide includes a training course for teachers, providing access to the material in both digital and printed formats. It includes certified training to support the development of school projects focused on marine conservation. In this context, teachers become science mentors, capable of guiding students in creating transdisciplinary, investigative, and experimental projects. The implementation of the new guide is scheduled to begin in January 2026, encouraging the use of Fundação Projeto Tamar's visitor centers as "open-air laboratories" and strengthening the connection between schools and marine conservation. Such initiatives raise environmental awareness, promote local community engagement, and highlight the importance of marine biodiversity, supporting UN's SDG goal 14 (Life Below Water). Our approach exemplifies an effective model for promoting Ocean Literacy in a society committed to marine conservation through the integration of research, education, and community engagement.

ENGAGING LOCAL YOUTH IN GREEN SEA TURTLE CONSERVATION: AN ENVIRONMENTAL EDUCATION APPROACH AT TORTUGA BAY, GALAPAGOS ISLANDS

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The Galapagos National Park Directorate (GNPD) has proactively led conservation efforts for green sea turtle (*Chelonia mydas*) populations through a long-term monitoring program at the principal nesting beaches of the archipelago: Quinta Playa and Bahía Barahona (south of Isabela Island) and Las Bachas

(north of Santa Cruz Island). Nevertheless, it remains vital to enhance community involvement in protecting this emblematic species through environmental education programs (EEP) that promote local awareness and strengthen participation in global conservation initiatives. The Fundación Educación para Comunidades Sostenibles (ECOS), in collaboration with the GNPD, has implemented an EEP centered on citizen science for the conservation of *C. mydas*, incorporating systematic nesting monitoring and environmental data collection conducted at public sites under GNPD supervision. While nesting data form the scientific core, the program also includes complementary education and outreach initiatives that build stewardship and scientific literacy among youth and community members. The youth-led ecological club Molas, composed of 65 students from five high schools on Santa Cruz Island, constitutes the program's core research group. Through peer-to-peer outreach and public events, these students have engaged an additional 149 classmates, reaching a total of 214 local student participants since 2015. Their efforts have also inspired participation from over 1,350 community members –relatives, friends, and local residents– who contribute to and support project activities. The students received training in nesting monitoring and data recording at Las Bachas, where GNPD performs primary management activities, and later expanded their fieldwork to Tortuga Bay (south of Santa Cruz Island), a public site where the EEP is implemented. This hands-on, participatory approach enables local youth to contribute directly to ongoing sea turtle conservation actions. Since its inception, the EEP has increased fieldwork hours from under 50 to over 900 and facilitated the identification and protection of 292 nests. The main threats observed by participants include nest flooding from high surf, predation by feral cats, dune erosion caused by wind action and, on several occasions, heavy rainfall events, as well as exposure to marine debris –particularly microplastics (<5 mm)– and potential boat strikes during nearshore activity.

FROM THREATS TO ACTION: BUILDING A UNIFIED EDUCATION AND OUTREACH PROGRAM FOR SEA TURTLES AND THEIR HABITAT IN THE KINGDOM OF SAUDI ARABIA*

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Despite their ecological importance, sea turtle populations in the Red Sea have received little attention relative to other regions. Today, escalating multiple anthropogenic pressures are threatening sea turtles and reshaping the future of the five species frequenting Saudi Arabia's coastal waters. In addition, cultural restrictions and regulations have distanced many citizens from engaging with or valuing the marine environments. This social gap, coupled with environmental pressures, demands coordinated (inter)national action and tailored conservation strategies. Literature and empirical data demonstrate that, initially limited to traditional harvesting, sea turtle threats in Saudi Arabia intensified by the 1990s, when industrial growth and oil expansion drove coastal development, habitat degradation, fisheries interactions, bycatch, and plastic pollution. Recognition of their ecological role in the 2000s spurred protection efforts; yet current giga-projects and climate pressures now call for integrated conservation strategies spanning both terrestrial and marine habitats. Within this evolving context, the establishment of the General Authority for the Conservation of Coral Reefs and Sea Turtles in the Red Sea (SHAMS) represents a significant step toward improved national coordination and policy development. A major milestone was the 1st International Symposium for the Conservation of Sea Turtles in the Red Sea (2024, hosted by SHAMS), which convened local and global experts to produce the Conservation Management Plan - aligned recommendations, laying the foundation for Saudi Arabia's first unified education and outreach program. Recognizing the diversity

of ecological pressures, cultural contexts, socio-economic dynamics, and the social gap in Saudi Arabia's Sea turtle conservation efforts, education and outreach must be regionally tailored to ensure relevance and impact. Building on the outcomes of the first symposium, ongoing research collaborations, and coastal community knowledge, Saudi Arabia now has a unique opportunity to engage its youth—who represent nearly 67% of the population under 35 (GASTAT, 2020)—in marine conservation. SHAMS' strategy follows a comprehensive approach across four pillars: (1) Education—through a structured literacy approach under the Blue Schools Initiative, extending from elementary to university levels and supported by age-specific materials such as the Marine Turtle Guides; (2) Outreach & Community Engagement—through citizen science initiatives, the development of a national digital platform, and collaboration with the tourism sector to promote responsible coastal and marine activities; (3) Capacity Building—via field ranger, teacher, and student training; and (4) Cultural & Behavioral Change—promoting stewardship and facilitating knowledge exchange between communities, educators, and authorities. The emergence of a national educational and outreach program for sea turtles marks a transition towards integrated, participatory, and knowledge-driven action. It connects our strategy with broader objectives under Vision 2030, the Saudi Green Initiative, and international commitments under IOSEA, PERSGA, and the SDGs (4, 13, and 14). By integrating past achievements with cultural awareness into a forward-looking framework, SHAMS aims to promote a culture of stewardship across the Red Sea, empowering youth and communities to embed sea turtle and their habitats' conservation into everyday practice.

ZAPATILLA LA TORTUGA MARINA: THEATER AS A TOOL FOR ENVIRONMENTAL EDUCATION

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Zapatilla the sea turtle is an interdisciplinary effort by Ayotzintli AC, in collaboration with Pocus Locus on the artistic side, as well as with the community station to obtain materials for the set design and with hands that create for the production of costumes and set design. This was made possible with two important objectives: to raise awareness about the current situation of sea turtles in Baja Sur and around the world, and to bring a cultural option related to sea turtles to communities near the beaches. This production was made possible through the "Tercera Llamada" call for proposals from the Baja California Sur State Department of Culture. In this way, the issue of sea turtle preservation has transcended beyond nesting beaches and environmental projects. To date, we have presented 25 plays in schools, theaters, and public spaces in communities throughout BCS. In these plays, we have worked with approximately 1,850 children and 750 adults, and we have also reached more than 5,000 people through electronic media designed to be shared on social networks. In addition, the project has raised more than 40,000 Mexican pesos ($2,000 USD) that have directly supported our monitoring efforts in feeding areas on the islands of the Gulf of California.

TURTLEVR: STUDENT ATTITUDES TOWARD THE USE OF VIRTUAL REALITY IN SEA TURTLE CONSERVATION EDUCATION*

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As charismatic megafauna, there is tremendous interest amongst the general public in learning more about sea turtles, contributing to their conservation, and (sometimes aspirationally) having a personal experience interacting with these animals. After having experienced nature, individuals typically report greater subject knowledge and support for conservation initiatives. However, there are often regulatory, physical, logistical, and/or financial limitations to who or how many individuals can access such experiences at any given time. For example, the Sea Turtle Biology course taught at Florida Gulf Coast University is an upper-level undergraduate elective with a maximum enrolment of approximately 30 students. While previous research has demonstrated the value and efficacy of experiential and place-based educational opportunities, there are significant hurdles to providing such opportunities in-person including the size of the enrolment, timing of the course relative to the nesting season, transport logistics to various sites, and permit restrictions. The use of immersive technologies ("virtual reality" [VR] and "augmented reality" [AR] under the umbrella of "extended reality" [XR]) has the potential to overcome many of these limitations. To test the utility and efficacy of this technology, morning nest patrol activities during the 2025 season on Cayo Costa and Don Pedro Island State Parks in southwest Florida were recorded using an Insta360 Pro 2 spherical virtual reality camera. Content included orientations to the study sites, ride-alongs in the survey vehicle, track identification to species, common threats to incubating nests, and post-hatch inventory data collection. This content was then assembled into a ~5 min video viewable on a Meta Quest 3 headset to virtually "place" students into the role of a morning surveyor. After viewing, students were evaluated on two dimensions: their subjective experience with the technology using a pre-/post-experience survey, and their objective knowledge retention of key components of the course curriculum based on a written exam. Preliminary results suggest students are excited by the integration of immersive technologies in the classroom and the opportunities they present, despite logistical complications in its use such as the time and effort to fit each headset for a comfortable viewing experience or issues with synchronization of content playback. Most of the students had limited prior experience with VR technologies and expressed interest in assisting with additional content creation and applications. Quantitative assessments of short- and long-term knowledge retention compared to traditional educational approaches are still underway. With some refinement, immersive technologies hold tremendous promise for improving access to not only experiential and place-based educational opportunities for students, but broader outreach and personnel training opportunities as well.

Fisheries and Threats

DEVELOPING A NOVEL AND LOW-BUDGET UNDERWATER CAMERA SYSTEM TO ASSESS SEA TURTLE BYCATCH*

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Sea turtles are highly vulnerable to bycatch in passive fishing gear throughout the world's oceans. Although their bycatch in passive gear has been well-documented, their behavioral responses to fishing gear is poorly understood, particularly due to the limited availability of footage documenting these interactions. While cameras have been widely used to capture animal behaviors in various terrestrial environments, applications to study sea turtle behavior in marine environments and fisheries are challenging due to the constraints of saltwater, harsh weather, costs, and logistics. Moreover, commercially available products, such as GoPros, only record footage for four to five hours before needing to be recharged. To overcome these challenges, we designed, constructed, coded, and mounted a novel and low-budget underwater camera system to assess the behavior of sea turtles in and around pound nets at a sea turtle hotspot off the coast of North Carolina. For approximately 600 USD, our novel system has a similar cost to a GoPro and its underwater marine environment attachments. Our camera system was able to record for over 40 hours on one charge and successfully captured numerous instances of sea turtle behavior, including inter- and intraspecific interactions between species in the pound as well as interactions with the fishing gear itself. Our results demonstrate the value of developing low-cost conservation tools that can transcend commercial-grade technology to study the behavior of marine species.

DEVELOPING A PLASTIC POLLUTION EXPOSURE INDEX FOR THE LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) DISTRIBUTION IN THE GLOBAL OCEAN: A GEOSPATIAL APPROACH*

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Sea turtles are exposed to macro- and microplastics via entanglements and ingestion, particularly at risk during their pelagic life stage (especially in the great ocean gyres) and at nesting sites. Given the circumglobal distribution, feeding preferences and specific diet of the leatherback sea turtle (*Dermochelys coriacea*), this species is one of the most vulnerable marine chelonians exposed to plastic ingestion among all seven sea turtle species, and susceptible to contain high plastics levels in their gastrointestinal tracts,

highlighting the imperative need of conservation efforts to combat ocean plastic pollution as a priority for leatherbacks as recent modeling data suggest this species is most effective to accumulating plastic debris in its GI tract. Ocean plastics have become one of the most pervasive pollutants, posing a great threat to all marine megafauna. Sea turtles are not the exception, as these species can be exposed to plastics through direct intake via ingestion of waterborne macro- and microplastics or indirectly via dietary exposure to microplastic-contaminated prey (i.e., mainly jellyfish). Amidst the unprecedented oceanic abundance of floating plastic particles (averaging ~170 trillion plastic pieces), limited geospatial risk assessment data exist on plastic exposure effects on sea turtles. Here, we develop the macro- and microplastic pollution exposure index (MPEI) for the leatherback sea turtle using geospatial statistical tools (ESRI's ArcGIS-Pro 2.9.5) by mapping the species' distribution native range (baseline map) and the distribution with a modelled year 2050-native range map based on IPCC-Relative Concentration Pathway (RCP)8.5 high-greenhouse gas emissions scenario (from AquaMaps:https://www.aquamaps.org). This data was analyzed in combination with two datasets of the ocean microplastic concentration distribution (i.e., Litterbase and Global Microplastic Initiative), which were first standardized as two layers, rescaled using values from 0 to 1 to produce a Macro/Microplastic Concentration Index (MCI). Then, a microplastic bioconcentration factor (BCFMP) was also applied to relate the microplastics concentration in the main prey item, jellyfish [CMP-biota], to the seawater plastics concentration [CMP-water], assuming steady state and equilibrium (concentrations are equally distributed between marine biota/prey and seawater): BCFMP= [CMP-biota]/[CMP-water]= 1. Thus, solving for CMP-biota: [CMP-biota]= BCFMP*[CMP-water]. Within this premise, to identify the zones of lower or higher plastic exposure risk, the MPEI was calculated as the probability product of the leatherback distribution values multiplied by plastic pollution distribution (MCI), giving a value from 0−1, where a higher number indicates a higher risk of plastic pollution exposure. The baseline geospatial analysis to project the global distribution of microplastics revealed spatial concentration gradients exhibiting MPEI hot spots with values as high as 97.4% around the western, central, and eastern tropical/subtropical Pacific, Caribbean islands regions, central and northwestern Atlantic, North Atlantic gyre, and western Indian Ocean (waters off Africa's southeastern coast). Under the 2050-native range distribution with the IPCC RCP8.5 scenario, the MPEI for the leatherback was relatively influenced because of changes in the species distribution versus plastics exposure in these ocean regions. These findings contribute to understanding the microplastic ecotoxicological risks for leatherback sea turtle populations and inform international policy to conserve sea turtles in the face of changing oceans.

TRACE ELEMENTS IN THE LEATHERBACK TURTLE EGGS: AN INSIGHT INTO OCEAN POLLUTION IN THE EASTERN PACIFIC*

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The eastern Pacific population of leatherback turtles (*Dermochelys coriacea*) is critically endangered, and evaluating exposure to trace elements is essential for identifying potential sublethal threats to female health and reproduction. Due to their long life spans, extensive migratory ranges, and pelagic feeding habits, leatherback turtles can integrate contaminant exposure across large oceanic regions and transfer accumulated elements to eggs through maternal investment. In this study, we quantified trace element concentrations in egg contents of *D. coriacea* collected during the 2023–2024 nesting season from three index nesting beaches along the Mexican Pacific. One egg from each of 34 females was analyzed (16 neophytes and 18 remigrants). Trace element concentrations followed the pattern Zn > As > Cu > Pb > Cd

> Hg. Zinc, an essential element, exhibited the highest mean concentration (0.0105 ± 0.0041 µg/g), whereas mercury, a non-essential and potentially toxic element, showed the lowest values (0.000039 ± 0.000008 µg/g). Significant differences between female identities were detected. Zinc concentrations were higher in eggs from neophyte females (ANOVA, $p = 0.003$), while mercury concentrations were higher in eggs from remigrant females (ANOVA, $p = 0.027$), suggesting cumulative exposure associated with repeated reproductive cycles. Overall, trace element concentrations in leatherback eggs were lower than those reported for other sea turtle species worldwide, indicating relatively low contaminant burdens and suggesting limited trace element pollution in the eastern Pacific pelagic environment. These findings highlight maternal transfer as a key pathway for trace element exposure in leatherback turtles and support the use of egg contents as a non-invasive tool for long-term monitoring of marine pollution in critically endangered populations.

ASSESSMENT OF BYCATCH RISK FOR SEA TURTLES IN THE COLOMBIAN PACIFIC

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Colombia's Pacific waters provide important foraging and migratory habitats for four species of sea turtles—leatherback, hawksbill, olive ridley, and green turtles—all of which are vulnerable to fisheries interactions. Bycatch impacts are influenced by both fisheries characteristics (effort, gear, distribution) and biological traits (late maturity, long lifespan, distinct ontogenetic habitats). Despite this, Colombia remains a data-deficient region for sea turtle bycatch risk. To address this gap, we conducted standardized port-based surveys to assess the magnitude and nature of bycatch, as well as fishers' perceptions of management measures and regulations. Surveys were administered during three field visits (October 2024, January and June 2025), covering nine fishing ports across three areas (Saija, Timbiquí, and Guapi). In total, 129 interviews were completed using a structured questionnaire designed to minimize bias and ensure comparability across sites. Limitations include reliance on self-reported data, which may under- or over-estimate bycatch events and reflect sensitivities around compliance and enforcement. Fishers reported interactions with all four species: olive ridley ($n = 82$), green ($n = 43$), hawksbill ($n = 33$), and leatherback ($n = 4$). Approximately 28.7% of respondents acknowledged consumption of incidentally captured turtles. Extrapolation across fleets, based on reported effort, suggests an estimated annual bycatch of ~1,543 individuals, with variation among fleets. Binomial models were applied to explore relationships between bycatch and fishing gear, effort, season, and port group. The best-fit model included gear type, port group, and effort parameters ($Df = 6$, $AIC = 178.7$, Accuracy = 0.784), with good discriminatory power (ROC AUC = 0.780). Geographic differences among port groups were observed, while gear and effort were not significant predictors. These findings highlight the importance of location-specific dynamics, while also underscoring the need for caution in interpreting self-reported data and for continued refinement of survey methods. Our results emphasize the relevance of advancing bycatch mitigation programs across the Colombian Pacific, while carefully managing community relationships to avoid stigmatization of specific ports. This study contributes baseline information for national assessments, supports outreach with artisanal fishing communities, and lays the groundwork for collaboration with fisheries agencies and the Ministry of Environment.

A CITIZEN SCIENCE APPROACH TO STUDYING INJURY AND MORTALITY PATTERNS OF SEA TURTLES IN THE EGYPTIAN RED SEA

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Studies of the injury and mortality patterns of sea turtles are vital to understanding what is needed for threatened and endangered species to recover. The objective of this research was to use citizen science sourced data to study the anthropogenic and natural causes of mortality and injury to sea turtles in the Egyptian Red Sea. Our results suggest that anthropogenic factors were responsible for the majority of sea turtle mortality and injuries. Fishing was believed to be the major source of mortality, while boat strikes were the major source of injuries in live turtles and the second cause of mortality. Sea turtles near the largest city in our study, Hurghada, had higher boat strike rates, suggesting a coastal urbanization effect. There is intentional hunting and carapace scute harvesting of hawksbill turtles, an IUCN critically endangered species, within the largest city. Hawksbill turtles appear more vulnerable to coastal urbanization than green turtles, but both species are threatened with anthropogenic effects, especially during the nesting season. No turtles were observed at fish restaurants after 2015, showing the effectiveness of law enforcement and public awareness campaigns. This study represents the first assessment of mortality and injury patterns and provides a baseline to assess future changes in the intensity of anthropogenic disturbances in the Red Sea.

ANTHROPOGENIC AND NATURAL CAUSES OF SEA TURTLE STRANDINGS ON RÉUNION ISLAND (2001–2024): A 23-YEAR ASSESSMENT*

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Stranding events are a critical source of information on marine wildlife health and human–ocean interactions, and have gained increasing attention as an effective way to assess wildlife threats. This study compiles 23 years (2001–2024) of records from Kélonia's Sea Turtle Care Centre to quantify the anthropogenic and natural causes of strandings and to examine trends and key threats affecting sea turtle populations on Réunion Island (South-west Indian Ocean). A total of 171 cases were analysed, including turtles found stranded ashore or recovered drifting nearshore. Each case was documented using a comprehensive approach combining field observations, clinical assessments, radiographic imaging, and laboratory analyses (haematology, bacteriology, coprology), as well as necropsies when relevant. Green

turtles (*Chelonia mydas*) accounted for 60% of all cases, followed by hawksbills (*Eretmochelys imbricata*, 35%). Loggerheads (*Caretta caretta*) and olive ridleys (*Lepidochelys olivacea*) represented just 5% combined. Most strandings (82%) involved juveniles, and over half of all turtles (56%) were recovered alive, mainly along the western coastline, where maritime traffic and human presence are concentrated. Anthropogenic causes predominated: vessel strikes (27%), pollution (23%, i.e., entanglement in ghost gear, plastic ingestion, and hydrocarbon exposure), hook ingestion (10%), and poaching (6%). Natural causes (e.g., predation) and disease accounted for 26 % of cases, while 8% remained undetermined. Importantly, turtles stranded ashore were about 2.5 times more likely to be found dead than those recovered in nearshore waters ($p < 0.05$). Moreover, both total strandings and anthropogenic strandings increased steadily and significantly over time (5.5% and 6% per year, respectively; both $p < 0.001$), without any clear seasonal pattern. These parallel trends are consistent with rising human activity at sea, a slowly growing sea turtle population, and improved public awareness and reporting. Despite this overall increase, the proportional contribution of anthropogenic causes showed no significant long-term trend ($p > 0.05$). Since 2018, however, anthropogenic factors have consistently represented more than 60% of annual cases, pointing to a recent predominance despite strong interannual variability. Average rehabilitation success reached 57.3% ($n = 96$), with significant variation depending on the cause of admission ($p < 0.001$). To integrate mortality occurring prior to rescue, a comprehensive survival rate (CSR) including turtles found dead before admission was calculated at 32% ($n = 171$). Notably, vessel strikes emerged as the most severe threat, being a leading cause of stranding and associated with the lowest CSR (<11%; $n = 47$). In fact, some injuries result in immediate mortality or are so severe that they prevent any possibility of recovery. This long-term dataset provides valuable insights into the impact of human activity on local sea turtle populations. Findings from rehabilitation and necropsy data have directly shaped management and outreach initiatives, including proposals for speed-limit zones, ghost-gear removal campaigns, and community education programs. By turning clinical observations into measurable indicators of coastal threats, this 23-year study reinforces rehabilitation centres as sentinel observatories for marine megafauna. It demonstrates how health and conservation data can drive evidence-based management in the South-west Indian Ocean.

BOAT TRAFFIC: FREQUENCY OF VESSELS IN THE ST. AUGUSTINE, FLORIDA, USA INTRACOASTAL WATERWAY

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In Northeast Florida, one of the leading causes of death among sea turtles is boat strikes. It is estimated that 20 to 30 percent of mortality is from interactions with boats, resulting in hundreds of deaths yearly. When sea turtles' surface to breathe, bask, or forage food, their hearing and vision are restricted, leaving them vulnerable. In St. Augustine, there is a large juvenile green sea turtle population. They come into our waterways to feed on the abundant resources that the slower moving water provides. This also means fishermen and recreational boaters prefer these areas over the open ocean, resulting in frequent interactions between boaters and feeding turtles. As more boats enter the waterways due to factors such as population growth and increased popularity of boating clubs, the number of interactions increases, thus, increasing the likelihood of fatalities. Starting in September 2025, three areas within the Intracoastal Waterway in St. Augustine, FL were monitored with a GoPro 12 Black. These areas are close by marinas, are popular fishing, and recreational boating areas; they also have had frequent sea turtle sitings. The surveys were conducted every Monday or Tuesday, Friday, and Saturday, or Sunday. Video was recorded once between 8AM and 11AM and once between 2PM and sunset for between 20-30 min, based on battery life. Each boat was counted for frequency per location, making special note of violations of minimal wake zones.

The data was then translated into average boats per hour for analysis. Which includes a t-test, temperature versus boats analysis, boats by day type analysis, and a boat by month/season analysis. We currently have 825 minutes of video data comprised of 35 surveys from Sept 26- Dec 2 and Jan 9 –Jan 27 and will continue until Feb 9, hoping to continue the project into the rest of the year. We found boat traffic on the weekends Fri-Sun averaged per hour (13.5 ± 4.5) was slightly higher on average than the weekdays Mon-Tues (3.8±3.6), although the standard deviation was high for both sets of data. This spread in data was likely due to the weather and sea conditions that impact boating as well. Several instances of high-risk behavior from boaters were recorded in shallow water areas, e.g. high operating speeds in minimal wake zones which could lead to a higher instance of sea turtle strikes. Data from this project will be compared to data from the Whitney Sea Turtle hospital to determine if there are seasonal patterns of boat strikes present and whether there is a correlation between all data collected. The sea turtle strike data over the past 10 years will also be analyzed in comparison to data on the increase in boaters that has been observed in the past decade. Our goal of implementing boating risk times will be determined by the collected recordings and Whitney Sea Turtle Hospital data. Allowing for better public awareness of sea turtles in the St. Augustine area and preventing future causalities.

GLOBAL OVERVIEW OF THE RELATIONSHIP BETWEEN HUMAN POPULATION SIZE AND BOAT STRIKE INJURY RATES IN SEA TURTLES

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Increasing coastal urbanization represents a substantial threat to sea turtle populations globally. As human populations increase along coastlines, the frequency of interactions between vessels and marine wildlife may conceivably increase as well. The objective of this study was to conduct a literature review to examine the relationship between human population size and boat strike injury rates in sea turtles. For each study, we recorded species, year, injury rates from live and stranded turtles, nearest city, and country. For studies spanning multiple years, we used the mean population size of the study duration. When a single boat strike rate was reported for multiple cities, their populations were combined. Studies reporting boat strike rates across large geographic or undefined areas were excluded. We also excluded studies of injury rates of nesting populations, rates reported from rehabilitation centers, rates that were not differentiated from other anthropogenic sources of injury, and sample sizes of less than 10. We then recorded the state or country's mean GDP per capita. We reviewed 100 published studies in which 15 articles met the criteria, yielding 13 data points for injury rates of live turtles and 19 data points for stranded turtles between 1983 and 2024. We found a statistically significant but weak positive relationship between human population size and boat strike injury rate in live turtles. We also found a weak but positive relationship between GDP and boat strike rates in stranded turtles, while we found a decrease in boat strike injury rates in countries with lower GDP. These findings suggest coastal development contributes to sea turtle strike risk, but the low r2 values suggest that other attributes of human lifestyle may contribute to boat strike rates. For example, countries with higher GDP had higher rates of turtle strandings attributed to boat strikes, likely due to high vessel density and larger and more powerful recreational boats. In addition, aspects of sea turtle ecology could potentially influence boat strikes, such as habitat accessibility, proximity to nesting or foraging grounds, study season, and marine protection status. *Caretta caretta* exhibited the highest average boat strike injury rate in live turtles, and *Lepidochelys kempii* exhibited the highest average rate for collision-related strandings. The feeding ecology of these species may contribute to their vulnerability, as both commonly forage in shallow, near-shore habitats that are readily accessible to boats. As coastal urbanization increases, it is vital to maintain and follow best practices to reduce vessel-related injuries to marine wildlife. Boating

regulations, including speed restriction zones and vessel design modifications, are crucial developments for sea turtle conservation.

FLASHING SOLAR-POWERED LIGHTED POUND NETS REDUCE SEA TURTLE BYCATCH*

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Pound nets, a globally important passive fishing gear, are known to incur high bycatch of sea turtles. However, the development and testing of bycatch mitigation technologies in pound nets is extremely limited. Here, we tested the effects of flashing, solar-powered green lights on sea turtle bycatch in Core Sound, North Carolina across 111 trials with over 2,500 hours of fishing effort. These trials represent the first assessment of flashing and solar-powered pound net illumination. Using generalized additive models (GAMs), we found a 38% significant predicted reduction in mean sea turtle bycatch per unit effort (BPUE = no. sea turtles per 24 hrs.) in lighted pound nets (control = 1.22 ± 0.10, lighted = 0.76 ± 0.06, predicted mean BPUE ± SE, p = 0.002, n = 106). By species, we found a 43% significant predicted reduction in green turtle BPUE (control = 0.76 ± 0.05, lighted = 0.43 ± 0.03, p = 0.017, n = 64 turtles), a 43% non-significant predicted reduction in Kemp's ridley turtle BPUE (control = 0.19 ± 0.02, lighted = 0.11 ± 0.01, p = 0.445, n = 16 turtles), and a 18% non-significant predicted reduction in loggerhead turtle BPUE (control = 0.27 ± 0.03, lighted = 0.22 ± 0.02, p = 0.337, n = 26 turtles) in flashing solar-powered lighted pound nets. Furthermore, we found a 65% non-significant reduction in recaptured sea turtles (i.e., any turtle previously captured during trials, control = 0.21 ± 0.004, lighted = 0.07 ± 0.001, p = 0.076, n = 15 turtles) and a 30% significant reduction in newly captured turtles (control = 0.95 ± 0.09, lighted = 0.67 ± 0.07, p = 0.006, n = 87 turtles). We also found a 40% significant predicted reduction in elasmobranch (i.e., shark & ray) BPUE (control = 0.59 ± 0.04, lighted = 0.36 ± 0.03, p = 0.045, n = 51) in flashing solar-powered lighted pound nets. Our results provide the first evidence that flashing solar-powered lights can reduce sea turtle and elasmobranch bycatch in coastal pound net fisheries and justify further research in other high-bycatch pound net fisheries.

ASSESSING THE RELATIONSHIP BETWEEN EPIBIOTA COVERAGE, BLOOD PARAMETERS, AND ANTHROPOGENIC LOAD IN MARINE TURTLES OF NORTHWEST FLORIDA

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Sea turtle health and survival is greatly impacted by marine debris such as plastics and fishing gear, water pollution, bycatch and climate change. One understudied aspect of sea turtle health is the presence and

quantity of epibiotic coverage. Epibionts are observed in large quantities on sea turtles that are traditionally stranded, i.e. found washed up on shore or floating at the surface. However, even less studied are the epibionts on incidentally captured sea turtles at recreational fishing piers. The objective of this study was to characterize epibiont coverage on the carapaces of three sea turtle species (*Caretta caretta*, *Lepidochelys kempii*, and *Chelonia mydas*), and to assess potential correlations between epibiont and anthropogenic load with overall health indicators, as measured by blood parameters. A higher percent coverage of epibionts is a potential indicator of reduced activity, prolonged debilitation, and a lengthy rehabilitation period. Preliminary observations suggest that sea turtles with internal fishing gear tend to exhibit a greater percent concentration of epibiont coverage as well as lower packed cell values and total solids values which may indicate anemia, dehydration and other health concerns. These findings aim to gain a more comprehensive understanding of anthropogenic impacts, contributing to the growing body of evidence that interactions between sea turtles and fishing piers have both direct and indirect effects on sea turtle health. Beyond the initial harm, these impacts manifest as measurable alterations in blood parameters and increased epibiotic colonization, both of which may serve as useful indicators for health and rehabilitation success, especially as these threats persist in the environment. Data for this study were provided from the Gulfarium Conserve Act Rehabilitate Educate (C.A.R.E.) Center located on Okaloosa Island, Florida.

POTENTIAL REVERSAL OF MARINE PLASTIC BAG TRENDS REVEALED BY LITTER INGESTION IN LOGGERHEAD TURTLES (*CARETTA CARETTA*)

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Plastic pollution represents one of the most pervasive environmental challenges of our time, posing severe risks to marine ecosystems and wildlife. Among the affected species, the loggerhead sea turtle (*Caretta caretta*) is particularly vulnerable due to its opportunistic feeding behaviour and frequent interaction with floating debris. Explicitly included by the European Commission in Decision (EU) 2017/848 under the Marine Strategy Framework Directive (MSFD), *C. caretta* provides valuable insights into the temporal and spatial dynamics of marine litter in the Mediterranean basin. Within this context, and in line with the objectives of the Horizon Europe REMEDIES project—aimed at preventing, monitoring, removing, and recycling plastic waste from rivers and marine environments—long-term monitoring activities have been intensified to better understand the evolving nature of plastic pollution and its ecological implications. In this study, we present recent data (2019–2025) on litter ingestion by *C. caretta* individuals found stranded, exhibiting abnormal buoyancy or by-caught along the coasts of Sardinia, (western Mediterranean sub-region). This work is part of the national monitoring activities carried out under national MSFD implementation agreements coordinated by ISPRA, ensuring methodological consistency and comparability across Italian marine regions. Standardized MSFD protocols were applied. A total of 120 turtles were examined, revealing a plastic ingestion frequency of 57.5 %. Compared to previous scientific literature from Tyrrhenian Sea (2008–2017), our findings highlight a potential inversion in the typology of ingested litter, with plastic fragments (USE-fra) now exceeding in number sheet plastics (USE-she), which historically represented the dominant category. To investigate whether a temporal trend exists, two Spearman rank correlation tests were applied using data from 2019 to 2025, one for sheet abundance and

one for fragment abundance. Although not statistically significant, the results highlighted a negative trend in sheet (Spearman's rho = −0.464, p = 0.294), but not in fragments abundance (Spearman's rho = 0.216, p = 0.641). This inversion suggests ongoing transformations in the sources, environmental fate, and degradation of plastic debris in the area, potentially linked to changes in waste management practices, the implementation of the Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment, and the cumulative effects of mitigation initiatives such as the REMEDIES project. These results reinforce the role of *C. caretta* as an effective sentinel species for detecting shifts in marine litter composition over time. Overall, the observed potential inversion between sheet plastics and fragments represents a significant ecological signal that mirrors both evolving pollution patterns and the early outcomes of targeted mitigation actions. Integrating biological monitoring with large-scale environmental initiatives such as Horizon Europe REMEDIES provides a comprehensive framework for assessing the effectiveness of current policies and advancing innovative solutions for plastic prevention, removal, and circular recovery in the Mediterranean basin.

SEA TURTLES SAVING SHARKS: A GLOBAL REVIEW OF ELASMOBRANCH BYCATCH MITIGATION IN SHRIMP TRAWL FISHERIES EQUIPPED WITH TURTLE EXCLUDER DEVICES

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In 1989, the National Marine Fisheries Service mandated the use of Turtle Excluder Devices (TEDs) in shrimp trawl fisheries operating in U.S. federal waters to mitigate sea turtle bycatch. Although TEDs have been remarkably effective at reducing sea turtle bycatch, their capacity to reduce bycatch of other vulnerable species remains largely unassessed. Like sea turtles, elasmobranchs (sharks, skates, and rays) are a globally threatened taxa whose slow life histories and susceptibility to interactions with fisheries have resulted in population declines in several species. Here, we assess the effects of TEDs on reducing elasmobranch bycatch in shrimp trawl fisheries worldwide. Our analysis encompassed 17 studies that covered 84 species and 26 families across four ocean basins. We included publications with both quantitative and qualitative reporting to assess the global distribution of elasmobranch interactions with TEDs. Notably, the majority of studies (N = 13) either preferentially reported reduction percentages for other species (such as sea turtles) or neglected to provide numerical data at all. Among those reporting explicit values (N = 4 studies), we found TEDs successfully reduced elasmobranch bycatch from 13% to 100% across all taxa. We emphasize the inconsistent reporting of quantified reduction percentages as both a conservation concern and a future avenue for conservation research and action.

SPATIOTEMPORAL ANALYSIS OF HAWAIIAN GREEN SEA TURTLE (*CHELONIA MYDAS*) STRANDINGS ON MAUI, HAWAII (2017-2024)

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The University of Arizona

Geographic Information Systems (GIS) enable visualization and analysis of datasets to reveal spatial and temporal patterns that inform conservation strategies, identify emerging threats, and improve our understanding of ecosystem dynamics. This study explores spatiotemporal patterns in the Hawaiian green sea turtle (*Chelonia mydas*) strandings and entanglements along the Maui coastline from 2017 to 2024, using data that was collected by the Marine Institute of the Maui Ocean Center (MOCMI) and made available through the National Oceanic and Atmospheric Administration (NOAA) Fisheries. Using this data, 1,297 strandings of Hawaiian green sea turtle were analyzed. Esri ArcGIS Pro was used to conduct Hot Spot analysis using the Getis-Ord Gi* statistic to determine spatial clustering of turtle strandings along the Maui coastline. Counts and percentages by age classes, region, and stranding causes were also calculated using summary statistics tools available in ArcGIS Pro. These results were visualized to create cartographic products that revealed spatial patterns along the Maui coastline. The majority of strandings involved sub-adults (36.1%) and juveniles (36.8%), followed by adults (23.1%). Hot Spot Analysis revealed spatial clustering of strandings with two hotspots along the central Maui coastline, four hotspots along the western coastline, and four hotspots along the southern coastline. Hot Spot Analysis also revealed the age distribution along Maui's coastline, showing a significant cluster of adults, sub-adults, and juveniles in different regions. The central coastline region shows the highest concentration of adult sea turtle hotspots (six locations); the western coastline had the highest hotspot for juveniles (eight locations), while the southern coastline has a mixture of all three age-groups (seven juvenile clusters and six adult/sub-adult clusters). The south region of the Maui coastline exhibited the highest stranding counts across all age classes, especially sub-adult (316) and juvenile (304) turtles. The western region was dominated by juveniles (120), followed by sub-adult turtles (99). The central region showed moderate strandings, especially among adults (75). Only two strandings were recorded along the eastern coastline of Maui. Fishing line entanglement was the leading cause of strandings (48.5%), followed by foul-hooked (22.2%). Overall, GIS tools effectively revealed spatial and demographic patterns in sea turtle strandings, providing actionable insights for conservation planning. These findings can inform targeted conservation actions, habitat protection, public awareness campaigns, and resource allocation. Future work should address data gaps in underreported regions, evaluate long-term injury outcomes, particularly in juvenile and sub-adult populations, and assess the impacts of human activities on turtle health and distribution.

LONG-TERM IMPACTS OF INTRODUCED PREDATORS ON GREEN SEA TURTLE NESTING BEACHES ON ULITHI AND SOROL ATOLLS IN YAP STATE, FEDERATED STATES OF MICRONESIA*

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Green Sea Turtle (*Chelonia mydas*) populations nesting on Ulithi and Sorol Atolls, Federated States of Micronesia, face significant recruitment challenges due to nest predation from introduced species, primarily monitor lizards, feral pigs, and rats. Historical nest predation rates on impacted islands have

exceeded 85%. This study uses long-term nesting data (1991–2025) from two beaches on Ulithi Atoll: Loosiep Island, which has been affected by introduced predators, and predator-free Gielop Island to quantify predation dynamics and evaluate the effectiveness of management interventions. Limited nesting observations from Sorol Island collected during 2024–2025 are included to document current nesting conditions and predation presence. The Bennett's Long-tailed Monitor (*Varanus bennetti*), endemic to parts of Micronesia and the Mariana Islands, was introduced to Loosiep and Sorol Islands during the 1940s–1950s. Using nesting data collected on Loosiep Island from 2008–2024, we compare nest predation rates before and after feral pig (*Sus scrofa*) removal and during monitor lizard eradication efforts (2019–2025), integrating predator demography to assess impacts on nest survival. Results indicate that pig removal substantially reduced peak historical nest loss (from ~86% to ~63%); however, overall nest survival remained low where monitor lizards and rats (*Rattus spp.*) persisted. Predation followed a bimodal temporal pattern: an early-incubation phase dominated by V. bennetti acting as a keystone excavator, followed by a late-incubation phase characterized by secondary scavenging. Partial predation by monitor lizards functions as the primary disturbance by opening nests and triggering secondary mortality via microbial contamination, altered nest microclimate, and facilitated access by scavengers (e.g., crabs). Rats further contribute to ecosystem degradation by suppressing seabird nesting, reducing nutrient subsidies that support vegetation, sediment stability, and invertebrate communities that influence the quality of sea turtle nesting habitat. A community-driven Integrated Pest Management (IPM) strategy was implemented on Loosiep Island, centered on targeted removal of nest predators and long-term biosecurity measures to protect nesting habitat. This approach has shown clear initial success: near-complete eradication of the monitor lizard population by 2025 coincided with the absence of detected nest predation and a significant improvement in nest survival. These findings demonstrate the feasibility and substantial conservation benefit of transitioning from short-term predator control to permanent protection of nesting beaches on small, bounded island systems. Extension of this eradication and biosecurity framework to Sorol Island and other impacted rookeries is recommended to enhance hatchling production, improve recruitment potential, and support long-term recovery of green sea turtle nesting populations.

AN EFFECTIVE FRAMEWORK TO UNDERSTAND MARINE MEGAFAUNA BYCATCH IN WEST AFRICA FROM STRANDINGS*

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Bycatch mortality is a major threat to marine megafauna worldwide. The on-going REDUCE project aims to increase knowledge and mitigate bycatch impacts on marine megafauna in the Central-Eastern Atlantic, using a variety of data including fisheries observers, fishers interviews, and animal tagging. Here we present an initiative to assess and, where possible, improve the potential for collecting information about bycatch mortality from stranding events. This initiative aims to establish a robust, effective and independent long-term framework to monitor stranded marine megafauna for a better understanding of the potential threats faced, based on a collaborative effort. Robust data collection will be pursued by creating a strong, stable and extensive network of stakeholders collecting information from strandings. Effectiveness is sought by learning from stakeholders and promoting information exchange, incorporating similar ongoing local and external initiatives, and providing logistical support for data and sample collection. Independence is sought by adapting data collection methods to local constraints, reinforcing capacity building, and strengthening communication. Initial individual and collective meetings with 22 stakeholders from 15 countries in the Central-Eastern Atlantic, have provided information on the current stranding systems, information collected and methods used, and the main limitations. Systematic collection

of basic data (e.g. species, location, dates and photographs) are common, but collection of relevant information for diagnosing the cause of a stranding or death and the later assessment of species and population status, is rare. Despite the differences found, there is a common and strong willingness to improve data collection from strandings. Therefore, we have created a collaborative repository with public material to support an optimised data collection from stranding events taking into account varying capacity levels (i.e., from species identification guides to detailed necropsy and sampling protocols for diagnosis of cause of death), with a private section for partners to share their own protocols and datasheets. This facilitates our evaluation of the harmonisation of current methods, for the later adaptation and development of necessary resources and training materials to promote harmonisation without "re-inventing the wheel", as well as ensuring adaptability, integrability and implementation, thereby building on a foundation of shared community knowledge. Furthermore, a characterization of the potential of stranding attendance systems as tools for monitoring the status of and impacts on marine megafauna populations in the Central-eastern Atlantic is underway, directly informed by stakeholders. These steps are already yielding results, with new data and samples being collected in several locations using adapted existing protocols. Until the REDUCE project concludes in December 2027, we hope to make the community collaborations stronger and effective, to support an independent network of organisations with increased potential to assess the impact of bycatch and other threats on marine megafauna.

LONG-TERM WILD RECOVERY AND RESILIENCE OF GREEN TURTLES TO VARIOUS ANTHROPOGENIC INJURIES*

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Anthropogenic injuries are widely reported in marine turtles, and efforts to promote recovery through treatment at rehabilitation centers have proven important. However, resilience and recovery trajectories of turtles healing in situ without intervention remain poorly quantified. We used repeated in-water photographic sightings to document natural injury recovery in green turtles at a coastal foraging ground around Liuqiu Island, Taiwan. Drawing from two photo-identification databases spanning 14 years, we identified 105 injured turtles among ca. 7200 sightings (709 individuals). External injuries (active or healed) were recorded for 105 turtles (13.3%; 104 green turtles and one hawksbill turtle). Primary injury causes were unknown (67.6%), fishing-line entanglement (17.1%), and propeller strike (15.2%). At the last recorded condition, 80.0% of injured turtles were fully healed, 7.6% partially healed, 6.7% freshly injured, and 5.7% were subsequently documented dead with injuries presumed causal. Healing stages were assigned from images using standardized visual criteria: "fresh" injuries showed open lesions; "partially healed" injuries showed tissue regeneration and incomplete closure; and "healed" injuries showed complete closure without inflammation/necrosis and regrowth/keratinization of scutes or soft tissue. Thirteen turtles with 19 injuries had multiple re-encounters, allowing for estimation of healing durations. Average healing times were 527 days (propeller strikes), 538.5 days (fishing line entanglements), and 560.2 days (injuries of unknown causes), with severe injuries requiring ca. 600 days and minor injuries ca. 491 days to heal. Recovery trajectories in wild green turtles were slower than those reported for other marine megafauna. Long-term resightings of five individuals confirmed survival after recovering from severe injuries of at

least 106 to 2264 days. These results provide long-term field evidence that natural recovery from external injuries in wild green turtles commonly requires about 1.5 years to hear. Moreover, approximately 10.5% of injured turtles suffered recurring injuries from propeller strikes, emphasizing the need for targeted conservation measures, including go-slow zones, recreational fishing regulations, and public outreach. This study highlights the value of long-term monitoring, supported by citizen scientists, in assessing sublethal impacts and guiding mitigation for marine megafauna.

NAVIGATING DANGEROUS WATERS: A MULTIFACETED APPROACH TO ASSESS THE IMPACTS OF VESSELS ON SEA TURTLES*

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Sea turtles often inhabit shallow coastal waters that experience boat traffic, leading to frequent interactions between turtles and vessels. Such interactions can result in injury or mortality and may also induce behavioral and physiological changes that increase energy expenditure, reduce fitness, or cause displacement from critical habitats. Although the direct effect of vessel strikes on sea turtles are well

documented, the overall magnitude of both lethal and non-lethal impacts remains poorly understood due to limited direct observational data on collisions, behavioral responses, and resulting mortality rates. In this study, we integrate multiple analytical approaches to quantify the lethal and non-lethal effects of vessel interactions on sea turtles across U.S. Atlantic and Gulf coastal waters. Lethal impacts were assessed by examining spatiotemporal trends in stranded sea turtles exhibiting vessel strike injuries (VSI) from 2010 to 2022. Non-lethal impacts, including changes in movement patterns, displacement, and energy expenditure, were evaluated using data from biologging devices (satellite telemetry and Customized Animal Solutions tags) and drone-based behavioral observations collected at a coastal foraging ground that supports an active recreational scallop fishery. Our results indicate that the occurrence of VSI is substantial, encompassing approximately 25% of all stranded turtles along the Atlantic and Gulf coasts of the USA. Green turtles and loggerheads accounted for most VSI cases, particularly in Florida and Texas, with statistically significant spatial clusters of strandings detected throughout the study region. Kemp's ridleys with VSI were concentrated in Florida, Virginia, Mississippi, and Texas, while most vessel-struck leatherbacks were documented in Massachusetts. Species-specific spatiotemporal trends in strandings with VSI were characterized, providing a foundation for identifying high-risk regions and prioritizing conservation actions. Biologging data revealed that satellite-tagged turtles exhibited larger home ranges and more frequent, faster movements during the scallop harvest season relative to non-harvest periods, suggesting behavioral adjustments linked to increased vessel activity. Fine-scale analyses from CATS Cam deployments demonstrated distinct responses to vessel passes. During the scallop season, mean dynamic body acceleration (DBA) decreased by 21% during dives coinciding with vessel detections compared to undisturbed dives, and post-dive surface intervals were 34% shorter following vessel passes. Outside the scallop season, differences in dive DBA between disturbed and undisturbed dives were minimal; however, post-dive surface intervals were longer when vessels were present. Complementary drone observations further confirmed that turtles modulate their responses depending on vessel proximity and position. Collectively, these findings indicate that vessel interactions impose both direct (lethal) and indirect (behavioral and energetic) consequences for sea turtles in coastal habitats. By integrating spatial, behavioral, and physiological datasets, this study enhances understanding of how vessel traffic influences sea turtle ecology and provides a scientific basis for developing targeted, region-specific management strategies aimed at mitigating vessel-related impacts in high-use coastal zones.

KILLING ME SOFTLY: THE HIDDEN THREAT OF SOFT PLASTICS ON JUVENILE GREEN TURTLES*

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The impacts of plastic ingestion on marine turtles are diverse, ranging from undetectable to lethal. Their severity depends on the volume and characteristics of the ingested plastics, as well as on turtle life stage, feeding behavior, and overall health status. Understanding these impacts and the underlying processes is central to assessing marine turtle vulnerability to the plastic pollution threat. This study examined a representative sample of juvenile green turtles from Uruguayan waters (n=150), obtained from multiple sources, including strandings, bycatch, rescues, and research captures. Individuals were categorized according to their level of impairment caused by plastic ingestion using an impact severity index (IPS 0 - 3), and their susceptibility was evaluated in relation to the volume and characteristics of the ingested

plastics. The analysis revealed a strong positive relationship between the cumulative volume of ingested plastic and the severity of impact. Soft laminar plastics, the most frequently ingested item, emerged as the most hazardous category. Their pliable characteristics enable turtles to swallow large pieces beyond the physical constraint of the mouth gap. Once in the intestines, these pieces act as meshes, entangling additional plastics and organic material, leading to the compaction of fecalomas. In our study, these obstructions resulted in emaciation and chronic debilitation syndrome in impacted turtles (n=14), alongside fatal outcomes in the most severely affected individuals (n=10). A critical finding is the existence of an 'accumulative side effect'. Turtles experiencing obstruction, even with reduced appetite, continue to feed but are unable to defecate. This leads to progressive retention of plastics and explains the disproportionately high plastic loads observed in impacted turtles (n=24), which accounted for 88% of the total volume of plastic retrieved (724,074 mm^3), whereas non-affected individuals (n=82) consumed the remaining 12% (114,886 mm^3). This marked disparity hampers efforts to define precise dose–response thresholds for health impairment. Age class and feeding behavior also influenced ingestion susceptibility in the individuals examined. Juveniles with a curved carapace length below 40 cm were more prone to severe impacts. Their higher vulnerability is likely linked to a relict opportunistic foraging behavior exhibited during recruitment to neritic habitats and before the ontogenic shift to herbivory. These smaller turtles, therefore, are more exposed to a broader range of plastics and ingestion of larger volumes. Overall, the findings demonstrate that both the volume and physical characteristics of ingested plastics are critical predictors of the severity of impact in sea turtles. Further research is needed to better understand the processes that lead from subclinical ingestion to severe degeneration, which remains particularly challenging due to ethical constraints on experimental studies with marine turtles. These findings highlight the vulnerability of turtle early life stages to plastic ingestion, which could be affecting the viability of certain populations, such as green turtles in the Southwestern Atlantic.

TRAPPED, CAUGHT, AND GHOSTED: HOW ACTIVE AND LOST FISHING GEAR IMPACT CRITICALLY ENDANGERED LEATHERBACK SEA TURTLES IN THE PACIFIC*

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Fisheries interactions with critically endangered Pacific leatherback sea turtles (*Dermochelys coriacea*) on the U.S. West Coast threaten the species' recovery and undermine protections provided to endangered species by federal and state laws. The latest scientific research models a continued decline in the adult female population of West Pacific leatherbacks nesting at Jamursba Medi and Wermon beaches, which are the primary nesting locations.1 Efforts to reduce bycatch and entanglement risk in fisheries often address when, where, and what type of fishing gear are used by fishery participants. Yet, gaps in fisheries management practices allow threats from abandoned, lost, or derelict fishing gear to persist. This presentation reviews population estimates for West Pacific leatherback sea turtles, analyzes entanglement data and lost fishing gear rates in fisheries in U.S. Pacific waters and explores how new regulations and existing environmental laws can address bycatch and entanglements. At all life-stages, leatherback sea turtle populations face threats from human activities. Habitat loss, nesting site degradation, fisheries bycatch, and egg harvesting impact leatherback sea turtle population recovery. Recent estimates find that the female adult leatherback population nesting at Jamursba Medi and Wermon beaches would decline to 50% of their 2017 abundance by about 2030 and to 25% of their 2017 abundance by about 2041, assuming a continued mean decline of 6% per year since 2017.2 According to the National Marine Fisheries Service, Pacific leatherbacks' most significant threat is becoming bycatch in foraging areas, migratory corridors, and off nesting beaches.3 State and federal agencies have implemented regulations to seasonally prevent active fishing in leatherback sea turtle critical habitat areas; however, threats in these areas persist due to

the presence of lost and abandoned fishing gear. Active and lost fishing gear directly contribute to serious injury and mortality of Pacific leatherback sea turtles via entanglements and ingestion, making it key for regulatory bodies to introduce management measures that limit fishing gear in leatherback critical habitat areas off the U.S. West Coast. Several state and federally managed fisheries off California, Oregon, and Washington authorize the use of fishing gear that causes leatherback sea turtle entanglements. Commerical Dungeness crab fisheries on the U.S. West coast have an estimated annual gear loss rate between 5% and 10% which equates to approximately 7,000-14,000 lost pots annually.4 American Samoa and Hawai‘i deep & shallow set longline fisheries lose approximately 5,714 hooks and monofilament branchline per hooks set annually. Minimizing gear loss through gear recovery programs, punitive or compensatory actions that disincentivize gear loss, and improved trap loss reporting can help reduce bycatch risk in leatherback sea turtle critical habitat areas which can move fisheries towards compliance with the federal Endangered Species Act. Infrequent and perfunctory biological opinions and analyses as well as insufficient regulations have allowed for risks to Pacific leatherback sea turtles to remain in West Coast fisheries. Implementing science-based solutions that address entanglements in active and lost fishing gear and ensuring compliance with state and federal conservation laws are critical to protecting Pacific leatherback sea turtles from further population declines.

A POTENTIAL 'WIN-WIN' SOLUTION: NET ILLUMINATION MAINTAINS A DIVERSE TARGET FISH CATCH AND MAY REDUCE BYCATCH AT A GLOBAL LEATHERBACK HOTSPOT*

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Coastal gillnets are among the most widely used fishing gear worldwide due to their high catch yields and relative ease of use, particularly in small-scale fisheries of developing nations. In Trinidad and Tobago (T&T), high levels of bycatch in artisanal gillnets off high-density leatherback nesting beaches is a major threat to the largest remaining nesting population in the Northwest Atlantic. Over the past decade, illuminating gillnets with artificial light has shown promise in reducing sea turtle bycatch while maintaining target fish catch in multiple coastal gillnet fisheries worldwide. With support from the T&T Fisheries Division, Future Fishers, and REBYC-III / CLME+, we collaborated with local gillnet fishers to conduct a net illumination study in surface-drift gillnets during the leatherback nesting season in 2024 and 2025. Across 60 fishing days, our results indicate that leatherback bycatch was reduced overall by approximately 59% in illuminated nets relative to control nets; however, highly variable and relatively low bycatch rates limited the power of the statistical analyses. Aggregate target catch rates (by weight and by estimated revenue) consisting of 40 species did not vary with illumination treatment. Participating fishers noted that the lights made releasing leatherbacks easier, resulted in less damage to their gear, and resulted in safer fishing operations due to the reduced severity and number of turtle entanglements. This study marks a pivotal step in a collaborative, long-term process to implement effective bycatch reduction strategies that support fisher livelihoods while reducing impacts of gillnet fishing at a global leatherback bycatch hotspot.

SEA TURTLE MORTALITY IN QUEENSLANDS SHARK CONTROL GEAR

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Incidental capture (bycatch) in shark control nets remains one of the most persistent anthropogenic threats to sea turtles in Queensland, Australia, occurring since 1962. Despite decades of conservation progress, there have been limited long-term analyses that quantify trends in turtle entanglement, survival, and potential recovery. Understanding temporal changes in catch and mortality patterns within the Queensland Shark Control Program (QSC) is critical to evaluating the program's ongoing ecological impact and informing evidence-based mitigation strategies. The Queensland Government makes the QSC data available to the public via the QFISH website. We used these data to analyse 25 years (2001–2025) of QSC catch records to assess long-term trends in sea turtle bycatch, identify fluctuations in survival rates, and evaluate whether management changes correspond with improved conservation outcomes. Catch data from the QSC program were compiled from 2001–2025, including species, location, gear type, and fate (alive or dead). Annual totals were calculated, and proportions of alive versus deceased turtles were used to assess trends through time and descriptive statistics. Between 2001 and 2025, six species of sea turtles were recorded in QSC gear. Green turtles (*Chelonia mydas*) were the most frequently captured (62%), followed by Loggerheads (*Caretta caretta*, 25%), Hawksbills (*Eretmochelys imbricata*, 6%), Flatbacks (*Natator depressus*, 5%), Leatherbacks (*Dermochelys coriacea* 1%) and Olive ridleys (*Lepidochelys olivacea*, <1%). Survival rates improved markedly; early records (2001–2010) averaged 70% survival, while those from 2021 to 2025 averaged 86%. Annual mortalities declined from peaks exceeding 20 turtles in early years to fewer than 10 since 2022. The year 2020 showed an anomalous mortality spike (57% dead), suggesting possible environmental or operational factors. The improvement in turtle survival rates likely reflects operational refinements, including the increased use of drumlines (hooks) and a decrease in the use of nets, as well as new management plans and improved response protocols. However, intermittent mortality peaks highlight the continued vulnerability of turtles to gear interaction. These findings demonstrate measurable conservation gains but reinforce the need for adaptive bycatch mitigation and continued long-term monitoring. Evaluating bycatch trends provides a valuable evidence base for refining marine wildlife management and supporting coexistence between fisheries safety measures and turtle conservation in Queensland.

MICROPLASTIC CONTAMINATION IN LOGGERHEAD AND GREEN SEA TURTLES: A COMPARATIVE STUDY ON EGGS, HATCHLINGS, AND THE NEST ENVIRONMENT

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Plastic pollution is an increasing threat to marine ecosystems, with sea turtles being particularly vulnerable to its impacts. While ingestion and entanglement of macroplastics have been widely documented in juvenile and adult turtles, much less is known about microplastic contamination during early developmental stages. To date, only a few studies have identified microplastics in loggerhead (*Caretta caretta*) eggs and embryos, and none have reported their presence in green sea turtle (*Chelonia mydas*) eggs and embryos. This study investigates the occurrence of microplastics in eggs, hatchlings, and nest environments of loggerhead and green sea turtles nesting on the beaches of Boca Raton, Florida (USA).

Specifically, it aims to determine whether nest environment, species, or temperature influences microplastic contamination and associated physiological stress responses. We are sampling 20 nests per species during both the 2025 and 2026 nesting seasons. From each nest, five unviable eggs, five live hatchlings, five dead hatchlings, and 250g of sand surrounding the clutch are being collected. Microplastics are quantified and characterized in egg yolks (from unviable eggs) and in the liver, brain, and yolk sacs (from dead hatchlings) using Fourier Transform Infrared Spectroscopy (FTIR). Nest sand is being analyzed using density separation and vacuum filtration to assess surrounding microplastic concentrations. Blood plasma from live hatchlings is being analyzed for thiobarbituric acid-reactive substances (TBARS), a biomarker of oxidative stress caused by lipid peroxidation. Nest temperatures are being continuously monitored with HOBO® data loggers to assess potential relationships between thermal conditions, microplastic uptake, and metabolism. During the 2025 nesting season, preliminary data have been collected from 12 green and 3 loggerhead nests. Oxidative stress levels have been low but are occasionally associated with minor physical abnormalities. Microplastic particles have been detected in sand samples, as well as in unviable eggs and hatchling tissues. We hypothesize that (1) microplastics will be present in both loggerhead and green turtle eggs and tissues, with higher concentrations in green turtles due to species specific habitat and diet differences; (2) polyethylene will be the most abundant polymer type; (3) increased microplastic concentration from samples in the nest will correlate with elevated TBARS concentrations in hatchling plasma; and (4) higher nest temperatures will enhance microplastic uptake through increased permeability and metabolic activity during incubation. This study represents the first comparison of microplastic contamination and oxidative stress between loggerhead and green sea turtle hatchlings. Findings will provide new insights into early life exposure of sea turtles to microplastics and their potential physiological consequences. Understanding how maternal transfer and nest environments contribute to contamination risk will inform conservation and management strategies aimed at decreasing the impacts of plastic pollution on marine turtle populations.

INSIGHTS FROM SATELLITE-TAGGED LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) USE OF DESIGNATED OFFSHORE WIND ENERGY AREAS ALONG THE U.S. EAST COAST

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As offshore wind energy development accelerates within the Mid-Atlantic Bight along the U.S. East Coast, understanding the effects of the construction and operation on migratory marine species is vital. Despite ongoing research, there is still a limited understanding of how these large-scale marine projects may affect oceanographic conditions and the migratory behavior of these marine species. For instance, adult sea turtles undertake long-distance seasonal migrations along the eastern seaboard to reach their foraging grounds and nesting sites. Satellite telemetry is a common practice in sea turtle conservation that offers insight into these migration patterns and habitat use across many life stages. This project utilized satellite telemetry to determine areas of use within the Bureau of Ocean and Energy Management's (BOEM) designated offshore wind energy areas for the endangered loggerhead sea turtle (*Caretta caretta*). The Bald Head Island Conservancy deployed 16 tags between 2017 and 2025 tracking post-nesting female loggerhead sea turtles' migrations from their nesting beach on Bald Head Island, North Carolina using Wildlife Computers SPOT & SPLASH10 and Telonics TAM tags. The tags were attached to nesting turtles on their return crawl to the ocean to avoid any potential damage to the nest site. Data collected from these satellite tags provided a detailed view of how the turtles utilize specific areas over time, shedding light on the temporal changes in high-use regions throughout their migration. Kernel Density Estimates (KDE) were used to identify seasonal hotspots and evaluate the use of designated offshore wind energy areas by loggerhead sea turtles.

Cluster analysis was applied to examine patterns in spatial use and diving behavior that may indicate habitat preference. We hope our findings provide insights that inform the timing of construction windows to minimize disturbance, obstruction, or harm to migrating sea turtles and other migratory marine species. These types of studies are essential for creating policies and conservation strategies that balance renewable energy with marine species protection.

LINKING SEA TURTLE MORTALITY TO FISHING ACTIVITY: A MULTIMODAL INVESTIGATION USING SEDIMENT CHEMICAL FINGERPRINTING*

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Determining the cause of mortality for stranded sea turtles is critical to reducing human-induced threats, including bycatch in commercial fisheries. Drowning by forced submergence was suspected in 44.1% of strandings in the northern Gulf of America (n = 1,594/3,616; 2010-2019), based on necropsy findings, including intra-airway sediment, normal nutritional condition, and the absence of injuries, disease, or evidence of other causes, such as harmful algal blooms. Incidental mortality in commercial fisheries has been inferred based on the lack of necropsy findings attributable to other mortality sources and high rates of finfish ingestion among the subset of these strandings analyzed for gut contents (68.1%; n=921/1,352; 2010-2019). Finfish are a common component of fisheries bycatch, and sea turtles are known to consume this discarded catch. However, direct evidence linking these strandings to specific fisheries has been lacking. To address this gap, we conducted a multimodal investigation integrating necropsy-based mortality assessments, sediment chemical fingerprinting, and spatial analyses of fishing effort. From 2019 to 2024, we collected 69 intra-airway sediment samples from fishery-suspect stranded turtles and 67 reference benthic sediment samples across potential fishing grounds. Electron-probe Microanalysis was used to analyze the chemical composition of detrital iron-oxide minerals in individual grains from the samples, treating the unique chemical signatures of iron-oxide minerals as a fingerprint for identifying sediment provenance. A custom MATLAB routine was used to statistically compare the 14-element compositions of iron oxide grains from turtle airway sediment with those from benthic sediment sources. Spatial interpolation of sediment geochemistry was combined with AIS-derived fishing effort rasters to evaluate overlap between turtle sediment matches and commercial fishing activity. Iron-oxide grains from turtle airways most frequently matched to locations within the eastern Mississippi Sound, Breton Sound, and offshore federal waters, identifying areas characterized by consistent trawl activity. This study demonstrated that chemical sediment fingerprinting, when coupled with analysis of fishing effort data, provides evidence for linking sea turtle mortality to fishing activity. This novel forensic approach, conducted as part of mortality investigation efforts under the Deepwater Horizon Sea Turtle Early Restoration Project, offers a powerful method for identifying locations of sea turtle mortality, advancing our understanding of fishery-turtle interactions, and supporting the development of targeted conservation actions to reduce incidental turtle bycatch in fisheries.

ASSESSING LOGGERHEAD TURTLE (*CARETTA CARETTA*) BYCATCH AND ASSOCIATED MORTALITY ACROSS FISHERIES ALONG THE SPANISH MEDITERRANEAN COAST*

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The incidental capture of loggerhead turtles in fisheries along the Mediterranean coast of Spain represents a major conservation problem, but updated bycatch rates are missing. This study aimed to identify the fishing gears responsible for loggerhead turtle bycatch and to estimate bycatch rates and associated mortality across the different fisheries in Spanish Mediterranean waters. To achieve this, 513 structured face-to-face interviews were conducted in 2022 and 2023 with fishermen representing at least 20% of the active fleet across ports along the Spanish Mediterranean coast (243 to artisanal, 164 to bottom trawling, 74 to purse seine, 11 to bottom longline and 21 to surface longline). We used the information collected during surveys to gather standardized data on monthly fishing activity and gear use and any instances of accidental capture of the loggerhead turtle (*Caretta caretta*) within the previous year and bycatch-related mortality. The average catch per unit effort (CPUE) was calculated, and bycatch and mortality were estimated together with their 95% confidence intervals, for each of the distinct zones and for the whole region, as well as for the main fishing gears considered. The overall annual bycatch was estimated at 1004 individuals accidentally caught (95% CI: 729–1,280) by the Spanish fleet operating in the Western Mediterranean. Artisanal boats captured annually 501 turtles (95% CI: 118–885) and bottom trawlers captured annually 379 turtles (95% CI: 251–506). The other fleets had a much smaller impact: 99 turtles (95% CI: 0–439) were bycaught annually in drifting longlines, 22 turtles (95% CI: 3–44) in purse seines, and 3 turtles (95% CI: 0–18) in bottom longlines. Direct estimated mortality was low (130 turtles for the whole fleet; 95% CI: 81-179), but total mortality is about 346 turtles annually, when post release mortality rates reported in the literature are considered. Spatially, the highest estimated bycatch occurred off the Ebro Delta and the adjoining continental shelf, with an average of 447 turtles accidentally captured per year. Our results show a clear decline in loggerhead turtle bycatch in the study area compared with previous periods, because of the reduction in the size of all the fishing fleets and major operational changes in the drifting longline fleet. Nevertheless, bottom trawlers and artisanal fishing boats still account for a considerable number of incidental captures and are responsible for most of the casualties. To ensure the conservation of the emerging nesting population of loggerhead turtles, it is essential to implement mitigation measures, such as Turtle Excluder Devices (TEDs) and spatiotemporal fishing closures, considering the seasonality of bycatch and the specific characteristics of each fishery in the Spanish Mediterranean.

BUOYLESS GILLNETS UNEXPECTEDLY INCREASE SEA TURTLE BYCATCH*

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Small-scale gillnet fisheries sustain coastal communities and economies across the globe, yet bycatch (i.e., the incidental capture of non-target species) remains a leading threat to sea turtles. Buoyless gillnets have been proposed as an affordable and practical gear modification to reduce sea turtle bycatch, yet research on their effectiveness remains limited to one published study in the Pacific that found a significant reduction in loggerhead turtle bycatch. Here, we partnered with local veteran fisher leaders to evaluate the effects of buoy configurations on bottom-set gillnets in Mexico's Gulf of California by testing a control (2.5 m between buoys) net, intermediate (5 m between buoys) net, and buoyless (0 buoys) net. Over 25 fishing nights, two nets were set each night with treatments randomly selected, yielding 17 deployments each for buoyless and intermediate nets and 16 deployments for control nets. Nets were deployed separately at randomized locations with a minimum spacing of ~200 m. Mean green turtle bycatch rates varied among treatments (Kruskal, $p = 0.018$), with the lowest bycatch rates recorded in control nets (1.04 ± 0.47 mean BPUE ± SE; BPUE = no. individuals per 100 m net per 12 h; N = 8 turtles), followed by intermediate nets (2.18 ± 0.76; N = 16 turtles), and buoyless nets (3.15 ± 0.72; N = 25 turtles). Similarly, mean stingray bycatch rates also varied significantly (Kruskal, $p < 0.001$), with the lowest bycatch rates recorded in control nets (4.44 ± 0.96), followed by intermediate nets (4.80 ± 1.18), and buoyless nets (11.07 ± 1.39). Taken together, buoyless nets significantly increased mean sea turtle and stingray bycatch rates by 202% and 149%, respectively, relative to control nets. Our findings serve as a cautionary case highlighting the importance of repeated experiments in diverse fishery contexts before emerging technologies can be broadly recommended as conservation solutions.

ARTISANAL FISHERS AT THE HELM: CO-DESIGNING ILLUMINATED NETS FOR SEA TURTLE BYCATCH MITIGATION IN ECUADOR*

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Six of the seven global species of sea turtles are listed as threatened or higher on the IUCN Red List due to anthropogenic threats. Among the most vulnerable is the Eastern Pacific subpopulation of the leatherback turtle, which has declined by over 90% from historic levels and faces a high risk of extinction without urgent conservation efforts. Ecuador is a critical region for intervention, accounting for a large proportion of sea turtle bycatch in Southeast Pacific gillnet fisheries. Illuminated nets have been shown to reduce sea turtle bycatch in various international fisheries, but successful implementation requires fisher

engagement and support. Preliminary trials from 2023-2024 with 35 fishers from the artisanal fishing port of Jaramijó, Ecuador were conducted with promising results for reducing bycatch, with a small significant negative effect on target catch by weight for tuna species. This present study was conducted with the collaboration of the same fishers to co-design a modified illuminated gillnet. Through a participatory workshop and survey instrument, the study quantifies responses to improve impacts on bycatch and target catch species through altering light placement. The resulting design, which positions lights 18 meters deep and 20 meters apart, was selected through a structured participatory process integrating local ecological knowledge. This involved collecting fisher depth and distance preferences for light placement to then create design options which were ultimately voted on to determine the most preferred design. Fishers who were not able to attend the workshop were later given the opportunity to complete the survey questions before the final design was selected. Although there was a strong enough consensus to select the above mentioned design, surveys were also analyzed to understand differences in responses between those that participated in the co-design workshop (n=15) and those that did not (n=18); as well as differences in responses between age classes, position worked, different crews, and responses by non-fishers who also attended the workshop. Differences in responses to multiple survey questions were found between those who participated in the workshop and those who did not, indicating that workshop participation aligned the group to a common goal more so than those that were only asked the survey questions. The strongest differences were found in responses between different crews, suggesting that some crews have strong alignment in thinking. While the modified design has yet to be tested in the field, the co-design effort achieved strong consensus and enthusiasm among participants. Our results exemplify the importance of participatory decision making with local fishing communities, and empowering them as an essential pillar of impactful fisheries science. The overwhelmingly positive feedback from fishers toward both the process and the selected design represents a meaningful step forward in developing effective, stakeholder supported bycatch mitigation strategies.

TRAFFICKING CURRENTS: THE ILLEGAL TRADE IN SEA TURTLES ACROSS ASIA*

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Although all seven species of sea turtles are protected under CITES, trafficking remains a persistent threat across Asia. Many countries also have national and local legislation in place, yet demand for meat, eggs, shells, and other body parts continues to drive illegal trade. Sea turtle poaching and seizure incidents are compiled through TRAFFIC's ongoing monitoring of publicly available sources and systematically recorded in the Wildlife Trade Information System (WiTIS). This study examined patterns of sea turtle trafficking from January 2015 to July 2025, focusing on countries in Southeast, East, and South Asia implicated as source, transit, and/or destination points. The analysis assessed temporal trends, incident hotspots, trafficking routes, and the types and volumes of commodities involved, as well as transport modes and concealment methods. A total of 530 incidents were recorded, capturing trade flows beyond Asia. Indonesia emerged as the most frequently implicated country in poaching and trafficking, with significant activity also recorded in Viet Nam and mainland China. Trafficking routes linked Southeast Asia with East and South Asia, as well as with countries outside the region, which were implicated as origins, transit points, and/or destinations. Most trafficking occurred via sea routes, followed by air transport. Sea turtle eggs were the most frequently seized commodity, with over 152,000 eggs confiscated. Their shells were also widely traded, with more than 15,600 worked shell artifacts and over 1,000 raw shells intercepted. In addition, 3,510 individual sea turtles were confiscated, predominantly in Indonesia, the Philippines, and Viet Nam. Nearly 13% of the 2,460 live turtles seized were hatchlings. Although the results likely underestimate the true scale of trafficking due to reliance on publicly available sources, they provide critical

baseline evidence on the geography, commodities, and routes involved. The study underscores the need for strengthened maritime surveillance, cross-border cooperation, and targeted interventions at identified hotspots to reduce illegal trade and improve sea turtle conservation outcomes.

A PRELIMINARY LOOK OF THE EFFECTS OF ACIDIFICATION ON SEA TURTLES (*C. MYDAS*) IN A BAY IN THE GULF OF CALIFORNIA

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Approximately 37% of the global population lives in coastal areas and depends on marine resources for socio- economic well-being. These regions exhibit strong spatial and temporal biogeochemical variability and are particularly vulnerable to ocean acidification (OA), which directly affects ecologically and economically important species. Coastal ecosystems are critical for maintaining ecological balance and conserving endangered species such as sea turtles, yet their environmental conditions are often difficult respond to climate change through shifts in distribution, nesting phenology, reproductive output, foraging and thermoregulatory behavior induced by extreme water temperatures; however, studies linking physicochemical variables (such as temperature, pH and dissolved inorganic carbon (DIC)) to sea turtle physiology or blood nutrient deficiencies (e.g. calcium) remain scarce. The aim of the current study is to provide more knowledge of the implications of ocean acidification through variables like temperature and biogeochemical parameters (pH and CID) for a better comprehension of the physiological response of *Chelonia mydas* in Bahía de los Ángeles B.C. Mexico, to understand their potential effects, and strengthen management and conservation strategies. Bahía de los Ángeles (BLA) is a northern neritic foraging area for sea turtles in the Pacific Ocean, characterized by high primary productivity, strong seasonal temperature variability (~30°C in summer and ~14°C in winter), and abundant benthic algae, invertebrates, and gelatinous megaplankton, key components of the green turtle (*Chelonia mydas*) diet. Despite its broad global distribution, Pacific American populations of this species are considered especially vulnerable to climate change. For this purpose, the seasonal and spatial variability of temperature, dissolved inorganic carbon (DIC), and total pH was evaluated using 19 monthly surveys conducted at five stations in BLA between June 2017-october 2019. Temperature and DIC showed a strong inverse relationship, with higher temperatures associated with lower DIC concentrations. While seawater pH declined independently of DIC. These changes may affect food quality and availability for *C. mydas* in BLA, which exhibited alterations in several blood parameters (i.e., calcium, lower relatively to previous reports (4.5–6.4 mg/dL; Anderson et al., 2011) based on data collected previously (2021-2025). To further investigate these findings and assess the effects of long-term carbonate variability, we will use more than 20 years of remote sensing data in a future study. This analysis will be conducted in comparison with the aforementioned data on several blood parameters of *Chelonia mydas* and its food sources (i.e., macroalgae samples).

WHEN TURTLES AND VESSELS OVERLAP: ASSESSING ENCOUNTER RISK ALONG FLORIDA'S ATLANTIC COAST*

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Sea turtle encounters with vessels can impact them in multiple ways, altering their behaviour and habitat use, and potentially causing collisions that result in injuries and mortality. As coastal areas become more urbanized and vessel traffic grows, vessel encounters will happen more often globally. Despite protective measures in some regions, such as speed limitation, recreational vessel activity in coastal areas remains a significant threat to sea turtles. This may result from the limited understanding of the spatial and seasonal dynamics of interactions between turtles and vessels, especially at regional scale. Thus, this study set out to determine the spatial and temporal patterns of sea turtle and vessel distributions along a 75 miles section of the East coast of Florida, an area with high incidence of turtle stranding with observed vessel strike injury (VSI). Spatial-temporal information on sea turtles and vessels were obtained from bi-monthly aerial surveys spanning across 2023 and 2024; these data were then spatially related to the distribution of stranded turtles with documented VSI. Across 34 aerial surveys efforts (round-trip surveys), 3271 turtles and 2407 vessels were observed. Within the same region and time scale, 174 turtles were found stranded with VSI. Our results indicate contrasting patterns between sea turtle distribution and vessel activity in the region: turtles showed significant spatial and temporal variability, with a sevenfold increase during the nesting season, whereas vessel activity remained relatively consistent across both space and time. A risk assessment was conducted based on turtle and vessel numbers indicating a higher likelihood of turtle-vessel encounters in the northern region of our study site and near tidal inlets. Sea turtles were particularly vulnerable during the nesting season when turtle densities are highest, with 20% of the study site identified as at risk for encounters. Ultimately, we highlighted a positive significant association between the location of observed stranded turtles with VSI, and the distribution of both vessels and turtles within the area. This indicates the effect of distribution changes on the risk of vessel strike incidents for sea turtles. This study provides critical evidence of how high turtle density during the nesting season increases the risk of interactions, with vessels highlighting the focus on localized and seasonal conservation measures. These findings can help strengthen and enhance the effectiveness of protective measures. Additionally, this work emphasizes both the potential and limitations of using aerial survey data to directly compare animal distributions with vessel activity.

MARINE DEBRIS INGESTED BY STRANDED SEA TURTLES IN FLORIDA VARY WITH AGE CLASS BUT NOT SPECIES*

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Over the years, plastic production has increased to astonishing levels and is predicted to continue. Sea turtles are known to mistake plastic for prey, which can result in gut compaction, gut perforation, and chemical leaching. Over time, environmental plastic will degrade into smaller pieces called microplastics, which sea turtles can also ingest and may affect sea turtle health through chemical leaching of toxicants.

Chemicals associated with plastics have been identified in tissues of sea turtles, and some are suspected to be endocrine disruptors. This study compared plastic ingestion across species and ontogenically, as different species and life stages inhabit different habitats which will influence exposure and thus risk. Plastic ingestion by sea turtles was investigated by collecting contents from the gastrointestinal tract of freshly euthanized or dead sea turtle carcasses. We collected 180 gastrointestinal tracts from loggerheads (*Caretta caretta*) (n=75), greens (*Chelonia mydas*) (n=65), hawksbill (*Eretmochelys imbricata*) (n=16), and Kemp's Ridley (*Lepidochelys kempii*) (n=23) sea turtles. The contents were digested with 10% KOH and then filtered through a 2mm metal filter. The retained plastic was then visually counted and categorized. Samples were then analyzed using a PerkinElmer Spectrum™ 3 FT-IR spectrometer fitted with an IRIS Diamond ATR attachment to identify polymer composition. Samples were analyzed up to three times in different locations to ensure accurate identification. The spectra data were analyzed using the PerkinElmer Polymers reference libraries to identify the polymer; all spectral matches had an index hit of 80 or higher. Over half of the sea turtles (57.7%) were found with marine debris in their GI tract. Marine debris was found in all species; hawksbills had the highest rates of plastic ingestion (62%) and Kemp's ridleys had the lowest (26%). Marine debris was found in all age classes, with washbacks having the highest rate (93%) and adults the lowest (18%). In total we have found is 3765 pieces of marine debris, with the greatest number found in one green sea turtle washback which had 779 pieces in its GI tract. Clear plastics and hard marine debris were the most common color and type ingested. Polyethylene and polypropylene were the most common polymers recovered from the sea turtles. There were no significant differences between species for count, polymer, color, or type. There was a significant difference between age ranges where washbacks had significantly more plastic recovered than the other age ranges. Hard plastic was the top type recovered for washbacks, while filament was the top for the other three age ranges. The most common polymer differed between age ranges, where polypropylene was the top polymer recovered from adults (25.4%) and juveniles (40.9%), nylon was the top polymer recovered from subadults (52.7%), and high density polyethylene was the top polymer recovered from washbacks (70.9%). This study is essential for conservation as it investigates the widespread ingestion of marine debris among sea turtles. Researching these patterns helps inform stakeholders and legislators on what actions are needed to reduce plastic pollution, mitigate its effects, and protect organisms and their habitats.

COLD-STUNNING REMAINS THE PRIMARY DRIVER OF SEA TURTLE STRANDINGS IN NEW YORK

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Long Island Sound and the Great Peconic Bay (New York, USA) contain southern barrier lagoons and eastern bays that are known habitats for foraging populations of juvenile sea turtles during the summer months. Every year, sea turtles strand throughout these areas due to climate-related cold snaps that typically occur in the late fall and lead to cold stunning, a physiological temperature shock like hypothermia. The cold renders turtles unable to swim and prone to washing up onto beaches. Cold stunning events in New York tend to last longer than a few weeks and typically affect juvenile Kemp's ridley (*Lepidochelys kempii*), juvenile green (*Chelonia mydas*) and sub-adult loggerhead (*Caretta caretta*) sea turtles. The New York Marine Rescue Center (NYMRC), rescues and rehabilitates sea turtles in New York and responds to the second largest number of cold stuns in the Greater Atlantic Region; encompassing marine ecosystems from Maine to North Carolina. From 1998 to 2019, a total of 510 sea turtles were recovered from New

York state waters or beaches. Recently, from 2020 to 2025, a total of 395 sea turtles were stranded in New York due to cold stunning. The number of sea turtles retrieved within the last five years has undoubtedly almost doubled compared to the amount of sea turtles recovered over a 21-year period. This rapid increase aligns with projections from Historical Trends in New York State Cold-Stunned Sea Turtle Stranding-to-Release: 1998-2019 (Montello et al., 2022). Of the 395 recent strandings recorded, 56% were *L. kempii* (n=220), 34% *C. mydas* (n=135), 10% *C. caretta* (n=38), and less than 1% were hybrids (n=1). While the 2022 cold-stun season saw 93 strandings, 2024 marked a historic peak with 156 recoveries, the highest annual total recorded in New York since records began in 1980. Over half of the 395 turtles were already deceased (n=210). Similar trends in survival and morphometrics were observed in this dataset, with annual survival rate ranging from 33% to 66% (mean=58%). Average morphometrics were consistent with the Montello et al (2022) findings for Kemp's ridley (27 cm SCL, 2.8 kg) and green turtles (29 cm SCL, 3.3 kg), although loggerheads averaged smaller sizes (46 cm SCL, 15.7kg compared to 55 cm SCL, 26.8 kg previously). The recent increase in cold-stun strandings appears to be driven by multiple factors, including gradual warming of northern waters that may encourage turtles to remain further north and delay their southward migration, the establishment of a public outreach program raising awareness about local sea turtle populations, and the implementation of an effective beach patrolling system that improves stranding detection and rescue efforts. Understanding these contributing factors is essential for developing targeted conservation strategies to reduce cold-stun mortality and protect vulnerable sea turtle populations in New York waters. These trends indicate that cold-stun strandings in New York are likely to become more frequent, highlighting the need to remain prepared for increasing numbers through continued research, monitoring, and conservation efforts.

FISHING FOR ANSWERS: DETECTING RECREATIONAL FISHING IMPACTS ON JUVENILE GREEN TURTLES (*CHELONIA MYDAS*)*

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Upon recruitment to neritic habitats, green turtles (*Chelonia mydas*) were historically thought to undergo a rapid dietary shift from omnivory to herbivory. More recent studies have demonstrated that this dietary transition is highly plastic and influenced by local resource availability. Juvenile green turtles opportunistically forage on higher trophic-level prey, including provisioned fish and fishery discards. Consumption of protein-rich diets can accelerate somatic growth, in turn lowering predation risk and decreasing age at sexual maturity. However, sustained high-protein diets can increase risk of renal disease and expose turtles to vessel strikes and fishing gear. In Florida, green turtles are the most commonly incidentally hooked species at coastal fishing piers. Understanding the extent to which recreational fishing contributes to their diet is therefore important for assessing both ecological and conservation impacts. Nitrogenous compounds in blood including total protein, blood urea nitrogen (BUN), and uric acid have been shown to increase in turtles fed high-protein diets. These commercially measurable analytes offer a cost-effective alternative to more invasive or expensive dietary assessments. To evaluate potential dietary supplementation with fishing bait or discards from piers, we collected blood samples from three groups of juvenile green turtles: (1) turtles hooked at a recreational fishing pier (n = 39, 2017–2023), (2) turtles captured on the reef adjacent to the pier (n = 29, 2020–2022 and 2024), and (3) turtles captured on a similar reef with minimal fishing pressure (n = 33, 2022–2024). Some turtles were repeatedly captured and resampled over the course of the study (for up to 5 captures). Five turtles were captured at both the pier and adjacent reef locations. We applied linear mixed-effects models to assess the influence capture location

and on total protein, BUN, and uric acid, while accounting for turtle size and individual. Total protein was strongly predicted by turtle size, with larger turtles exhibiting higher values, but was not influenced by capture location. BUN concentrations decreased with increasing turtle size but were significantly higher in pier-hooked turtles compared to reef-captured turtles. Uric acid also decreased with increasing turtle size, with no significant effects of capture location. In this study, nitrogenous blood analytes were primarily size-dependent and contrast with studies where green turtles were heavily provisioned with fish or fed high protein diets in a controlled setting. Elevated BUN and uric acid concentrations in smaller turtles are consistent with increased protein intake, potentially linked to opportunistic feeding on bait or fishery discards from recreational fishers during early recruitment, declining as turtles grow and transition primarily to herbivory. These findings underscore that anthropogenic food sources may have disproportionate ecological significance for smaller, recently recruited turtles and that future studies should account for ontogenetic dietary shifts to fully understand their conservation implications. Future conservation and management efforts should prioritize reducing interactions between fishers and green turtles by limiting turtle exposure to fisher-sourced protein, implementing bycatch reduction and mitigation strategies that account for temporal patterns in turtle and fisher abundance, and engaging in long-term planning to minimize the placement of fishing piers near habitats preferred by turtles.

MICROPLASTIC IN MARINE ALGAE FROM GREEN TURTLE (*CHELONIA MYDAS*) FORAGING AREAS MONITORED BY THE ARUANA PROJECT, BRAZIL

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The presence of microplastics (MPs, ≤ 5 mm) in marine environments is one of the main environmental issues today, with increasing reports of interactions with various organisms. Once ingested, MPs can cause obstructions, toxicity, and cellular and biochemical effects, and can also be transferred along the food chain, contaminating fish, birds, turtles, and marine mammals. Studies have shown that all seven sea turtle species have interacted with solid waste, with the green turtle (*Chelonia mydas*) being the most studied due to its coastal habits during the juvenile stage, when it uses shallow areas for feeding and growth. In Brazil, studies have indicated the ingestion of anthropogenic debris associated with macroalgae, but few have specifically evaluated the presence of MPs in these organisms, likely underestimating the impact of debris on turtle diets. This study aimed to quantify and characterize microplastics present in macroalgae from two green turtle feeding areas monitored by the Aruanã Project, which works for the conservation of sea turtles in the state of Rio de Janeiro. Sampling was conducted in the winter of 2024 at Itaipu Beach (Niteroi) and Marina da Glória (Rio de Janeiro). Algae were collected from three quadrats (30 × 30 cm) in shallow rocky shore areas during high or rising tide. After being separated by class (green, red, and brown), the algae were weighed (wet weight), washed, and this liquid was vacuum filtered using glass fiber filters. The filters were examined under a stereomicroscope, and the microplastics were quantified and analyzed for size, shape, and color. A total of 450 g of algae were collected in Itaipu (423 g green and 27 g red) and 722 g in Marina da Glória (174 g green and 548 g red). In Itaipu, the MP concentration was 0.26/g in green algae and 0.11/g in red algae, while in Marina da Glória the values were 0.05/g and 0.02/g, respectively. The mean MP size was 0.22 mm (ranging from 0.01 to 4.45 mm). Fibers predominated (57.9%), followed by

fragments (34.7%), films (4.3%), pellets (2.1%), and foam (0.72%). Blue was the predominant color (51.4%), followed by black (18.1%) and transparent (13%), with smaller proportions of white, gray, silver, red, pink, and brown. Differences in concentration between the areas may be related to herbivory pressure. In Itaipu, the disposal of fish viscera by fishermen provides an additional food source for turtles, reducing algae consumption and, consequently, herbivory pressure, favoring algal growth and the retention and accumulation of MPs. In contrast, at Marina da Glória, the presence of short-stemmed algae suggests intense herbivory, likely reducing MP retention by these algae and potentially favoring the direct ingestion of MPs by turtles. The findings highlight the importance of considering macroalgae as potential vectors of MPs in the food chain and integrating trophic and behavioral aspects when assessing the exposure of green turtles to plastic pollution.

LONG-TERM TRENDS OF INJURY OBSERVATIONS IN NESTING LOGGERHEAD TURTLES ON WASSAW ISLAND, GA, USA

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Mark–recapture studies of nesting sea turtles have been conducted since the 1950s and remain a cornerstone of population monitoring worldwide. While these programs have provided valuable estimates of population size, recruitment, and survivorship, far less attention has been given to injury prevalence among nesting females— despite its potential influence on long-term survival and reproductive output. The Caretta Research Project (CRP) has conducted mark–recapture efforts on Wassaw National Wildlife Refuge (NWR), Georgia, since 1973, generating one of the longest continuous datasets on nesting loggerhead sea turtles (*Caretta caretta*) in the Northwest Atlantic. Using these long-term records, our objectives were to determine 1) if the proportion of injured turtles is changing over time, and 2) if one injury type - or hypothesized injury source - is more prevalent than others. When a nesting female presented with a notable defect, the injury was documented with a written note and field sketch. Injuries were later classified by body region, injury type, healing status, and probable cause when identifiable. We assessed injury trends from 1997-2017 using a generalized linear mixed model (GLMM), with injury presence/absence as the response variable, and year as a fixed effect. Separate binomial GLMMs were used to evaluate trends in probable injury sources, retaining year as a fixed effect in each model. The odds of injury decreased by approximately 3% per year from 1997 to 2017 ($\beta = -0.033$, 95% CI: -0.053, -0.012, $p = 0.003$; binomial logistic regression), corresponding to a small decline in injury probability across the study period. However, year explained little variation in injury occurrence, indicating that other factors, other than time, likely play a larger role in injury risk (Tjur's $R^2 = 0.0063$). We found that boat injuries declined over time (OR = 0.91 per year, 95% CI ≈ 0.86–0.96, $p < 0.001$). Shark injuries were initially more likely than boat injuries (OR = 2.14, 95% CI ≈ 1.02–4.48, $p = 0.045$) but exhibited a similar decreasing trend over time (interaction $p = 0.236$). Injuries of unknown origin were slightly more frequent than boat injuries at the beginning of the study period (OR = 2.09, 95% CI ≈ 1.06–4.00, $p = 0.033$) and increased significantly over time relative to boat injuries (interaction OR = 1.09 per year, 95% CI ≈ 1.03–1.15, $p = 0.003$). Integrating injury surveillance into long-term mark–recapture programs provides a more complete picture of population health. The Wassaw dataset serves as a vital baseline for tracking changes

in injury prevalence, which could be used to compare trends across other nesting beaches. Future work could involve linking these long-term field data with rehabilitation and stranding records, which can be used to refine estimates of survivorship and identify key sources of injury and mortality within the Northwest Atlantic loggerhead population. Together, these efforts have the potential to advance understanding of cumulative threats to sea turtles and reinforce the importance of coordinated conservation and research.

THE IMPACT OF BYCATCH ON CRITICALLY ENDANGERED WEST PACIFIC LEATHERBACK TURTLE POPULATION VIABILITY*

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West Pacific leatherback turtles nest in Indonesia, Papua New Guinea, the Solomon Islands and Vanuatu. They migrate and forage throughout the South West Pacific Ocean. Since 2018 there has been an increase in bycatch of leatherbacks in Australia and New Zealand. Here we employed Population Viability Analysis (PVA) to examine leatherback population persistence under various bycatch scenarios. Under pre-2018 bycatch conditions, our population viability analysis models predict a declining growth rate ($\lambda = 0.987$), a significant reduction in population survival probability (-28%) and a large reduction in adult population size (780 to 59) over the next ten generations. Minimal additional mortality from bycatch (2 adults per year), such as seen since 2018, greatly exacerbates the risk of extirpation (by approximately 40%). Not all risk is equal, as the small Solomon Islands subpopulation is predicted to be extirpated by 2062 under pre-2018 bycatch conditions, but the additional mortality accelerates the timeline to extirpation by 25 years. Unknown post-release survival rates and limited understanding of other fisheries-related impacts add further uncertainty to the resilience of West Pacific leatherbacks to bycatch. Both bycatch reduction and enhanced research on post-release survival should be prioritised to ensure that Australia and New Zealand contribute to preventing the extirpation of the Critically Endangered West Pacific leatherback population.

WHAT HORIZON? THE EFFECT OF LIGHT POLLUTION ON LOGGERHEAD (*CARETTA CARETTA*) HATCHLINGS ON BALD HEAD ISLAND, NC, USA

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Artificial light pollution is known to be detrimental to nocturnal and migratory species causing significant change to natural behaviors. It can disrupt migration, foraging and reproduction in numerous taxa, including birds, amphibians, and insects. Additionally, all life stages of sea turtles are affected by artificial light. Specifically, hatchlings emerging from nests may become misorientated due to artificial skyglow, disrupting their sea finding behavior, which can lead to severe exhaustion and even mortality. Bald Head Island (BHI) is a barrier island located at the southeasternmost point of North Carolina, USA known for its dark skies. However, loggerhead (*Caretta caretta*) hatchlings are still vulnerable to misorientation

driven by skyglow from nearby coastal communities. This study aimed to quantify skyglow intensity and directionality across the beaches of BHI to determine the relationship between light pollution and hatchling misorientation. The Bald Head Island Conservancy's Sea Turtle Protection Team conducts nightly patrols to monitor sea turtle nesting activity and subsequent nests along seven miles of beach on the island. Skyglow intensity readings were collected at seven locations across BHI, spaced one mile apart on patrols during the 2024 and 2025 nesting seasons using a Unihedron Sky Quality Meter (SQM-L). The meter was pointed directly overhead at a 90 degree angle and in each cardinal direction at a 0 and 45 degree angle from the horizon. Readings were collected at various times of night (2000-0500) and at hatch events throughout the season, regardless of sky condition (moonless, clear, cloudy, etc.). The direction that misoriented hatchlings crawled was also recorded during hatching events. One-way ANOVAs (Tukey's HSD post-hoc) compared skyglow intensity across directions and locations, while a Chi-square Goodness-of-Fit test assessed hatchling misorientation by direction. In addition, a heatmap was created from misorientation data collected across previous seven seasons (2019-2025) to determine hotspots. Skyglow intensity was significantly higher to the north and west, facing the greater Wilmington and Southport, NC areas across all sample locations. The heat map revealed misorientation across all beaches though, misoriented hatchling crawl direction was significantly higher to the north and west, suggesting a correlation between hatchling misorientation and the brighter skies. Our results suggest that skyglow from other municipalities in the area may be the main driver of misorientation on BHI, rather than localized light pollution. This study highlights the harmful effects of artificial light pollution on emerging loggerhead hatchlings and can provide insight for resource managers and local government officials to create broader conservation strategies focusing on mitigating the effects of light pollution in the surrounding region.

INTERACTIONS BETWEEN SEA TURTLES AND SMALL-SCALE FISHERIES IN GOA, INDIA*

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Sea turtles are an important component of India's natural heritage, and five species – the green, hawksbill, leatherback, loggerhead, and olive ridley turtles – feed in its coastal waters and nest on the mainland and island beaches. Sea turtles are vulnerable to a number of threats, one of the largest being impacts from fisheries. The scale of threat from fisheries, especially small-scale fisheries is not well understood. Understanding the major sources of fisheries bycatch is one of the global research priorities for sea turtles, and this survey is part of a systematic study of turtle interactions with small-scale fisheries on the west coast of India. We conducted structured face-to-face interviews with fishers across Goa in May 2024. Participants were recruited using convenience and snowball sampling. The survey tool was 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 were sourced from the Olive Ridley Project-Ghost Net Data protocol (www.oliveridleyproject.org). The final survey tool consisted of 51 open and close-ended questions that collected information about fisher demographics, their fishing gear, and observations and interactions with sea turtles. Interviews were conducted in Marathi, Konkani, or Hindi as preferred by the respondent, and after voluntary informed consent for participation was obtained. In this presentation we will report on fishing gear and practices, bycatch rates, outcomes of interactions with fisheries and perceptions of turtle population trends as described by respondents. Fishers predominantly used monofilament gillnets, water <20km from the shore with soak times of <2hr. The self-reported bycatch rates are low, but consistent with responses in the adjacent state of Maharashtra. Fishers shared observation of floating, entangled, and stranded sea turtles,

likely the result of interactions of fisheries, as well as ghost gear. Many fishers perceived a decrease in both the number of bycatch turtles and the number of turtles in local waters over time, likely reflecting a decreasing population due to threats, including interactions with fisheries, at different life stages.

DISENTANGLING BYCATCH: SEA TURTLE BEHAVIORAL RESPONSES TO GILLNETS AND ARTIFICIAL LIGHT*

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Fisheries bycatch causes sea turtle mortality worldwide. Gillnets are among the most globally ubiquitous fishing gear, but their nonselective nature results in high sea turtle bycatch. However, little is documented about the behavioral interactions of sea turtles with gillnet fishing gear and bycatch reduction technologies (BRTs) developed to prevent these interactions. Here, we measured the behavior of wild-caught green and loggerhead sea turtles in controlled binary choice trials in a test tank at the St. Lucie Nuclear Power Plant in Jensen Beach, FL. Treatments were designed to reveal what factors might contribute to sea turtle entanglement and net avoidance in the presence of gillnet BRTs, specifically visual-based BRTs. We identified avoidance and disentanglement behaviors when interacting with gillnets, namely U-turns and reversals, respectively. We also found that loggerheads were more likely to become entangled than green turtles, with both species being more likely to become entangled at night. Rather than being deterred by a green LED light, both species tended to swim towards the light when given the choice between a passageway with a deactivated light and an activated green LED light. Additionally, when presented with the choice between an illuminated net and a green LED light by itself, both species appeared to choose the passageway with the green LED light. Controlled trials with wild animals provided us a unique opportunity to assess sea turtle interactions with gillnets and BRTs on a finer scale than is typically feasible in open ocean field trials. These results suggest that sea turtle entanglement is likely at least partly based on visual cues and they may become entangled in nets because they do not detect them. Presumably, green LED lights are effective because they illuminate the net instead of the lights themselves or that illumination enables turtles to disentangle themselves more easily. Understanding fine-scale behaviors associated with bycatch can help inform optimized bycatch reduction strategies.

SPATIAL AND TEMPORAL TRENDS IN SEA TURTLE BYCATCH OFF THE PACIFIC COAST OF PANAMA AND COLOMBIA*

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Sea turtles face multiple anthropogenic threats, with bycatch in fisheries representing one of the most significant causes of their global population decline. Four species of sea turtles—leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), and green turtles (*Chelonia mydas*)—inhabit the coastal waters of the Pacific of Panama and Colombia, where all are susceptible to injury or death from interactions with fisheries. The population-level impacts of bycatch result from the interaction between fisheries characteristics—such as effort, gear type, and spatial distribution—and biological traits of sea turtles, including late maturity, long lifespan, and the use of distinct breeding and foraging habitats. Although previous research in the Eastern Pacific has identified regional bycatch hotspots and developed mitigation strategies, critical data gaps persist in Panama and Colombia, both considered data-deficient regions. To address this, we designed a novel study to evaluate sea turtle bycatch along the Pacific coasts of both countries through the integration of voluntary fisher-reported data, a pilot small-scale fisheries observer program, and monitoring data from government agencies and private fishing companies. Between 2013 and 2018, we recorded 241 sea turtle bycatch events in six fisheries clustered in four groups (shrimp trawl, gillnet, longline, and purse seine). The most common turtle was *L. olivacea* (n=155), followed by *C. mydas* (n=41), *E. imbricata* (n=21), and *D. coriacea* (n=6). To evaluate spatial and temporal patterns in bycatch risk, we employed generalized linear models (GLM) with binomial distribution, linking bycatch occurrence to fishing effort, gear type, port location, and season. Environmental covariates (sea surface temperature, chlorophyll-a concentration, and bathymetry) were analyzed using Generalized Additive Models (GAMs) to capture non-linear relationships with bycatch probability. This represents the first coordinated effort to assess the cumulative impacts of multiple fisheries on sea turtles in a data-limited region, establishing a foundation for evidence-based management and bycatch mitigation strategies in the Eastern Pacific.

CONDITION OF GREEN TURTLES *CHELONIA MYDAS* IN THE FEEDING AREA OF LA PUNTILLA, ARICA, NORTHERN CHILE

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The physical condition of green sea turtles (*Chelonia mydas*) inhabiting the La Puntilla feeding area, Arica Bay (northern Chile), was assessed between August 2012 and January 2016. A total of 134 individuals (juveniles, subadults, and adults) were examined with the aim of characterizing external injuries and conditions potentially associated with anthropogenic pressures. Overall, 51 turtles (38.1%) exhibited at least one type of external affection. Recorded injuries included exfoliation of dorsal scutes, irritation of the nictitating membrane, corneal ulcerations, and integument perforations associated with barnacle attachment. Additionally, malformations of the carapace and cephalic scutes were observed, as well as wounds to the head, carapace, and plastron, hook-related injuries to the buccal region and extremities, carapace cuts caused by fishing nets, impacts to the carapace, and limb amputations. A substantial proportion of these injuries was attributable to interactions with human activities, particularly fishing gear, maritime traffic, and other coastal uses. Research on injuries affecting sea turtles has traditionally focused on nesting beaches, emphasizing predation, egg consumption, and incidental or directed capture. In contrast, less attention has been given to the risks faced by turtles within their feeding grounds, despite the prolonged use of these habitats during critical life stages. Arica Bay represents the most important green turtle foraging area in Chile and is subject to intense anthropogenic pressure, including port operations, vessel traffic and anchoring, recreational activities, and fishing conducted under multiple modalities (recreational, artisanal, industrial, and ancestral practices such as the chinchorro), in addition to the presence of a maritime fuel terminal. Collectively, these results demonstrate that feeding areas can constitute high-risk zones for *C. mydas* and highlight the need to incorporate these habitats into conservation and management strategies. We recommend strengthening protection measures through community outreach and awareness programs, training in handling, manipulation, and best practices for sea turtles aimed at local stakeholders, and stricter regulation and effective enforcement of human activities within the sector.

SEA TURTLE BYCATCH AT FISHING PIERS IN THE NORTHERN GULF OF MEXICO: A DECADAL REVIEW OF REHABILITATION OUTCOMES*

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Recreational bycatch of threatened and endangered species is particularly difficult to study because recreational fishing is generally self-reported. Three species of sea turtles, Green, Loggerhead and Kemp's Ridley, are frequently caught at fishing piers along the Gulf of Mexico (GoM) coastline. Pier-based bycatch is increasing and why certain species are more frequently caught remains unclear. Further, some individuals are repeatedly caught at fishing piers. To address these questions, we analyzed 10 years of stranding data from the C.A.R.E. Center. The C.A.R.E. Center responds to approximately 99% of stranding events from a 180-mile stretch of the northern GoM coastline. Initially, juvenile green sea turtles were the dominant

species captured, however, a shift to loggerheads has been observed. Additionally, bycatch followed a seasonal pattern with increased bycatch from April – August. Across all species 61% of individuals presented with internal hooks, and 39% presented with only external hooks. Overall, a total of 440 incidental capture events occurred. Of these, 77 individuals were rescued ≥ 2 times and comprised 237 capture events. In general, the mortality rate of bycaught turtles treated in rehabilitation (6%) was lower than other stranding types (40%), and green sea turtles had the lowest mortality. Our study reveals there are important species-specific patterns in bycatch, hook location, and mortality. Changes in the frequency of bycatch and dominant species suggest that population density could be a driving factor, as all three species are in varying stages of population recovery following ESA protection in the 1970s. Bycatch follows a distinct seasonal pattern. Summer coincides with the other big seasons in the Gulf coast: nesting, tourism, and fishing. However, this also suggests that enhanced outreach during the summer could be effective to facilitate reporting. Fortunately, mortality from bycaught turtles is low compared to other stranding events. A minority of all bycaught turtles seem to habituate to fishing piers and become repeat offenders. This study provides essential background data to begin to understand and assess the threat that recreational fishing has on sea turtle bycatch.

ASSESSING THE EXPOSURE OF THE MOST IMPORTANT NESTING AREA FOR SEA TURTLES IN THE MEDITERRANEAN REGION TO LIGHT POLLUTION

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Artificial light at night (ALAN) is impacting sea turtle nesting around the globe by decreasing the nesting attempts, disorienting the sea turtle hatchlings while trying to find the sea, and disrupting hatchlings' offshore migration. In the Mediterranean Sea, the Kyparissia Bay is considered the most important nesting site for loggerhead sea turtles, with several thousand nests on an annual basis. This study reports for the first time the vulnerability of the core 10 km of nesting area to ALAN pollution, evaluates the potential impact on sea turtle conservation, and discusses mitigation measures as coastal urbanization and touristic activity increase rapidly in the region. Our findings show that although the area is not affected by ALAN pollution to its great extent, a specific region (Kalo Nero) is subjected to high illumination at night by local restaurants and bars, leading to reduced sea turtle nests and a significant threat to hatchlings.

NEAR SHORE RECREATIONAL FISHERIES INTERACTIONS ON MAUI (HI)*

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The IUCN lists fishery interactions as one of the greatest global threats to marine turtles, yet every region has a distinct fishery associated these interactions. In Hawai‘i, near shore recreational fisheries are listed as the top threat to Green (*C. mydas*) and Hawksbill (*E. imbricata*) turtles, Hawai‘i‘s nearshore species. Hawaii‘s foraging grounds and coral reef tract habitat for turtles occur near shore and often overlap with high traffic fishing areas. In accompaniment with Hawaii‘s limited fishing regulations, large numbers of turtles are entangled statewide annually. On Maui (HI), The Marine Institute at the Maui Ocean Center has operated the sea turtle stranding network for 9 years; between 2020 and September 2025, a total of 1,597 turtles have been rescued, 78% (n=1,255) of which had fishery interaction listed as the primary cause of stranding. Of the 1,597, 12% (n=197) required rehabilitation, 26% (n=51) necessitated forelimb amputation, and 97% (n=1,388) of all turtles recovered alive (n=1,421) were successfully returned to the wild immediately. While the threat to these animals is clear, the fishery of primary contribution remains obscure. This presentation will cover historical data on Maui, describe common fishing techniques to Maui, and potential paths forward.

A 12 YEAR TREND OF SEA TURTLE STRANDINGS IN TAIWAN, 2014 − 2025

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Taiwan's systematic sea turtle stranding rescue operations began in 2014. The period from 2014 to 2018 was marked by a spontaneous development phase led by sea turtle researchers, while the period since 2019 has been one of policy-driven implementation. Over this 12-year period, more 2,500 sea turtle stranding events were reported across Taiwan, along with an additional 400 fishery bycatch incidents. These stranding events were primarily distributed across three major regions: Northern Taiwan, Southern Taiwan, and the Penghu archipelago. The analysis of stranded sea turtles in Taiwan consistently shows that the Green sea turtle (*Chelonia mydas*) is the dominant species, accounting for 81.2% of all stranding events. The remaining cases are distributed among four other species: Hawksbill (8.6%, n=201), Olive Ridley (5.4%, n=125), Loggerhead (3.9%, n=92), and Leatherback (0.5%, n=11). More complete records for both the analysis of stranding causes and the identification of fishery bycatch types have been maintained since 2019. From 2019 to 2024, sea turtle bycatch resulting from fishing activities accounted for 10.4% of the total reported cases. The primary types of bycatch were accidental captures in set nets (59.6%, n=118), entanglement in gillnets (18.2%, n=36) and capture by trawling (6.1%, n=12). It is noted that the types of fishery bycatch exhibit regional differences and are likely underestimated. In the analysis of sea turtle stranding causes were entanglement in marine debris or ghost net (7.3%, n=124), vessel strikes (2.5%, n=43) and ingestion of fish hooks (1.2%, n=21). Notably, a high percentage (41.9%) of the vessel strike incidents occurred around Xiao Liuqiu, which may be linked to the high volume of shipping traffic in that area. It is important to note that while Green turtles form the bulk of strandings across the region, the

specific species proportions can differ somewhat across different regions of Taiwan due to localized factors such as foraging grounds, coastal activities, and fishing hotspots.

SEA TURTLE BYCATCH MANAGEMENT OUTCOMES IN HAWAI'I'S DEEP-SET LONGLINE FISHERY EVALUATED WITH MACHINE-LEARNING

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Global efforts to reduce sea turtle bycatch in pelagic longline fisheries have achieved substantial success, driven in part by new management frameworks implemented over the past few decades. Yet as these regimes evolve, unintended challenges can emerge or obscure the underlying drivers of bycatch, causing interactions with sea turtles to persist or even rebound to concerning levels. The Hawai'i deep-set longline fishery exemplifies these challenges. In 2004, sea turtle mitigation regulations were implemented for both the Hawai'i deep-set and shallow-set longline fisheries, including the mandated use of large circle hooks and finfish bait. Management attention focused primarily on the shallow-set fishery due to its operation in surface waters where sea turtles generally occur. Consequently, the shallow-set fishery adopted additional protective measures over time, including annual fleetwide bycatch caps and enhanced monitoring. In 2012, new requirements aimed at protecting false killer whales in the deep-set fishery mandated weak circle hooks of 16/0 or smaller and were expected to also reduce sea turtle mortalities. However, the impact of Hawai'i deep-set longline fisheries on leatherback turtles (*Dermochelys coriacea*) is four times greater than that of the shallow-set fishery and is at a greater risk of exceeding the three year incidental take statement (ITS). Leatherback turtle bycatch in the Hawai'i deep-setting longline fishery recently exceeded the 3 year ITS (72 takes, 27 mortalities) and triggered formal reconsultation under the Endangered Species Act. This resurgence warrants particular evaluation of deep-setting longline since it comprises 97.5% of total Hawai'i longline effort and leatherback interactions are three times more lethal than in shallow-set fisheries. Leatherback sea turtles may be at particularly greater risk because they dive deeper than other sea turtle species, increasing overlap with deep-set gear. While existing mitigation measures (e.g. circle hooks, bait restrictions, and hook size requirements) were designed to reduce sea turtle bycatch, their effectiveness in the deep-set fishery has not been formally evaluated. The Hawai'i deep-set longline fishery operates with some gear flexibility that creates opportunities for a comparative analysis. Since 2004, vessels have used hooks ranging from 14/0 to 16/0 in size, including offset circle, offset tuna, round circle, and offset flat circle, while bait types have varied among sardine, milkfish, and saury, 36% of which were blue-dyed. Additionally, 79% of the fleet stern-set, while 21% side-set, with an unlikely but unknown chance of changing turtle bycatch. Using nearly twenty years of monitoring data, we applied an ensemble random forest model to identify the environmental and operational covariates that shape bycatch risk for sea turtles in the Hawai'i deep-set longline fishery. We then constructed a prediction grid based on the standard set to compare the relative importance of each gear component for expected risk. As one of the world's most regulated and monitored tuna fisheries, the Hawai'i longline fleet provides a unique window into the broader global challenge of understanding sea turtle interactions in dynamic fishing environments.

DIAMOND-BACKED TERRAPIN BYCATCH REDUCTION IN THE NORTH CAROLINA COMMERCIAL BLUE CRAB FISHERY: A CASE STUDY OF FISHER ENGAGEMENT AND COLLABORATION*

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Fisheries bycatch is a prominent issue in many fisheries globally and poses a threat to nontarget species across multiple taxa. While advances have been made in bycatch reduction gear technology in numerous fisheries, uptake of these technologies by the industry is often slow and in many cases, fishers are particularly hesitant to adopt bycatch reduction gear technologies that have been developed by scientists or third parties without input from the fishing industry. The commercial blue crab (Callinectes sapidus) harvest represents one of the most valuable fisheries in North Carolina and is a significant economic driver for coastal communities. The estuarine diamond-backed terrapin is listed as a species of "Special Concern" by the North Carolina Wildlife Resources commission, and a report submitted by the Scientific Council on Amphibians and Reptiles concluded that incidental bycatch in crab pots is the most serious threat to diamond-backed terrapins in North Carolina and throughout their range. Efforts to reduce bycatch by installing bycatch reduction devices (BRDs) to funnel openings on crab pots have been met with strong resistance due to perceived reductions in blue crab catch. The North Carolina Marine Fisheries Commission (NCMFC) has recognized diamond-backed terrapins as a species impacted by fishing activities under its jurisdiction, and in 2020 designated Diamondback Terrapin Management Areas (DTMAs) at two waterbodies in southeastern North Carolina, in which a North Carolina Division of Marine Fisheries (NCDMF) approved bycatch reduction devices must be incorporated into crab pots. While this regulatory measure was taken, the NCDMF acknowledged the need to explore alternative gear modifications that exclude terrapins while minimizing impacts to target species catch and may be more accepted by fishers. The primary goal of our study was to test the efficacy of gear modifications proposed by fishers to reduce terrapin bycatch without the need to install a BRD. Two designs were tested, a narrow funnel design (NFD) and a reinforced funnel design (RFD), to examine efficacy in terrapin exclusion and assess impacts to blue crab catch. Results from fisheries-independent and fisheries-dependent testing demonstrate that the NFD (74% bycatch reduction) effectively excludes diamond- backed terrapins without significant reductions in catch rate or size of blue crabs. Our study highlights a case in which direct collaboration with fishers led to the identification of a simple gear modification that presents a viable means for significantly reducing diamond-backed terrapin bycatch without negatively impacting blue crab harvest. The NFD has been approved for use within DTMAs by the NCMFC and ongoing work aims to promote use of the NFD in fishing communities throughout North Carolina, form additional collaborative partnerships with fishers, and assess the socioeconomic factors that influence fisher willingness to adopt bycatch reduction gear technologies. Adoption of fishing gear technology often spreads via "word of mouth" throughout fishing communities, and this approach has led to the development of new collaborative partnerships initiated by our previous fisher partners. Lessons learned from this case study may be broadly translatable to addressing bycatch in other fisheries, including those that include sea turtle bycatch interactions.

ARTIFICIAL LIGHTING AS A THREAT TO SEA TURTLE HATCHLINGS: AN ASSESSMENT OF COASTAL LIGHT POLLUTION ON TOPSAIL ISLAND, NORTH CAROLINA, USA

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Artificial lighting poses a significant threat to sea turtle hatchlings by disrupting their natural orientation behavior toward the ocean. Hatchlings rely on natural light cues to navigate from nest to sea. Anthropogenic light sources can cause disorientation and lead to increased predation, exhaustion, and mortality. This study assessed light pollution along 42 km of nesting beach in the southeastern United States to evaluate the spatial extent and intensity of coastal illumination affecting sea turtle habitat. During the 2024 and 2025 nesting seasons, the Topsail Turtle Project, a program of the Karen Beasley Sea Turtle Rescue and Rehabilitation Center, conducted systematic nighttime surveys along Topsail Island, a 42 km nesting beach in coastal North Carolina. Standardized Sky Quality Meter (SQM) readings and visual assessments were performed at 160-meter intervals. All visible lights were counted and categorized using a 45-degree line of sight at each observation point. Light sources were classified by type including residential (indoor and outdoor), commercial (indoor and outdoor), municipal, and transient. Indoor residential lighting was identified as the most prevalent light source affecting the nesting beach. SQM readings revealed substantial variation in sky brightness across the survey area, with densely, higher profile developed sections of the island showing significantly elevated light pollution levels compared to less dense or lower profile buildings beach segments. Light pollution intensity correlated with proximity to residential development, and indoor lighting penetrating through windows and doors represented the dominant source of illumination visible from the beach. Coastal development, particularly residential indoor lighting, represents a pervasive threat to sea turtle hatchlings. The prevalence of indoor residential sources suggests that mitigation efforts focused primarily on outdoor and commercial lighting may be insufficient. Management strategies should incorporate regulations addressing indoor lighting visibility during nesting season, including requirements for window coverings, shielding, or wavelength-specific lighting. Additionally, comprehensive lighting ordinances that address all anthropogenic light sources in proximity to critical sea turtle nesting habitat are needed in the three towns of Topsail Island.

In-Water Biology

INVESTIGATING FORAGING SITE FIDELITY OF NESTING LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) ON JUNO BEACH, FLORIDA*

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Satellite telemetry and capture-mark-recapture studies have shown that many cheloniid sea turtles exhibit fidelity to specific foraging grounds. In contrast, previous research suggests that leatherback sea turtles (*Dermochelys coriacea*) display regional fidelity to broad foraging areas rather than discrete sites. However, these conclusions are largely based on tagging studies conducted at foraging grounds, which often include individuals from multiple nesting stocks. Turtles from the same geographic nesting aggregation may exhibit fidelity to similar foraging regions, thus re-tagging individuals with known foraging histories provides a rare opportunity to investigate fine-scale, individual-level foraging fidelity and quantify the persistence of habitat use over time. Here, we use satellite and acoustic telemetry to assess the foraging site fidelity of the southeastern Florida nesting aggregation. Specifically, we investigate whether individual turtles return to the same foraging grounds across consecutive nesting seasons and evaluate the consistency of their movement patterns over time. Twenty satellite transmitters were deployed on 10 nesting leatherbacks over multiple nesting seasons on Juno Beach, Florida, USA (26.9433N, -80.0708W). Nine turtles were initially tagged in 2023 and re-tagged in 2025, and one turtle, initially tagged in 2022 and re-tagged in 2023, was fitted with an additional Innovasea Inc. V16 acoustic transmitter. To examine migratory routes, location data were filtered using a continuous-time correlated random walk state-space framework. Turtles that reached foraging areas were assigned to geographic regions, and individual core (50%) and resident (95%) utilization distributions were calculated. Finally, interannual overlap in foraging areas was quantified to assess foraging site fidelity. All turtles tracked to foraging grounds for two nesting seasons (N = 5) demonstrated foraging site fidelity. Individuals established foraging residency in the Mid-Atlantic Bight (N = 2), the Gulf of St. Lawrence (N = 1), and on the Scotian Shelf (N = 2). The inter-annual overlap between overwintering foraging distributions ranged between 0–99.99%, and the overlap of core foraging areas varied between 0–94.6%. When comparing the home range sizes of the entire post-nesting movement track of each individual, including migration routes and internesting habitats between seasons, the core distribution overlapped between 0.1–74.2%, and the resident distribution overlapped between 39.8–99.3%. Although the extent of habitat use varied among years for some individuals, each turtle returned to the same foraging region across consecutive nesting seasons, demonstrating a consistent spatial link between the southeastern Florida nesting aggregation and distinct foraging areas. This pattern indicates that individual turtles maintain strong foraging site fidelity, highlighting the importance of continued monitoring of environmental and anthropogenic stressors within these habitats. Monitoring environmental changes, such as shifts in ocean temperature, productivity, or prey availability, is particularly critical, as these factors can influence the health, distribution, and long-term stability of this nesting aggregation. Moreover, confirmation of individual site fidelity provides valuable information for complementary research projects, such as stable isotope analysis, that depend on the assumption that turtles repeatedly use the same foraging areas across years.

SCIENCE BITES: JAW MORPHOLOGY AND FORAGING BEHAVIOR AS MECHANISMS OF COEXISTENCE FOR HAWAI'IAN SEA TURTLES

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Green turtles (*Chelonia mydas*) and hawksbills (*Eretmochelys imbricata*) can be observed feeding in Hawai'ian coastal waters. Both species are especially common in Maui, where they consume similar species of algae. Those observations prompted us to examine how their differences in morphology (specifically, jaw and head shape) might be related to how, and where, they foraged. GoPro and Sony Underwater cameras were used to record naturally behaving green turtles and hawksbills as they fed on substrates with differing surface topography. Two main foraging behaviors were observed: cropping (scrapping algae from surfaces) and mining (removing obstructions to access algae). These foraging strategies were analyzed for the frequency of occurrence for each turtle species and their relationship to the substrate type: coral reef, flat rock-reef, and rock-boulder. Differences in head morphology and jaw structure of the two species appeared functionally specialized for obtaining algae from substrates differing in surface topography. Green turtles have a short face with U-shaped jaws whereas hawksbill jaws are elongated, narrow and V-shaped. Both species foraged in coral reef areas with green turtles mainly foraging at flat rock-and boulder sites. Green turtles were observed cropping algae from flat surfaces of the substrate in rock-reef and rock-boulder areas. Even when green turtles fed at coral reef sites in close proximity to hawksbills, they foraged on flat surfaces of volcanic rock that protruded between coral outgrowths. Hawksbills were not observed using the cropping behavior. Instead, hawksbills fed on algae located in coral crevasses, often mining coral "obstructions" to access small colonies of algae located in tight areas. This field-intensive behavior study provides insight into how sympatric species with overlapping resource requirements avoid competition.

STRATEGIC SOCIALITY IN JUVENILE GREEN SEA TURTLES (*CHELONIA MYDAS*)

Fiona Lee Beu

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The expansion of global ecotourism has altered the environmental conditions of juvenile greens at an early stage of their development, but the full impact of these anthropogenic activities is not yet understood. As they grow accustomed to daily human presence, they are forced to make cost-benefit decisions about energy expenditure, in order to mitigate the long term consequences of such engagement. This in-water observation study within Princess Alexandra Marine Park, a mixed-use MPA in Providenciales, Turks and Caicos, recorded the daily foraging behavior of a cohort of eight juvenile green turtles during various levels of anthropogenic presence. A single researcher with a snorkel observed grouping, non-random social interactions and measured time spent at the surface. Over 9 hours of these activities were analyzed using face scale identification and an ethogram of behavior. Findings indicate the preference for congregate foraging and suggest that time spent at the surface plays an important role in assessing the location of

conspecifics from an elevated vantage point. Such group vigilance may be a valuable survival strategy, yet it also makes them more vulnerable to human interference. Gaining insight into the habits and preferences of juvenile greens can inform conservation approaches, help mitigate harm, and advise more sustainable practices, to insure long-term coexistence in areas of ecotourism.

POST-RELEASE MONITORING: ASSESSING REHABILITATION SUCCESS IN GREEN SEA TURTLES AFFECTED BY DISEASE AND HABITAT DEGRADATION

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Environmental changes can significantly affect sea turtle foraging behaviour and the post-release success of rehabilitated individuals. Flood events, in particular, often lead to the degradation or loss of critical seagrass habitats. Between 2021 and 2022, a series of unusual weather patterns impacted south-eastern Queensland, Australia. Three consecutive La Niña events triggered multiple floods across the Fraser Coast region, resulting in the highest recorded river flows from the Mary River in over 110 years. These floods produced extensive sediment plumes in Hervey Bay and the Great Sandy Straits, causing widespread destruction of essential seagrass meadows along the east coast. Following this environmental disruption, a new disease known as Soft-Shell Syndrome emerged, and reports of debilitated and emaciated sea turtles increased by 400%. To better understand the post-release success of turtles affected by these events, satellite trackers were deployed on ten rehabilitated individuals. Specifically, the tracking data helped determine whether turtles resumed normal foraging behaviour, where they searched for food, and whether they utilised areas of recovering seagrass. These monitoring efforts addressed a significant gap in sea turtle rehabilitation research, offering valuable information on the long-term outcomes of treatment and release. By linking environmental change, disease emergence, and post-release behaviour, this work contributes to a more holistic understanding of sea turtle health and resilience in the face of climate-driven habitat loss.

PICKING UP THE PIECES: FORENSIC METHODS TO REVEAL DUROPAGHOUS PREDATOR INTERACTIONS WITH MOLLUSCAN SHELLFISH IN FLORIDA

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Loggerhead sea turtles (*Caretta caretta*) and whitespotted eagle rays (*Aetobatus narinari*) are key consumers of coastal molluscan shellfish, producing highly fragmented prey remains during feeding events. Tracking foraging activity and prey selection in situ typically requires invasive methods, including tissue sampling, lavage, or attaching biologging tags. To address this, we aim to track foraging events of these large, mobile durophagous predators passively, using forensic molecular and morphological analyses of naturally recovered shell fragments. We leveraged metabarcoding (i.e., MiFish primer set) to detect and classify predation from fragments collected in a laboratory setting as well as the field. Controlled tank feeding trials with captive turtles and eagle rays were conducted to validate this approach, providing baseline data on fragment characteristics and the persistence of predator DNA on regurgitated shells up to

48 hours after consumption. In the field, 35 strombid conch shell fragments, along with control water samples, were collected and swabbed for DNA in the Upper Florida Keys. Preliminary results show that predator DNA was detected on prey shell fragments both in controlled feeding trials out to 48 hours and in the wild. By integrating insights from both experimental and natural settings, this study will enable non-invasive monitoring of loggerhead and whitespotted eagle ray feeding activity and improve our understanding of their ecological impact on molluscan populations.

PROMISE OR PERIL IN A WARMING OCEAN? AN EMERGENT PATHWAY LEADS NORTH PACIFIC LOGGERHEAD SEA TURTLES INTO THE NORTHERN CALIFORNIA CURRENT SYSTEM*

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Over recent decades, the eastern North Pacific Ocean (ENP) has undergone significant climate-driven change, characterized by rising sea surface temperatures (SSTs), a northward expansion of the North Pacific Transition Zone (NPTZ), and more frequent marine heatwaves. Juvenile North Pacific loggerhead sea turtles (*Caretta caretta*), a highly mobile species sensitive to environmental variability, have emerged as a sentinel species within the region. When loggerheads migrate from the eastern subtropical gyre to coastal habitat, they do so offshore of the Baja California Peninsula, Mexico. Analysis of an extensive satellite tracking data set (n=285,1997–2023) revealed no prior observations of juveniles entering the colder, nutrient-rich waters of the northern California Current System (CCS). However, the gradual northward shift of loggerhead foraging habitat has been observed in parallel with an increasingly oligotrophic NPTZ. In 2024, four of 28 satellite-tracked individuals deviated from historic migratory routes and entered the northern CCS. To understand the physical mechanisms that enabled these novel movements, we integrated SST, chlorophyll-a concentrations, and surface current conditions experienced by these individuals and compared them to historical records within the region. During September-October 2024, these turtles reached 45°N latitude, where they encountered strong eastward flow within the North Pacific Current (NPC), thermally suitable conditions, and enhanced productivity. These conditions created a transient, high-latitude migratory corridor into the northern CCS. While three of these turtles benefited from reaching enhanced forage habitat in the California Current System, one likely suffered cold-stunning upon entry into suboptimal waters. The other 24 turtles remained south of the NPC, in the subtropical gyre. Our study represents the first confirmed use of a new, northern CCS migratory corridor by juvenile North Pacific loggerhead sea turtles. These findings expand on the conceptual framework of the 'thermal corridor

hypothesis,' which suggests that sea turtles opportunistically exploit anomalously warm conditions to reach foraging habitats along the North American coast. They also emphasize the role of additional environmental drivers, such as advective current systems, in these movements. Under accelerated climate change, such transient pathways may become increasingly prevalent, with significant implications for conservation planning and fisheries management.

DIET COMPOSITION OF GREEN (*CHELONIA MYDAS*) AND HAWKSBILL (*ERETMOCHELYS IMBRICATA*) TURTLES AT KEY FORAGING LOCATIONS IN HAWAI'I*

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Sea turtles demonstrate trophic plasticity, with interspecific and population-level variation in diet observed even across small geographic scales. Additionally, differences in the nutritional composition and digestibility of algae and seagrasses are expected to influence turtles' life history characteristics and physiological processes. Consequently, characterizing site-specific dietary patterns provides valuable insight into sea turtle ecology and supports effective conservation and management efforts. Previous research demonstrated that green turtles (*Chelonia mydas*) in Kāne'ohe Bay, a key foraging site for Hawaiian green turtles, exhibited a progressive dietary shift toward non-native algal species. However, this population's diet has not been reassessed in nearly a decade. To address this, we analyzed the forestomach contents of 42 green turtles collected in Kāne'ohe Bay in 2018–2019 and compared our results to earlier findings. We identified all food items to the lowest possible taxonomic level, measured wet mass, and calculated the frequency of occurrence among turtles (F), average percent contribution by mass (W), and Index of Relative Importance (IRI). We also provide preliminary comparisons with stomach content analyses from Hawaiian hawksbill turtles (*Eretmochelys imbricata*), a uniquely isolated population. Our results indicate that the non-native red alga *Gracilaria salicornia* is now the most frequently consumed dietary item by green turtles in Kāne'ohe Bay (F = 88.1%, W = 63.2 ± 40.8%, IRI = 88.4%), followed by *Acanthophora spicifera* (F = 35.7%, W = 16.6 ± 32.7%, IRI = 8.3%). By contrast, in 2009, *Acanthophora spicifera* was reported as the dominant dietary item (F = 64%) by Russell and Balazs. Preliminary hawksbill data similarly indicate heavy reliance on algae, with an overall diet composed of approximately 81% algae by wet weight. Analysis of trace amounts of (<1%) food items included sponges that were successfully identified as Suberites sp., a potentially native sponge, through both DNA barcoding and morphological assessments. These results show that food items from gut contents yield high-quality DNA for sequencing. Ongoing analyses will identify hawksbill prey items to finer taxonomic levels while incorporating an additional 20–30 samples. These updated findings highlight the dynamic foraging behavior of sea turtles and their potential responses to changes in prey availability. The increased dominance of G. salicornia in green turtle diets may reflect shifts in algal abundance, differential nutritional value, or selective preference for this non-native species. By providing current, quantitative data on the feeding ecology of both Hawaiian turtles, our work enhances understanding of trophic interactions in local ecosystems and informs future conservation and management strategies for these species.

PROTECTING THE EARLY LIFE OF EASTERN PACIFIC LEATHERBACK SEA TURTLES BY COMBINING NEW SATELLITE TRACKING TECHNOLOGIES AND NUMERICAL MODELING*

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Having experienced a dramatic decline of more than 97% since the 1980s, the Eastern Pacific leatherback turtle (*Dermochelys coriacea*) population is now facing extinction. Its conservation requires the implementation of protection measures covering all its life stages and all associated habitats. Although major conservation efforts have been undertaken to protect nesting beaches and limit the largely fisheries-induced adult mortality, the juvenile oceanic phase – the so-called "Lost Years" – remains poorly understood and thus under-protected. An initial attempt to address knowledge gaps regarding dispersal and movements during early life history stages was performed by simulating hatchling dispersal from Playa Grande (Costa Rica) using the Sea Turtle Active Movement Model (STAMM) forced by the surface ocean current provided by the Copernicus Marine Service (regular and systematic reference information on the blue water sea states). This simulation suggested that juveniles dispersed within the North Pacific, which is a finding totally inconsistent with observed adult foraging grounds in the Southeast Pacific, and contradicting the "Learned Migration Goal" hypothesis. Recent deployments of novel microsatellite tags on leatherback neonates in Florida and on larger juveniles in Thailand revealed unexpected and important insights regarding the dive behaviors of early-stage leatherbacks. We incorporated these empirical observations into STAMM, now using subsurface currents to govern dispersal. The results dramatically altered dispersal outcomes, producing many more trajectories into the Southeast Pacific, which is consistent with observed adult migrations. This initial breakthrough into the mystery surrounding early dispersal of juveniles from the Eastern Pacific subpopulation highlights the synergy between empirical observations and numerical modeling. This approach can be applied to support decision-making processes that inform conservation and management measures. Within the data framework of the Copernicus Marine Service, we developed an interactive online tool that links dispersal simulations with fisheries data, to assess risks of interactions and to explore conservation and management scenarios to inform marine spatial planning efforts. More broadly, this combined approach demonstrates how fundamental science that combines both observational and simulated data can be transformed into risk management or decision support tools. These tools, in turn, can be used by decision makers or ocean resources users (e.g., for commercial and recreational fisheries, energy extraction, and shipping). Such integrated approach may be used to study other sea turtle populations, address other threats (e.g., plastic pollution) or investigate the sensitivity of sea turtles dispersal and population dynamics to changes in the ocean state (i.e., currents, temperature, productivity) generated by different climate change scenarios.

RESOURCE PARTITIONING BETWEEN JUVENILE GREEN TURTLES *CHELONIA MYDAS* AND HERBIVOROUS FISHES IN THE EASTERN MEDITERRANEAN SEA UNDER TROPICALIZATION

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Tropicalization refers to changes in community composition due to the poleward expansion of tropical species as a result of global warming. The native community of roving herbivores inhabiting the eastern Mediterranean Sea included the green turtle (*Chelonia mydas*) and two species of herbivorous fishes, the salema (*Sarpa salpa*) and the parrotfish (*Sparisoma cretense*). Currently, the region also supports a large population of the marbled spinefoot (*Siganus rivulatus*), a Red Sea invader reported to overgraze macroalgal forests in shallow infralittoral rocky habitats. As a result, the population of salema has declined throughout the eastern Mediterranean Sea, but nothing is known about the potential impact of the spread of the marbled spinefoot on green turtles. Here, we used the stable isotopes of C, N and S to characterize the isotopic niches of green turtles, salema, parrotfish and spinefoot off Cyprus to assess the potential the impact of the latter on the food availability for native herbivores. Samples from macroalgae (thallus), seagrasses (blades), fishes (dorsal white muscle) and green turtles (epidermis) were collected along the western coast of Cyprus in 2023 and 2024. The δ13C, δ15N, and δ34S values in roving herbivores and their putative diet items were used to estimate the proportional contributions of food sources to diets using the Bayesian mixing model MixSIAR. Furthermore, the R package "nicheRover" was used to assess the overlap between the isotopic niches of the four species considered. The results revealed low overlap between the isotopic niches of green turtles and the three species of herbivorous fishes, mostly because of the high reliance of juvenile green turtles on red macroalgae and the consumption of animal prey. Conversely, brown macroalgae prevailed in the diets of the three fish species, in combination with the seagrasses Posidonia oceanica (for salema and spinefoot) or *Cymodocea nodosa* (for parrotfish). These results suggest complementarity between the isotopic niches of native roving herbivores and a stronger impact of spinefoot on salema than on green turtles or parrotfish. It is worth noting that the high contribution of red macroalgae to the assimilated diet of juvenile green turtles is explained by the much higher digestibility of red macroalgae compared to that of seagrasses and brown macroalgae. Nevertheless, the digestibility of seagrasses for juvenile green turtles is positively correlated with water temperature and hence, the consumption of seagrasses is expected to increase off Cyprus in parallel to the increase of winter sea temperature. If so, juvenile green turtles and spinefoot may replace salema as the major grazers on Posidonia oceanica seagrass meadows in the eastern Mediterranean Sea.

INFLUENCE OF OCEANOGRAPHIC VARIABILITY ON THE FORAGING AREA SELECTION OF LOGGERHEAD TURTLES (*CARETTA CARETTA*) IN THE EASTERN GULF OF AMERICA*

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Evaluating how oceanographic variability shapes foraging in marine megafauna is critical for anticipating ecological responses to a changing ocean. The loggerhead turtle (*Caretta caretta*), a long-lived migrant and sentinel of pelagic ecosystem health, displays marked behavioral plasticity under dynamic conditions. This study focuses on the eastern Gulf of America (internationally referred to as the Gulf of Mexico), a region influenced by the Loop Current, mesoscale eddies, and interannual variability, and quantifies how environmental conditions from 2019 to 2024 relate to area-restricted search (ARS) and transit behavior in adult loggerheads. The analysis integrates satellite telemetry from 136 individuals with daily gridded environmental fields. Tracks undergo rigorous quality control, state-space smoothing, and 12-hour regularization. Predicted positions are matched to sea surface temperature, chlorophyll-a, mixed-layer depth, sea surface salinity, near-surface circulation (eddy kinetic energy, log-transformed), mixed-layer thickness, and bathymetric depth. Covariates are standardized, multicollinearity is evaluated, and two-state Hidden Markov Models fit with environmental effects on transition probabilities; alternative structures are compared using AIC and sensitivity checks. Results show clear separation between movement states. ARS is characterized by shorter step lengths (mean = 3.18 km per 12-h step; SD = 2.54) and low directional persistence (von Mises concentration $\kappa = 0.16$), whereas transit is characterized by longer step lengths (mean = 14.98 km per 12-h step; SD = 9.43) and higher directional persistence ($\kappa = 1.10$). At mean environmental conditions, turtles tend to persist in their current state, with stay-in-state probabilities of 0.963 for ARS and 0.895 for transit. Environmental covariates are associated with switching dynamics, indicating that thermal structure, stratification, circulation, and habitat context may jointly influence transitions between behavioral modes. Integrative frameworks linking movement to ocean variability provide essential tools for anticipating how climate-driven changes in temperature, mixing, productivity, and circulation may reshape loggerhead behavioral dynamics and space use in the region.

DO GREEN SEA TURTLES REMAIN IN A MARINA ALL DAY? DAYLONG MONITORING USING PHOTOIDENTIFICATION

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Green sea turtles are found in coastal marine environments. Aside from nesting on beaches, they are often observed in the intracoastal waterway where they are seen foraging algae and other biofouling organisms from man-made structures in marinas. Previous research at marinas in and around St. Augustine, FL, USA shows that green sea turtles return to their foraging sites, but it is unclear whether they stay in the marina for the entire day, or if they disperse which allows other groups of sea turtles to forage in that area. Prior surveys at these marinas have all been snapshots in time with no information of what they do outside of that one sighting. The Camachee Cove Yacht Harbour was chosen as our sample site due to the influx of turtles observed there compared to other survey sites. During these surveys, the entire perimeter of a marina

was walked, and pictures of every turtle were taken to record the head scale pattern. To have a finer scale view of what turtles are doing during the day, we conducted surveys every two hours on a Saturday; collecting photos of the head scales of each turtle. These photos were analyzed through Internet of Turtles: software for identifying turtles within a population to find out if any individuals are seen at the marina multiple times throughout the day. Data analyzed for October 4th, 2025 showed a total of 25 turtles throughout the day (five surveys). Out of the 25 turtles, 15 were seen only once, while 10 were seen multiple times, with one turtle being seen during four of the five surveys. Three of the 25 turtles were matched to the long-term photoidentification project that has been ongoing at this marina since June 2020. These early results indicate that while some turtles do stay at the marina for several hours, many of the turtles are only seen once. This indicates that only visiting the marina once a week for surveys in the long-term project may be drastically underestimating the number of turtles using these marinas as foraging grounds.

USING HYDROACOUSTICS TO DETECT OBJECTS IN THE WATER IN NORTHEAST, FL, USA: POTENTIAL FOR OBSERVING SEA TURTLES

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Side-scan sonar uses hydroacoustics to produce imagery of the seafloor through a process of towing a transducer that emits sound pulses. The sound waves reflect objects and return to the transducer. Side-scan sonar is used to identify marine habitats, features, and objects on the seafloor. Marine organisms can be identified by shape, size, color value, and shadow orientation. The objectives of this study were to evaluate the effectiveness of side-scan sonar to track sea turtle populations and map habitats. Side-scan sonar with a frequency of 600kHz was towed along different transects with ranges of 50m, 25m, 10, and 5m from a 22-foot Tracker center console boat. The minimum depth recorded was 3m with a maximum of 22m. Tows were conducted for a total of 111 minutes over three different sites. The gain was adjusted to ensure optimal return on the computer. The data was then analyzed at the lab; there were 14 points of interest. After reviewing 111 minutes of data from the tows 14 individual features were notable, 12 of which appear to be man-made structures. The smallest object detected was 0.73 meters by 0.58 meters. Determining volume was difficult, so we are reporting only the surface area. Two of the objects were deemed to be living organisms due to the fact they had a detached shadow as well as a lighter appearance which indicates soft tissue. One of the organisms was 2.74 meters long, and the other was 3.35 meters. These results confirm that the side-scan-sonar is effective at distinguishing living and non-living objects, and their location relative to the seafloor. This can be determined based on whether the object's shadow is attached or detached and how light the object is. These early results indicate this instrument will be useful to document estuarine habitat and potentially visualize sea turtles resting on the bottom or swimming in the water column.

ILLUMINATING THE FIRST SWIM: A UV-TAGGING AND DRONE-BASED FRAMEWORK TO QUANTIFY INITIAL SEA TURTLE HATCHLING DISPERSAL*

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The first hours and days at sea are thought to represent a critical survival bottleneck for sea turtles, yet long-standing assumptions about near-immediate mortality remain largely untested. Direct behavioral observations under natural conditions are virtually absent: neonates are too undersized for conventional telemetry, and visual tracking methods suffer from low resolution, short duration, and small sample sizes. We introduce a low-cost, field-ready method that overcomes these constraints by pairing lightweight UV-fluorescent tags with drone-mounted UV excitation and optical tracking. Tags (<0.10 g; ≈ $0.30 USD) can be applied rapidly to entire cohorts, while overhead drones detect and follow in-water hatchling dispersal in real time. Video data are processed through an OpenCV-based pipeline to extract trajectories and behavioral metrics including swim speed, dive frequency, heading variance, and track duration. Detection accuracy and continuity are benchmarked against hand-labeled ground-truth datasets across environmental gradients (wave height, turbidity, moonlight, cohort size). Validation thresholds include ≥ 80 % track continuity for segments > 8 min within 150 m from shore and < 10 % false-positive rates. Preliminary field trials in Antigua, West Indies (2025) demonstrated reliable detection of hawksbill hatchlings (*Eretmochelys imbricata*), yielding extractable trajectories and revealing distinct behavioral strategies such as directional swimming versus surface drifting. The framework enables simultaneous tracking of entire hatchling cohorts, substantially increasing data yield relative to prior approaches to support robust behavioral classifications. Ongoing analyses will expand to additional cohorts, apply unsupervised clustering to identify behavioral groupings, and test environmental predictors of derived movement patterns using generalized linear mixed models. Future work will integrate these behavioral datasets with physical oceanographic models to estimate dispersal kernels, identify dominant transport pathways, and link early movement behavior to population-scale dispersal outcomes. By directly quantifying dispersal behavior under natural conditions, this study provides the first scalable in-water hatchling tracking framework for early sea turtle life stages. Its low cost and transferability enable conservation partners to replicate the approach globally and integrate it into broader monitoring and management programs.

SEA SURFACE TEMPERATURE AND THE TORTUOSITY OF SATELLITE-TAGGED SEA TURTLES

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Many marine organisms face unsuitable environments and conditions, potentially threatening their survival, as excess greenhouse gases produce shifts in ocean temperatures, chemistry, and currents. Unfortunately, these conditions are now changing so rapidly that scientists are challenged to come to a firm understanding of how abiotic factors impact them. Among these vulnerable species, sea turtles, as ectotherms, are particularly vulnerable to increased climate anomalies – marine cold snaps and heat waves – as they rely on the interplay between environmental resources and their behavior to regulate their body temperature. Sea turtle metabolism, cognitive processing, and body movements progressively slow with decreasing temperatures up to the critical temperature threshold, often followed by cold-stunning events. However, aside from the known effects of cold stunning, currently, little research exists on how lower temperatures explicitly impair the navigational abilities of sea turtles. To address this research gap, this study investigates the tortuosity of sea turtle paths in relation to water temperature. The tortuosity of an animal's path can reflect the departure of its path from straightness, indicating an animal's behavior, and can be measured by multiple variables, including sinuosity index, fractal dimension, straightness index, and angular variance of turning angles. We will focus on finding the sinuosity indices or the curvature of their paths as previous sea turtle studies have not examined this relationship before. Increased sinuosity may indicate an animal's difficulty in locating necessary habitat or resources, or in directly navigating to a desired waypoint. To examine changes in tortuosity and sea surface temperature, we collated two existing datasets of sea turtle satellite telemetry tracks in collaboration with NOAA's National Centers for Environmental Information, the U.S. Geological Survey, and the Gulfarium Marine Adventure Park. We will extract in situ sea surface temperature data from the Naval Research Laboratory's HYCOM server, and the 'trajr' package in R software will facilitate the analysis of each turtle's sinuosity. We will then develop a regression model using the tortuosity index (TI) as the response variable and sea surface temperature (SST) as a potential explanatory variable, to explore how tortuosity and water temperature relate. We hypothesize that colder water will result in slowed physiological responses, negatively impacting their ability to navigate and geolocate, causing more sinuous satellite tracks. If a strong relationship is found, then scientists may need to develop more complex models to predict migration in the face of a shifting climate. Understanding the link between water temperature and navigational ability may explain why cold stunning, predation, or fatality are more likely to occur, as increased energetic requirements may result from slowed or impaired navigation. This study may also support better predictions of movement patterns and highlight latitudinal limitations to sea turtle migration and foraging at the northern or southern ends of their range. Overall, it will highlight the significance of satellite-tagged data in the conservation of threatened and endangered sea turtles and other migratory species, which face growing threats from anthropogenic climate change.

REVEALING IMMATURE HAWKSBILL AND GREEN TURTLE DIETS USING OPTIMISED DIETARY DNA METABARCODING IN THE WESTERN INDIAN OCEAN*

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The highest density of foraging immature hawksbills (*Eretmochelys imbricata*) recorded in the world has recently been measured in a lagoonal habitat in the Chagos Archipelago (Indian Ocean), accompanied by the slowest growth rates and poorest body condition ever measured in this species. This exceptional density, resulting from long-term conservation, poses questions about food availability and the carrying capacity of environments for turtles, which may become increasingly important across species due to ongoing conservation successes around the world. To better understand the carrying capacity of different ecosystems, we have set out to assess the diet of foraging hawksbills in this high-density lagoonal habitat and compare to contrasting habitats in the region. Traditional methods of sea turtle diet analysis, such as direct observation and oesophageal lavage, have long incurred challenges such as small sample sizes, high levels of invasiveness and underestimation of gelatinous diet items. Dietary metabarcoding is a relatively under-explored technology in turtles that can complement these methods, enabling large-scale, non-lethal and taxonomically broad analysis of diet composition efficiently and cost-effectively. We applied this approach to characterise the diets of immature hawksbill and green turtles (*Chelonia mydas*) in two contrasting habitats in the Chagos Archipelago: an ocean-facing reef (where turtles appear to be in good body condition) and a sheltered lagoon (where exceptional densities, slow growth and poor condition have all been measured). Oesophageal and cloacal swabbing was collected for dietary DNA metabarcoding. We will discuss the methodological optimisation steps undertaken to refine and validate the metabarcoding protocol. Initial trials successfully amplified and sequenced dietary data from a diverse range of taxa, including cnidarians, sponges and macroalgae (Rhodophyta, Ochrophyta and Chlorophyta). Two key optimisation challenges were identified: primer selection and the dominance of turtle DNA, particularly in cloacal swabs. Swabs from both turtles and habitats were then sequenced with five different primer sets (targeting eukaryotes: 18SV4, 18SV7, 18SV9; metazoan: COI and algae: 23S) to optimise primer choice in this population. Mock communities of ten putative local diet items covering a breadth of taxonomic groups were included to assess coverage and evaluate amplification biases. The presence of polymerase chain reaction (PCR) blocking methods (custom-designed peptide nucleic acid (PNA) clamp and blocking primers) was tested to mitigate host dominance, in addition to a comparison of high-fidelity versus Taq polymerases. This work provides a foundation for effective, large-scale analysis of sea turtle diet in a remote island ecosystem. Further, it provides a methodological framework applicable to other sea turtle species and populations worldwide.

DIET COMPOSITION AND TROPHIC PLASTICITY OF GREEN TURTLES ACROSS WEST AFRICA

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Green turtles (*Chelonia mydas*) are often regarded as specialized herbivores, but their diet can vary with age/size and geographical location. In most regions they are known to mainly feed on seagrass and algae, but in cooler waters animal consumption increases and may even dominate. West Africa harbours large aggregations of green turtles, but knowledge of their diet and foraging ecology across the region remains limited. Understanding trophic flexibility is particularly relevant given projected climate-driven loss of West African seagrass beds. To evaluate the feeding habits along environmental gradients, we investigated green turtle diet and trophic niche along West Africa's latitudinal range to assess reliance on seagrass and potential capacity to shift to alternative food sources. Sampling was conducted between December 2023 and May 2025 in four key foraging areas: Banc d'Arguin (Mauritania), Joal and Saloum Delta (Senegal), the Bijagós Archipelago (Guinea-Bissau), and Ahwiam (Ghana). Turtles were captured in-water using nets deployed from small boats. We measured curved carapace length (CCL) and collected esophageal swabs for DNA metabarcoding, a minimally invasive method for diet assessment. DNA was extracted and sequenced to identify dietary items. We analysed esophageal swabs from 114 turtles (mean CCL 77.2 ± 19.8 cm, range 33.0–108.5 cm) representing multiple size classes and age groups. Results confirmed a mixed diet composed of algae and seagrass, as expected, but also revealed substantial ingestion of animal taxa, particularly cnidarians. The most frequent taxa detected included seagrasses, red algae, Leptothecata (hydrozoans), Cnidaria and bryozoans. Diet composition varied markedly across the latitudinal gradient, with turtles from the northernmost and southernmost sites exhibiting the most distinct diets. Turtles in Mauritania fed mostly on seagrass, whereas those in Guinea-Bissau and Ghana mainly on red algae. Senegalese turtles displayed the most variety and intermediate composition of the diet between Mauritania and Guinea-Bissau. Turtles in Ghana had the least diverse diet, feeding almost exclusively on red algae. Within-country comparisons also showed local-scale dietary differences. In Senegal, turtles from the open coast of Joal displayed a different diet than the ones from Saloum Delta, mostly with similar taxa but in different proportions. In the Banc d'Arguin, Mauritania, the diet also varied , with closest sites showing the most similar dietary items. Seasonal variability in Mauritania and Senegal (April vs. November/May) indicate changes in food composition, likely reflecting fluctuations in resource availability, though small sample sizes limit interpretation. The diversity and abundance of animal taxa may hint a greater role of animal prey than previously thought in West African green turtle diets. However, because many of these taxa include pelagic and benthic life stages, future work should examine whether green turtles primarily graze on benthic substrates, ingest epiphytic sessile forms together with algae and seagrasses or also feed on pelagic organisms. This study provides the first large-scale diet characterization of green turtles across West Africa. Our results evidence trophic plasticity and capacity of green turtles to adapt to local resource conditions, a key trait for resilience under ongoing climate-driven habitat change.

SPATIAL MODELS OF LOGGERHEAD TURTLE AVAILABILITY BIAS IN THE MEDITERRANEAN SEA*

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For air breathing marine animals, quantifying their diving behavior is crucial to understanding their ecology. In addition to the ecological insights gained, the amount of time animals spend at the surface is important for estimating animal abundance at sea. Availability bias, commonly expressed as 'g0', the proportion of time animals are available at the surface to be seen by aerial and shipboard line transect surveys, greatly impact at-sea abundance and distribution estimates. For sea turtles, average g0 estimates can vary from 0.05-0.9 depending on the species, season, and region. g0 is commonly incorporated into at-sea abundance estimates as a single value, despite animal dive behavior being a complex process that varies in space and time. We analyzed satellite telemetry data from 139 loggerhead turtles (*Caretta caretta*), ranging in size from 32-94 cm (mean = 66.5 cm) and of both sexes. Tags were deployed from sites in Spain, Italy, Cyprus, Turkey, Greece, and Croatia, were of several different makes, and were deployed under multiple data collection programs. Depth data were aggregated into a common format across tag types and programs: 6h mean estimates of g0. We fit spatial models relating loggerhead sea turtle g0 estimates to environmental covariates at multiple depth bands: surface, shallow (2m), and deep (4m), to account for different viewing conditions during line transect surveys. Environmental covariates that could plausibly influence animal dive behavior, as well as random and fixed effects relating to individual animals, were tested in a generalized additive mixed model (GAMM) framework. Models with limited numbers of covariates and less complex relationships to environmental covariates were selected for the surface and shallow depth bands, incorporating depth, bottom temperature, vertically integrated chlorophyll-a, salinity, and animal ID into the model. Simpler models were selected to improve ecological interpretability, ameliorate spatial autocorrelation present in the dataset, and to account for animal ID being one of the more important factors in the model. A model for the deep depth band was not selected, as little deviance was explained by environmental covariates relative to individual animal behavior. This may indicate that animal behavior at depth is more variable than closer to the surface, driven more by individual behavior, or that the available covariates lacked explanatory power. Monthly average predictions of g0 were derived covering the entire Mediterranean Sea. Mean g0 at the surface was 0.28 (CV 0.06) across all months and

locations. Mean g0 within the 2m depth band was 0.43 (CV = 0.08) across all locations and months. As expected, uncertainty was higher in the 2m depth band as more of the water column was considered 'available'. These models increase our understanding of how loggerhead turtles utilize 3-dimensional habitat dynamically in space and time and will improve abundance estimates critical to conservation efforts in the Mediterranean Sea.

SPATIAL ECOLOGY OF HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) NESTING AT GANDOCA BEACH, COSTA RICA: HABITAT USE, HABITAT SELECTION, AND MIGRATORY CONNECTIVITY*

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The hawksbill turtle (*Eretmochelys imbricata*) is considered critically endangered worldwide, facing threats from exploitation, bycatch, and habitat degradation in coastal ecosystems. Their recovery depends on protecting critical habitats, including internesting areas, migration corridors, and foraging grounds. While hawksbills nesting on Costa Rica's eastern coast linger locally during the internesting period, they later migrate to foraging grounds elsewhere in the Caribbean. Our study aimed to identify spatially explicit foraging areas of hawksbills nesting in Costa Rica, elucidate migratory corridors and habitat connectivity, and describe habitat use and selection by analysing spatial data. We further sought to identify oceanographic drivers influencing these movements. These data are essential for guiding multinational conservation priorities and protecting key coastal and shelf habitats for hawksbills in the wider Caribbean. Nine female hawksbills were equipped with high-resolution Iridium transmitters between 2020 & 2025 while nesting at the Gandoca-Manzanillo Wildlife Refuge (RNVSGM), Costa Rica. We used integrated state-space models, home-range mapping, and environmental GAM models to examine habitat use and selection, migratory connectivity and oceanographic influences. Behavioural states were inferred using a two-state Hidden Markov Model fitted to step length and turning angle data, distinguishing area-restricted search (internesting/foraging) from directed migration. Satellite tracks were divided into three phases: internesting, migration, and foraging. Phase-specific home ranges were quantified by 50% and 95% utilisation distributions (UDs) using kernel density estimates. Migration tracks were summarised by length, duration, and displacement to characterise movement extent. Migration headings were compared to near-surface currents from CMEMS using cosine similarity (SC) to test whether turtle movement aligned with dominant current patterns. Habitat selection during migration and foraging was modelled using Poisson point-process generalised additive models (GAMs) with environmental predictors including bathymetry, sea-surface temperature, chlorophyll-a, current velocity, and distance to coast and reef habitats. These analyses evaluated whether oceanographic and productivity features influenced movement orientation and space use. The analysed tracks spanned the EEZs of Costa Rica, Nicaragua, Honduras, and, in one case, Mexico. Internesting behaviour was highly localised (50% core area: 0.00–0.69 km²; 95% UD: 0.08–19.84 km²), showing strong site fidelity near RNVSGM. While all females migrated toward the Nicaraguan shelf zone, foraging home ranges were larger (50% core: 0.69–70.01 km²; 95% UD: up to 552.17 km²). All post-nesting migrations followed a consistent loop pattern: turtles departed the Costa Rican coast, were carried offshore into deeper Caribbean waters, consistent with advection by the cyclonic circulation of the Colombia–Panama Gyre (CP-G), before redirecting coastward and north toward foraging grounds. Cosine-similarity analysis yielded a pooled SC = 0.32 (SE 0.12), indicating partial alignment of migration headings with surface currents and suggesting current-aided movement. These findings highlight the importance of RNVSGM and its marine extension as both a nesting hub and ecological gateway for transboundary hawksbill migrations. The identified Nicaraguan shelf area bordering Honduras represents a key foraging

region. The observed migration loops and current alignment suggest that the CP-G shapes hawksbill dispersal, likely reduces transit costs, and maintains habitat connectivity across EEZs. Understanding these mechanisms supports coordinated regional management and the recovery of this critically endangered species.

MAKE EFFORT COUNT: GENERATING REPRESENTATIVE MARK-RESIGHT DATA AND APPLYING A STANDARDIZED SITE FIDELITY INDEX TO STUDY GREEN TURTLE FORAGING AGGREGATIONS

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Determining population dynamics and site fidelity of marine turtles in foraging habitats is crucial for effective conservation management, yet few in-water survey designs highlight the importance of statistically robust mark-resight aggregation data. We carried out standardized snorkel photo-ID surveys to generate representative mark-resight histories for green turtles at two adjacent reef sites on Liuqiu Island, Taiwan, across nine quarterly sampling periods (October 2020–November 2022; 105 surveys). We recorded sightings, of which 3,845 (92%) were photo-ID valid, identifying 398 individuals, and the majority (65.4%) were juveniles. To evaluate representativeness, we compared four survey designs (Single-, Double-, Triple-, and > Triple-event) using coverage-based sampling coverage (iNEXT model). > Triple-event surveys (six survey events every three months) achieved > 95% sampling coverage and produced a 1.7-fold higher resighting rate than conventional single-event surveys (one survey event every three months). Detectability varied with tide cycles: flood and high tides had the most sightings, while flood and ebb tides yielded more unique individuals, indicating that tide cycle can bias inference if not accounted for. Using the representative mark-resight dataset, 82% of turtles (n = 327) were resighted on different days, including multi-year stays (>2 years for 16%). The total number of turtles recorded across both sites per sampling period ranged from 75 to 253 (mean 168.8), indicating a large and stable aggregation. We then applied the Standardized Site Fidelity Index (SSFI) to turtles for the first time (range 0–0.0827; mean 0.024) and identified two fidelity groups via one-dimensional hierarchical clustering. Adult-sized turtles had lower SSFI values than juveniles and subadults, consistent with an ontogenetic expansion of home range. Interstudy comparisons using open-access photo-ID data suggest that absolute SSFI values are not directly comparable across datasets because SSFImax varies with sampling frequency and study duration; thus, comparisons should emphasize distributional patterns (e.g., skewness and variability). It also highlights the need for transparent effort metadata to facilitate interstudy comparison. Overall, combining routine sampling-coverage diagnostics, applying SSFI, and strengthening commitments to open data provides a practical framework for comparable site-fidelity inference and evidence-based conservation of foraging turtle aggregations.

MIGRATION PATTERNS OF MALE NORTH PACIFIC LOGGERHEAD TURTLES *CARETTA CARETTA* SPENDING SUMMER IN HIGH-LATITUDE WATERS*

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Knowledge of the spatiotemporal distribution of sea turtles has been biased toward adult females because of the inaccessibility of males. A recent study found a male-biased sex ratio among adult-sized loggerhead turtles (*Caretta caretta*) at a high-latitude summer-restricted foraging ground, the Sanriku Coastal area (northeastern Japan, 39°N), far from the nesting grounds of the North Pacific population. To describe the spatiotemporal distribution of males and explore potential mechanisms for the male bias in this area, we conducted satellite tracking of 16 juvenile- to adult-sized males (straight carapace length: 56.3–88.9 cm) migrating to the Sanriku Coastal area between 2009 and 2017. Of these, 9 males were tracked until the following spring's mating season; 4 (including 2 adult-sized males) migrated to the vicinity of their nesting grounds. After the mating season, these males left the nesting grounds until the middle of the females' nesting period, and all males, which include those migrating to the vicinity of nesting grounds and remaining in oceanic areas, remigrated to the high-latitude area (approximately 40°N) during the following summer. These results suggest that males may benefit from utilizing the nutrient-rich but distant high-latitude foraging grounds, including the Sanriku Coastal area, for longer period than post-nesting females, who must remain around the nesting grounds until mid-summer. This behavior likely explains the observed male-biased sex ratio in this summer-restricted foraging ground. Our study highlights the importance of comparative studies to understand the significance of high-latitude foraging grounds for male loggerhead turtles in the entire North Pacific population.

AN INTEGRATED SPECIES DISTRIBUTION MODEL FOR LEATHERBACK SEA TURTLES IN THE NORTHEAST US SHELF*

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Leatherback sea turtles (*Dermochelys coriacea*) inhabit the Northeast US Shelf, including state and federal waters, which provide important seasonal foraging habitats during the summer and fall. Understanding and predicting leatherback distribution is crucial for managing human impacts such as bycatch in fishing gear and vessel strike. However, knowledge gaps about leatherback distribution hinder the development of effective management strategies and impede our ability to predict climate-driven distribution shifts. We developed an integrated species distribution model to predict leatherback sea turtle distribution over the Northeast US Shelf. We combined presence-only and presence-absence data, collected between 2003 and 2023, from multiple sources including the New England Aquarium, North Atlantic Right Whale Consortium, the Mass Audubon Wellfleet Bay Wildlife Sanctuary, the Massachusetts Sea Turtle

Disentanglement Network, the National Marine Fisheries Service, and OBIS SEAMAP. These datasets included data from satellite telemetry (n = 6,445 data points from 29 tags), citizen scientists (n = 2,079), line transect aerial surveys (searched 2,907,175 plots, 309 presences), and opportunistic sightings from shipboard and aerial surveys (n = 1,209). To model the probability of gelatinous prey species ("jellyfish") presence (e.g., scyphozoans, salps, and siphonophores) we used boosted regression trees with NOAA's ECOMON survey data collected between 2003 and 2019. To predict the likelihood of jellyfish presence, we used a series of environmental covariates, the most important included daylength, the derivative of daylength, oxygen, and bottom temperature. We used the modeled gelatinous prey layers as covariates within the integrated species distribution model. To combine these disparate datasets and describe the monthly intensity of leatherback turtle sightings in an area, we used point processes and joint likelihood methods.

DEVELOPING A NOVEL SATELLITE TAG ANCHOR SYSTEM FOR LEATHERBACK TURTLES TO SUPPORT BYCATCH IMPACT ASSESSMENTS*

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Understanding leatherback turtle (*Dermochelys coriacea*) movements and post-release mortality following longline fishery interactions is a critical management need. However, such studies have been constrained by the requirement to bring leatherbacks onboard for satellite tag attachment, which is impractical on most longline vessels. To overcome this, in 2020 NOAA's Pacific Islands Fisheries Science Center (PIFSC) and Office of Protected Resources (OPR), in collaboration with Wildlife Computers, initiated the development of a Leatherback Anchor System (LAS) designed to enable satellite tag deployment from the vessel's side. The leatherback's unique carapace—composed of interdigitating bone beneath thick connective tissue—was identified as a suitable site for secure, non-invasive anchoring. The caudal carapace was selected for its tissue depth and distance from vital organs, offering a consistent and safe deployment zone. Following multiple design iterations, the team developed the LAS, comprising a stainless-steel anchor implanted using a spring-powered Leatherback Anchor Deployment Device (LADD). This two-component system enables quick and reliable implantation. More than 59 cadaver trials, informed by CT imaging and veterinary consultation, refined the system to a field-ready state. Beginning in 2024, PIFSC and OPR partnered with the Southeast and Northeast Fisheries Science Centers (SEFSC, NEFSC) to obtain permits and conduct field trials to evaluate LAS deployment and tag retention. This collaborative effort is supported by the Sea Turtle Stock Assessment Improvement Framework Approach (STA-IFA). In May 2025, the team conducted fieldwork off the coast of North Carolina, capturing thirteen leatherbacks, seven of which were tagged using the LAS and six via traditional pygal attachment, allowing for direct comparison of deployment efficiency and tag performance. All tags continued transmitting successfully through June 9, 2025 (mean = 22.7 days, SD = 2.8), with the exception of one that failed to transmit. Building on these successes, an additional nine tags (five LAS anchors and four pygal attachments) were deployed off the coast of Massachusetts between September 13 and 19, 2025. As of October 21, 2025, all remain actively transmitting. Concurrently, a new LAS design is under development that passes through the pygal and incorporates a small retention lever, with the goal of improving hold time relative to the current model, which penetrates below the interdigital bone. Here, we report on the LAS/LADD development, field trials,

preliminary results, and ongoing design improvements. This innovative tagging system represents a major advance in leatherback telemetry and has the potential to significantly enhance our understanding of leatherback-fishery interactions, improve post-release mortality estimates, and support conservation and management efforts in both U.S. and international waters.

DIGITIZING IN-WATER SEA TURTLE HABITATS, MOVEMENTS, AND CONSERVATION DATA IN THE RED SEA: A GIS-BASED FRAMEWORK FOR EVIDENCE-DRIVEN CONSERVATION

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In-water habitats and movement patterns of sea turtles remain among the poorly documented aspects of their biology, crucial for effective conservation and management. In the Kingdom of Saudi Arabia (KSA) Red Sea—home to five sea turtle species, including the Endangered *Chelonia mydas* and Critically Endangered *Eretmochelys imbricata*—baseline information has long been fragmented or localized. Building on SHAMS' 2024 in-water monitoring program, which standardized survey methodologies and produced the first coordinated dataset on turtle distribution, behavior, and threats along the Red Sea coast, this project establishes the first digital, GIS-based In-water habitat atlas for sea turtles in the Kingdom. The initiative compiles and digitizes both published and field data describing foraging, mating, developmental, and resting habitats, as well as migratory routes. A hexagonal spatial grid of 4 km² resolution ensures consistent spatial coverage and minimizes edge and directional bias, while preserving ecological relationships between neighboring cells. Each grid cell integrates multi-source information—including field-validated in-water surveys, satellite telemetry, drone imagery, environmental assessments, and literature records—into a unified geodatabase. This equal-area design allows for robust cross-scale comparisons, linking site-specific observations to regional analyses and improving spatial continuity for modeling habitat connectivity and ecological gradients. To date, data from more than 70 standardized snorkelling surveys (2024–2025) have been incorporated, encompassing detailed habitat descriptors (seagrass, coral reef, lagoonal, and mixed systems), life-stage classification, and verified records of anthropogenic pressures such as habitat degradation, fisheries interaction, vessel traffic, and marine debris. High-accuracy photo-identification, biometric data, and GPS-referenced sightings ensure spatial precision and ecological reliability. The resulting digital atlas establishes a dynamic and interoperable framework for advanced spatial analyses, including the identification of critical habitats, ecological corridors, and conservation priority zones. Furthermore, it provides tools for assessing exposure risk and simulating potential habitat shifts under projected environmental and developmental scenarios. Designed for scalability and iterative updating, the system will support predictive modeling through spatial statistics and machine-learning applications as new data become available. This initiative represents a transition from descriptive monitoring to predictive, evidence-driven conservation. By consolidating available data into a standardized geospatial infrastructure, SHAMS is enabling integrated marine spatial planning and more effective management of sea turtles. The framework directly supports the forthcoming 2025–2027 Sea Turtle Conservation Management Plan, aligning with the actions established during the first International Sea Turtle Symposium in the Red Sea, and strengthens Saudi Arabia's contribution to marine biodiversity conservation at both regional and global levels. Beyond its local application, the digital platform establishes

a scalable model for using geospatial science and technology to enhance transboundary collaboration and protect sea turtle populations and their critical habitats across interconnected marine regions worldwide.

COMPARISON OF ISOTOPIC NICHES OF BREEDING GREEN TURTLES AT TWO MAJOR CARIBBEAN ROOKERIES*

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Understanding variability in feeding strategies among and within sea turtle populations, including differences between sexes, is essential for developing effective conservation strategies. In the Caribbean, green turtles exhibit complex migratory connections between breeding and foraging habitats that differ greatly in oceanographic and ecological conditions. We compared the isotopic niches of adult female and male green turtles breeding at Isla de Aves (AV), Venezuela, with those of females nesting at Tortuguero (TR), Costa Rica. These rookeries represent contrasting environments—a remote and small oceanic island vs. a continental beach—providing a natural framework to examine how geography and sex influence habitat use and trophic diversity. We analyzed tissue samples from 170 females and 41 males captured at AV (2008–2012) and 376 females nesting at TR (2007–2009), for stable carbon ($\delta^{13}C$) and nitrogen (δ15N) isotope ratios. To quantify niche area (SEAb) and overlap, we evaluated differences in isotopic central tendency and dispersion using PERMANOVA and Bayesian ellipse metrics. Results revealed clear isotopic differentiation between the two rookeries. Females from AV exhibited significantly larger isotopic niche areas (SEAB = 34.4‰², 95% CI: 25.5–44.0) than those from TR (SEAB = 9.2‰², 95% CI: 6.8–11.8). Mean $\delta^{13}C$ values were −10.7 ± 5.1‰ for AV and −9.9 ± 2.6‰ for TR females, while δ15N values averaged 7.1 ± 2.4‰ and 7.1 ± 1.2‰, respectively. The isotopic ellipse of AV females fully encompassed that of TR, suggesting AV females had a greater diversity of foraging habitats. Within AV, early-season females exhibited isotopic niche areas more than twice as large (SEAB = 34.3‰²) as late-season females (SEAB = 14.4‰²). Males showed a similar pattern, with early-season SEAB = 28.3‰² compared to 8.6‰² later in the season. Sex-related variation was also evident: early males and females overlapped extensively (76%), whereas late-season groups diverged sharply (<25% overlap). These differences were unrelated to body size or clutch size. The large isotopic area observed at AV suggests the use of multiple foraging habitats across the southern Caribbean, potentially including coastal and oceanic habitats characterized by distinct baseline productivity and trophic structures. The island, located about 670 km north of mainland Venezuela and 200 km west of Guadeloupe, is surrounded by deep, productive waters influenced by seasonal upwelling. In contrast, TR, on the Caribbean coast of Costa Rica, is associated with stable neritic feeding grounds dominated by seagrass meadows, which likely contributed to a narrower isotopic area. By focusing on isotopic niche structure rather than specific foraging locations, this study highlights how geographic

context and sex may influence ecological diversity and adaptive capacity. The broader niche of AV turtles suggests greater ecological flexibility, enabling individuals to use varied habitats. Conversely, the narrower niche of TR turtles suggests specialization in stable coastal ecosystems, which may increase their vulnerability to seagrass decline and coastal development. Recognizing these contrasting strategies is essential for regional conservation and recovery planning that safeguards all potential foraging habitats, from oceanic waters to coastal seagrass meadows.

PATTERNS OF MIGRATION BEHAVIOUR IN ADULT FLATBACK AND LOGGERHEAD TURTLES*

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Tracking technologies have revolutionised our understanding of how marine animals interact with their environment, offering unprecedented insights into the spatial ecology of wide-ranging species such as sea turtles. For decades, satellite telemetry has been central to identifying critical habitats and migration corridors, forming the foundation for conservation planning and management. Implicit within much of the early literature, however, is a simplifying assumption: that turtles follow a relatively direct and predictable route from nesting beaches to distinct foraging grounds. While this framework has provided useful generalisations, it risks obscuring the diversity and complexity of turtle movement strategies. In this study, we compile and analyse satellite tracking and flipper tag recovery data from a large dataset of flatback (79 tags) and loggerhead turtles (35 tags) in Queensland, Australia. By synthesising movement trajectories across this diverse dataset using steady state models and other exploratory tools, we explore the complexity of sea turtle migration, from non-migratory residents to meandering ocean or coastal wanderers. While our studied loggerhead turtles generally conform with the direct migration patter, our data on flatback turtle migration and foraging shows a high variation and includes strong inter-individual behavioural patterns, highlighting divergence from the generalised beliefs of migration. Rather than treating these behaviours as exceptions, we propose that they form part of a broader continuum of strategies that together define the ecological versatility of sea turtles. From our work we challenge the assumption of linear or "normal". Our growing evidence reveals that many turtles deviate markedly from generalised patterns, engaging in detours, extended stopovers, looped routes, or even remaining within near-nesting coastal waters for prolonged periods. These apparent anomalies, once dismissed as outliers, may instead reflect adaptive responses to local environmental variability, resource distribution, or individual life-history traits. Understanding such behavioural flexibility is crucial for predicting how turtles will respond to accelerating environmental change. Our findings emphasise the need to rethink what constitutes "normal" migration and to recognise behavioural diversity as both common and ecologically significant. This shift has profound implications for how we model turtle movement, identify key habitats, and design spatial protection measures. By reframing the concepts of expected behaviour in sea turtle ecology, we move closer to understanding the true complexity of how these ancient mariners use the coastal and oceanic waters.

SHORTFALL IN THE SYNTHESIS OF REGIONAL GREEN TURTLE CONNECTIVITY ACROSS SOUTHEAST ASIA*

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Sea turtles require a wide range of habitats to complete their reproductive migrations and ontogenetic shifts, including movement corridors through the waters of multiple countries and open seas. Managing turtle populations throughout these movements is challenging because they often move through and beyond local or national management boundaries. Despite substantial research using various sampling methods such as telemetry tracking, flipper tagging, photo-ID, genetic, and stable isotope analyses over decades, understanding the movement of sea turtles and the way they link habitats remains siloed and limited by the lack of a comprehensive meta-analyses that integrate multiple approaches and data sources. Such meta-analyses are also frequently constrained by the common reliance on English peer-reviewed journal articles in literature reviews and dataset compilation, which overlooks important information found in grey literature and literature written in non-English languages. To address this gap, we conducted a systematic multi-language review of the movement and migratory connectivity of green sea turtles (*Chelonia mydas*) around Southeast Asia. Our findings revealed that most (>60%) of green turtle movement and migratory connectivity data were documented in grey literature, along with an additional 8% comprising unpublished data over the past four decades. Movement studies were mostly confined to specific ocean basins or exclusive economic zones in Malaysia, Taiwan, Thailand, and Indonesia. In this presentation, I will focus on the migratory connectivity network of the green turtle across nations and territories, highlighting various levels of evidence of animal movement that are synthesised at the regional level in terms of publication type, language, and accessibility. Our study indicates that non-English studies and grey literature are likely underrepresented in global syntheses due to barriers in accessibility and visibility. More effective approaches for collecting and synthesising marine turtle connectivity data across multiple languages and data sources are necessary to accurately identify their critical habitats and ensure they receive adequate protection.

TEMPORAL ANALYSIS OF THE HONU (*CHELONIA MYDAS*) POPULATION IN KAHALU‘U BAY, HAWAI‘I

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Kahalu‘u Bay on Hawai‘i Island is an important nearshore foraging habitat for Green sea turtles (Honu; *Chelonia mydas*). Kahalu‘u is a culturally and ecologically significant area as well as a cherished community gathering place. Kahalu‘u Bay is home to an ancient coral reef ecosystem. This reef provides habitat for hundreds of species including threatened honu, rare corals, and endemic species found nowhere else in the world. Over the last several decades, Kahalu‘u has been damaged by an increase in chronic stressors. These stressors include physical damage from over 400,000 beachgoers each year, impaired water quality from nearby cesspools and runoff, more intense and frequent marine heatwaves and damage from sea level rise. In order to better understand the dynamics of the honu population in Kahalu‘u we have been using photo identification to track individual honu within the bay. Over the last 6, years we have identified 54 individuals within the bay. The majority of the honu observed were juvenile or subadults based on carapace length. Individuals were identified based on their unique facial scale patterns. Honu counts were performed, on average, 12 times per month. Each month the total number of distinct individuals were recorded as well as how often each individual was observed. These data revealed that within the honu population some individuals were observed in more than 4 months of the year (classified as residents), others were observed in 3-4 months (classified as snowbirds) and others were only observed during one or two months (classified as tourists). Of the 54 individuals, 8 have been observed every year throughout the study. The total number of honu sightings as well as to a lesser extent the number of different individuals show a distinct distribution through the calendar year, with highest numbers being observed from August through February. Data also revealed that in 2024 there was a large increase in the number of new, juvenile honu observed in the bay; 14 new individuals as compared to 1-5 in previous years. The reason for the large increase in new juvenile honu in 2024 is not clear but it is intriguing that this same year the bay experienced a very unusual and robust bloom of limu kahili (*Tubinaria ornata*), which appeared to be a favorite food of the honu. During the COVID pandemic of 2020 the dramatic decrease in visitors to Kahalu‘u allowed the bay to rest. Following this rest period there was a noticeable increase in limu, one of the honu‘s primary food sources, covering the papa (intertidal area) at Kahalu‘u. In order to help preserve this important area, The Kohala Center‘s ReefTeach program, a community driven stewardship effort, initiated new educational outreach coupled with explanatory signage to help keep visitors from entering the intertidal area. The success of these outreach efforts is perhaps evident in the dramatically greater numbers of resident honu that we have seen in Kahalu‘u over the last two years.

HITCHHIKER LOAD REDUCES HOST GRAZING EFFICIENCY

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Symbiotic relationships are often associated with costs and benefits for the species involved. Assessing these relationships can be challenging in the marine environment due to logistical constraints in monitoring over large spatial scales. One of the common marine symbiotic associations between sea turtles and remoras is traditionally considered commensalism; however, there is little evidence supporting this classification. We examined interactions between green turtles (*Chelonia mydas*) and remoras (*Echeneis naucrates*) using SCUBA observations (n = 71) and underwater videos (n = 37) in the Egyptian Red Sea in 2023. Using focal observations, two divers recorded the number of remoras per turtle (remora load), seabed depth where the turtle was grazing, and estimated turtle size. To assess costs and benefits to turtles, we tested the effect of remora load on host grazing rate (bites/min) and counted instances of remoras cleaning their hosts. We also explored the relationship between host depth and remora load. Green turtle grazing rates decreased by ~30% across the observed remora load range (0-3 remoras; $p < 0.05$), indicating that high remora loads could reduce host foraging efficiency. In contrast, we recorded only one event of a remora cleaning a turtle carapace, suggesting that cleaning benefits are minimal. Our results also showed that remora load increased with depth (1.5-16.4 m; $p < 0.05$); however, there is limited information on vertical space use of remoras to explain the benefits of deeper habitats. Our study is the first to report the sea turtle-remora relationship from the Red Sea, and the broader Indian Ocean region, whereas previous reports were from the Atlantic and Pacific Oceans only (n = 13 studies). Furthermore, we provide the first quantitative assessment of the remora-sea turtle relationship, which suggests that the relationship may switch between commensalism and parasitism depending on hitchhiker load.

SOCIAL BEHAVIOR REPRESENTS AN EMERGING PARADIGM FOR MARINE TURTLES

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Marine turtles have historically been considered solitary animals, with limited records of them engaging in non-reproductive social behaviors. However, recent evidence is emerging that suggests social behaviors may extend well beyond mating and may be more prevalent than believed, thereby challenging this basic marine turtle life history paradigm. Here, we review the current state of knowledge on social behavior in marine turtles, discuss potential effects on populations and ecological consequences, and provide recommendations for future research. A wide variety of social behaviors have recently been observed across positive, negative, and neutral interactions. Antagonistic behaviors observed include biting, contests, pursuing, nudging, ramming, antagonistic body contacting, gaping, nuzzling, and displacing, while non-antagonistic behaviors include congregating, group cleaning, group resting, grooming, rubbing, head touching, non-antagonistic body contacting, flipper flapping, following, approaching, and inspecting.

Other behaviors have also been documented that imply the capacity for social behavior, including vocalizing, herd foraging, group basking, herd migrating, social facilitation of hatching and emergence, and interspecific interactions. The implicit behaviors suggest that social behavior may be even more prominent in marine turtles than has been found explicitly. Our review demonstrates that marine turtles engage in both intraspecific and interspecific non-reproductive social behavior, representing a new paradigm in our understanding of marine turtle behavior with implications for effects at the levels of populations and ecosystems.

COUPLING SATELLITE TELEMETRY AND STABLE ISOTOPES FOR NESTING HAWKSBILLS IN THE WIDER CARIBBEAN

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Satellite telemetry provides detailed information on sea turtle movements, including migratory routes and the locations of site-specific behaviors, but the technology's high cost limits sample sizes. Stable isotope analysis, in contrast, offers a relatively inexpensive means for revealing insights into the habitat use of individuals, with isotope ratios alone being difficult to spatially anchor. Integrating these complementary approaches—by using the ratios of tracked animals to create an "isoscape" or a map of isotopic variation—can offer a tool for inferring foraging locations of untracked individuals and identifying critical foraging sites worthy of prioritization in management. However, the utility of this approach depends on whether spatial gradients in isotopic values exist across the region. We evaluated geographic patterns in isotopic composition of critically endangered hawksbill turtles (*Eretmochelys imbricata*) nesting at two sites in the Caribbean. Turtles were sampled for skin tissues and outfitted with satellite transmitters at Buck Island Reef National Monument, U.S. Virgin Islands (N=31; 2009–2013) and Long Island (Jumby Bay), Antigua (N=20; 2015–2021). We evaluated movement patterns using switching state-space models applied to Argos telemetry data and georeferenced skin carbon (δ13C) and nitrogen (δ15N) isotope ratios to the foraging sites identified from the telemetry models. We then used Empirical Bayesian Kriging to generate isoscapes for both elements. Tracking data revealed that turtles crossed multiple national jurisdictions, with foraging areas extending to the waters of the Bahamas, Nicaragua, the Greater Antilles, the Leeward Islands of the Lesser Antilles, and Venezuela. Skin d13C ranged from -18.29 to - 12.10 ‰ and δ15N ranged from 4.52 to 11.40 ‰. We integrate these results to explore whether the hawksbill d13C and δ15N isoscapes contain sufficient spatial differentiation for inferring the origin of untracked individuals. This study, to our knowledge, represents the first attempt to combine satellite telemetry and stable isotope analysis for hawksbills globally, offering key insights into whether an isoscape-based foraging area assignment is tractable within the Caribbean Basin, or whether other methods are needed.

DISPERSAL AND HABITAT USE OF JUVENILE KEMP'S RIDLEY TURTLES IN THE GULF OF MEXICO*

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As climate change and other anthropogenic factors continue to impact marine ecosystems, understanding the distribution of juvenile marine turtles during their dispersal stage is critical for effective conservation and management. We used satellite tracking data from 25 wild-caught dispersal stage juvenile Kemp's ridleys (*Lepidochelys kempii*; mean: 19.1 ± 3.1 SD cm SCL) captured between 2011 and 2022 in the Gulf of Mexico (GOM). To predict the turtles' distribution, we employed 26 environmental variables to train species distribution models (SDMs) using the dismo package in R. Model performance was evaluated using area under the curve (AUC) and the true skill statistic (TSS) to select the best-fitting models. Sea surface temperature, the Okubo-Weiss parameter, eddy kinetic energy, and bathymetry emerged as the most influential variables for predicting Kemp's ridley distribution. These findings suggest that ocean eddies may play a significant role in the dispersal of juvenile Kemp's ridleys in the GOM, potentially providing favorable habitat or aiding in transport during their movements. These variables highlight essential environmental factors that can guide predictions of juvenile Kemp's ridley distribution during their early dispersal life stage. By refining and expanding these models, future research can better predict the distribution of Kemp's ridley turtles across different regions or life stages, supporting efforts to protect this vulnerable species in the face of climate change and natural disasters.

JUVENILE GREEN TURTLE DISTRIBUTIONS IN THE GULF OF MEXICO DURING THE ELUSIVE "LOST YEARS"

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Understanding the habitat use of juvenile green turtles (*Chelonia mydas*) during their elusive "lost years" is crucial for advancing conservation efforts, especially as environmental variability intensifies due to climate change. Here, we identify environmental drivers of movement and habitat use to address this knowledge gap. The movement patterns of wild-caught dispersal stage juveniles offer essential data for understanding early behavior; however, few data are available for this young life stage. We analyzed satellite tracking data from 77 juvenile green turtles (mean: 18.6 ± 3.0 SD cm SCL) collected between 2011 and 2022 in the Gulf of Mexico (GOM). The average tracking duration was 31.2 (± 13.7) days, yielding 6,436 individual turtle locations. We used 26 environmental factors to construct species distribution models (SDMs) in R using the dismo package. Model performance was evaluated using the area under the curve (AUC) and the true skill statistic (TSS) to determine the best-fitting model. Our findings reveal that high-suitability habitat is concentrated along the northern and eastern Gulf shelf, especially in regions influenced by seasonal productivity and dynamic current regimes. Among environmental variables, distance to seamounts, sea surface temperature, and current speed were the

strongest predictors of distribution. These findings provide a template for identifying essential habitats and environmental drivers for dispersion among juvenile green turtles in the GOM. Additionally, our approach can be adapted to predict green turtle distributions in other regions and life stages, as well as other species, thereby enhancing our understanding of how marine turtles interact with changing environments.

EARLY MAGNETIC FIELD EXPERIENCE AFFECTS LOGGERHEAD SEA TURTLE ORIENTATION RESPONSES*

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Loggerhead sea turtles (*Caretta caretta*) must traverse vast distances across the ocean during the earliest stages of their life. One navigational tool they rely on during this journey is Earth's magnetic field, which provides geographically distinct magnetic signatures along their migratory route. Loggerhead hatchlings from the southeastern USA emerge from their nests immediately able to swim in ecologically adaptive directions in response to magnetic signatures that exist along their migratory path within the North Atlantic Gyre System (NASG). Because these orientation responses are present at hatching, they must be at least partially inherited, yet also flexible enough to adjust to the gradual shifts that will have occurred in Earth's magnetic field between theirs and their parents' migration in the NASG. Here, we investigate whether hatchling turtles may achieve this flexibility by registering the local magnetic field during their first swim offshore and setting it as a baseline field. In doing so, turtles could establish a reference that reflects up-to-date magnetic conditions and use it to calibrate inherited orientation responses to magnetic fields encountered later in their migration. To test this, we placed newly hatched loggerhead turtles from Florida, USA in a tank inside a magnetic coil system that can simulate 'displacement' to the magnetic field signatures of other geographic locations. In each treatment, we exposed swimming turtles to two sequential magnetic fields: a baseline field, which simulates the first field a turtle would swim in, followed by a test field, which simulates a magnetic field turtles would encounter later on their migratory route. When turtles experienced their first swim in the local Florida, USA field, followed by testing in the magnetic field that exists near Cape Verde, they responded with significantly oriented swimming (n=26, p=4.0E-4). However, if turtles were first exposed to a non-local magnetic field (replicating either Cape Verde or Barbados), turtles subsequently did not orient when swimming in the test field at Cape Verde (Cape Verde, n=27, p=0.94; Barbados, n=27, p=0.57). Follow-up experiments further confirmed that turtles who swam first in the local field (Florida, USA) could appropriately orient in another migratory route field near Puerto Rico (n=49, p=0.01), but if turtles experienced their first swim either of two non-local magnetic signatures that did not represent a geographic region, they subsequently failed to orient in the Puerto Rico field (n=39, p=0.11; n=24, p=0.80). These findings are consistent with the idea that a key baseline field set during the first swim influences a turtle's magnetic orientation, though whether this serves to calibrate these responses remains to be seen. Regardless, these findings highlight the importance of early magnetic field experiences in sea turtle navigation. Specifically, sufficient exposure to the natal beach magnetic field, which is also believed to facilitate natal homing as reproductive adults, appears necessary to respond to distant magnetic fields as hatchlings. Future work should further investigate the potentially complex interaction between magnetic environment, inherited information, and other potential mechanisms involved in shaping these orientation responses.

SURFACING BEHAVIORS FOR THREE SPECIES OF CHELONIIDS ALONG THE EASTERN UNITED STATES AND IMPLICATIONS FOR CONSERVATION MANAGEMENT

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Three species of cheloniids make seasonal migrations along the east coast of the United States (US). These include the loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), and Kemp's ridley turtle (*Lepidochelys kempii*). These turtles move between tropical and subtropical habitats in the southeastern US to temperate habitats as far north as the Gulf of Maine. These coastal areas are known for high density vessel traffic, as well as intensive use by commercial and recreational fisheries. The goal of this study was to investigate the surfacing behavior and movement patterns of cheloniids along the eastern US to assess spatio-temporal patterns. Three ecologically significant regions within the eastern US seaboard were examined: Southern New England, the Mid Atlantic Bight, and the South Atlantic Bight. Our objectives were to: 1) identify changes in surfacing behavior along different areas of the East Coast, 2) identify changes in surfacing behavior when sea turtles are migrating versus foraging, and 3) identify areas where turtles may be at higher risk of vessel strike (e.g., higher surface times) for targeted conservation management. To determine turtle surface time, we used high-resolution (± 1%) percent-dry timeline (PDT) data from 32 satellite tags deployed on juvenile loggerhead (n = 10), green (n = 9), and Kemp's ridley (n = 13) sea turtles released in Nantucket Sound, Massachusetts. To assess animal movement patterns, we examined move persistence values (g) generated by the R package, aniMotum. Overall, average PDT was low for all three species in each of the regions, with minor increases as turtles traveled further down the coast. Kemp's ridley turtles had the largest variability in g throughout the study region; however, average g was consistently in the upper range for all species indicating increased movement (e.g., migrating). The findings from this study are key for identifying areas in need of novel or increased conservation management, specifically useful for understanding how surfacing behaviors and movement patterns may increase vulnerability for human interaction.

POST-RELEASE CHANGES IN THE FINE-SCALE DIVING BEHAVIOR AND ACTIVITY OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) FROM THE NORTHEASTERN GULF OF MEXICO

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Biologging devices have been used to provide critical insights into the ecology of many animal taxa and are particularly valuable when studying species that are difficult to observe directly, like sea turtles. However, post-release changes in movement and behavior, likely the result of capture, handling, and tag attachment, can introduce biases that need to be accounted for when analyzing the data obtained from tag deployments. Fortunately, recent advancements in biologging devices allow not only for horizontal movements to be monitored at high resolution, but vertical movements as well, often in concert with behavioral data collected by integrated cameras. These types of data allow for rigorous assessment of post-release effects on study subjects. Here, we investigated short-term changes in loggerhead sea turtle (*Caretta caretta*) behavior following capture and release in the Northeastern Gulf of Mexico, Florida, U.S.A, using

tags equipped with high-definition cameras, pressure sensors and tri-axial accelerometers to record movement and diving behavior at sub-second resolutions. We used a generalized additive model framework to identify non-linear temporal changes in sea turtle behavior following release. Longer handling times were associated with more frequent, shorter dives and more swimming. These dive characteristics were also seen immediately following release. Dive activity (dynamic body acceleration) was nearly twofold higher immediately following release relative to when it had stabilized, suggesting greater energy expenditure. However, these behavioral effects were relatively short lived. Diving frequency and activity decreased over time as dives became longer and the probability of observing individuals foraging and resting increased. However, we found that the time it took for behaviors to stabilize to what might be considered more natural varied substantially depending on the behavior considered. As such, investigators should carefully consider how behaviors of interest change after release to avoid biases in interpretation, rather than just excluding data before a pre-defined cutoff. Our data contribute to a growing literature investigating the effects of capture and handling on post-release behavior of tagged animals across a variety of taxa and highlight the need to consider behaviors separately. This will help to limit biases when interpreting tagging data and serve to fine tune tagging methods to improve animal welfare.

BEHAVIORAL OBSERVATION OF GREEN SEA TURTLES IN NORTHEAST FLORIDA, USA MARINA

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Green sea turtles (*Chelonia mydas*) in northeast Florida are an understudied population. Juvenile green sea turtles use the Intracoastal Waterway as foraging and resting areas. By observing behaviors, data can be collected on individuals as they feed and use marina habitats. Starting in August 2025, behavioral observations of sea turtles were conducted at a marina in St. Augustine, Florida, USA. Weekly surveys were conducted by walking the marina to monitor sea turtle presence. Once a sea turtle was spotted, a voice memo was recorded on a phone for up to 10 minutes, or until the turtle was no longer in sight. These recordings were of behavioral observations, e.g. the turtle was eating off the dock or a boat, swimming in the middle of the marina, swimming in between a dock and a boat, if they were with or interacting with another turtle, how many breaths the turtle took, and if they were visibly suffering from health issues such as positive buoyancy syndrome. To date, 98 minutes of data was obtained from 10 turtles. On average sea turtles had a respiration rate of 0.50 breaths/min ± 0.67 SD. Green sea turtles spent the majority of their time feeding for an average of blank 52.17% and ± 37.04 SD. Through the preliminary data collected, it was discovered that the primary behavior seen is feeding. In most of the observations, the sea turtles were seen feeding off the dock as well as consuming algae from the hull of boats. Monitoring feeding habits is crucial as they reveal a sea turtle's role in maintaining a healthy ecosystem and can provide insight on ways to help conserve them by highlighting activity patterns. Additionally, weekly sightings of these turtles can help surveil health defects and abnormal behaviors, such as positive buoyancy syndrome. This allows for immediate care and can be used as the baseline for future research.

DISTRIBUTION AND MOVEMENTS OF SEA TURTLES AT INSULAR FORAGING GROUNDS IN THE WESTERN PACIFIC OCEAN: INSIGHTS FROM 10 YEARS OF IN-WATER SURVEYS AND 200 SATELLITE TAGS*

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The Mariana Islands in the Western Pacific Ocean are home to endangered populations of foraging green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles, yet systematic studies for both species are scarce in this region. We provide the first integrated description of distribution and movement behavior for sea turtles in the Mariana Archipelago (Guam and the Commonwealth of the Northern Mariana Islands) based on ten years of in-water surveys and 200 satellite telemetry deployments. Boat-based surveys recorded 1,096 turtle encounters around Guam, Tinian, and Saipan, comprising 871 green, 100 hawksbill, and 125 unidentified turtles. Green turtles outnumbered hawksbills by roughly nine to one. Captures totalled 281 turtles, of which 234 were greens and 47 were hawksbills. Satellite tags were deployed on 200 individuals, including 164 greens and 36 hawksbills. Most captured turtles were juveniles with straight carapace length less than 55 cm. Relative abundance from encounters per unit effort (EPUE) highlighted consistent nearshore hotspots. Green turtle EPUE was highest at sites such as Gab Gab and Dadi Beach on Guam and along multiple coastal sections of Saipan. Hawksbill EPUE peaked at Inner Glass Breakwater and Double Reef on Guam and along northwest Tinian. EPUE maps from this study delineate distinct areas of concentration for each species. Satellite tracking showed small home ranges and strong site fidelity for both species. Core use areas generally for green and hawksbill sea turtles measured a few tenths of a square kilometer and overall home ranges were commonly about two square kilometers. We classified individual movements into four movement patterns (MP). The great majority remained within a single foraging area (MP1). A smaller subset used multiple distinct foraging areas within the same island (MP2). Two turtles exhibited inter-island movements (MP3). Three turtles, all hawksbills, departed the Marianas entirely (MP4). Of the MP4 cases, two hawksbills, including one adult female (72.3 cm straight carapace length: SCL) and one presumed subadult (61.7 cm SCL) migrated about 2,100 km southeast to Ant Atoll (Pohnpei) in the Federated States of Micronesia. The third subadult (58.4 cm SCL) hawksbill migrated to the Republic of the Marshall Islands, a journey of approximately 2,500 km. Excluding migratory periods, habitat use for all green and hawksbill turtles was neritic with most dives shallower than 15 m, but with recorded dive depths extending to 100 m. Average experienced temperatures were warm,

30–32 °C, and both species spent most time in water shallower than 30 m. With 200 satellite tags deployed and a decade of building local research collaborations, we identified that the Mariana Archipelago functions primarily as developmental habitat for range-restricted juvenile green and hawksbill turtles that reside in shallow coastal waters for years. EPUE maps and telemetry together identify discrete nearshore habitats that are likely sensitive to local stressors and therefore high priorities for marine spatial planning and management. This project was a monumental effort which yielded the greatest understanding of foraging behavior for these two endangered (US ESA) species in the Pacific Islands Region.

ENVIRONMENTAL AND HUMAN INFLUENCES ON GREEN SEA TURTLE HABITAT USE IN THE RARE BRACKISH RIVER, OKINAWA, JAPAN

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Shiokawa River, located on the Motobu Peninsula of Okinawa, Japan, is one of only two known salt water rivers globally, and it has been designated as a Natural Monument of Japan. Shiokawa is scientifically classified as an anchialine spring. This unique brackish ecosystem, with seawater gushing out from underground springs, has long been known by local people as a site where green sea turtles (*Chelonia mydas*) ascend the river. However, scientific understanding of the environmental ecology in such habitats remains extremely limited. Investigating sea turtle behavior in this unique salt river is critical for species conservation and provides insight into ecological interactions in rare brackish habitats worldwide. From September 2024 to August 2025, we conducted observations of sea turtle sightings and environmental information along the Shiokawa River, from sunrise to sunset across different tidal stages. Water temperature in Shiokawa remained stable throughout the year. Sea turtle sightings were concentrated in the early morning and late afternoon, suggesting that habitat use may be influenced not by temperature fluctuations, but by tidal accessibility and reduced human disturbance. These patterns suggest that Shiokawa's role as a sea turtle habitat is shaped more by its unique physical features and patterns of human use. The consistent water temperature quiet conditions during early morning and late afternoon hours, may provide favorable conditions for resting or foraging. Based on individually identified sea turtles, at least seven individuals ascended the river during the study period. Furthermore, photographic records confirmed that at least one individual sea turtle has used the river mouth repeatedly since 2023, indicating strong site fidelity. This study provides the first record of sea turtle behavior in a salt river, and underscores the importance of integrating community-based monitoring to support conservation of these exceptional habitats. These findings demonstrate that even small and rare salt water rivers can provide essential ecological resources for sea turtle. By combining systematic observation with community engagement, this study contributes not only to species conservation but also to a broader understanding of globally rare brackish river ecosystems. Continued monitoring and sustained collaboration with residents are needed to understand long-term habitat use and to support conservation efforts.

CARETTA CARETTA MIGRATION AND FORAGING HABITS IN THE DAY/NIGHT CYCLE

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The night is a fascinating time; it is normally believed that animals are either diurnal or nocturnal. This, however, may not be true for animals such as migrating marine fauna like sea turtles. These migrations occur over several days/ weeks and do not seemingly allow for rest. A study on green sea turtles (*Chelonia mydas*) has shown that they will stray off course through the night during their migration patterns and realign themselves once it is daytime (Shimada et al.,2016). Currently, the duration and depth loggerhead turtles will dive during the day and night is known for foraging juveniles (Howell et al., 2010), however, it is unknown what specific behaviours adult loggerhead turtles exhibit during the day versus the nighttime during both migration and foraging. These parts of turtle life history are generally important to understand so we can more adequately protect loggerhead turtles from human activities such as boating, fishing, and light pollution by identifying when key areas are inhabited or travelled through. This study examines behavioural differences in loggerhead sea turtles (*Caretta caretta*) during daytime and nighttime using data collected from Fastloc GPS satellite tags for 38 individual turtles on the coast of east Australia. The dataset will be divided into migration and foraging periods, enabling comparisons of day versus night activity across life stages. This project highlights the differences in day and night travel speeds during their migration, and compares distances to shore, or any reef/island features, between the day and night during their foraging timeline. It is expected that the migration speed will be slower at night to compensate for the lack of navigational cues as well as the stray in course from day to night, and that turtles will leave sheltered habitats and move closer to shore during foraging due to more sheltered habitats available. Understanding these behavioural patterns is vital for conservation policy, as turtle movements at different times of day may increase or decrease exposure to human impacts. This work can therefore inform strategies for more effective species protection.

CAN PROJECTS LIKE INATURALIST BOLSTER PHOTOIDENTIFICATION DATABASES? OUTCOMES FROM A NORTHEAST FLORIDA, USA PROJECT

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Sea turtles represent a highly migratory endangered species. It is often difficult to gather data on fine-scale movements of these species due to the amount of time and effort needed to collect said data. Because of this, many studies are limited in the number of field-days researchers can devote to collecting data which can make inferences more difficult. A growing effort to involve the public in citizen science efforts has led to more data collection than could be done by researchers alone. Since 2020, we have been using photographs of green sea turtle head scales to determine unique individuals for a long-term dataset. These surveys are conducted weekly at two marinas in the Intracoastal Waterway located in Saint, Augustine, FL. These efforts represent only a snapshot of green sea turtle juveniles at these specific marinas. Photos from iNaturalist were downloaded from 2016 through December 2025 that were identified as green sea turtles. Our long-term dataset indicates that green sea turtles are present in our estuary for at least four years, therefore, four years before the start of the monitoring project was chosen as the starting point. Our project is limited to St. Johns County in northeast Florida, so only iNaturalist photos from this county were

used. A total of 221 observations were documented on iNaturalist for this location and time frame, as well as being labeled "research grade". The majority of observations only had the month and year of sighting, so all images were coded as being seen on the first day of the month listed. Out of these 187, 71 were determined to be potentially usable because the head scales were visible. The others were not used due to a variety of factors including the turtle being too far away or the image being too blurry. Once uploaded to Internet of Turtles, we were able to analyze 63 of the observations. Seven turtles matched our previous photos and added a total of 1376 days between sightings. The remaining 56 turtles were new sightings and expanded our database of individuals. We contacted the observers of the 71 turtles uploaded to iNaturalist for the location of their observations and received data on 40 of the observations. Twenty-seven observations were within a marina we already survey, but 13 observations were from areas outside of our study area. We also saw two observations of turtles swimming in pairs which corroborates our previously collected data. This indicates citizen science is a useful and practical way to increase effort in our sea turtle monitoring projects and can potentially help fill gaps on behavior.

STRAIGHT FROM THE CLOACA: THE COPROPHAGOUS RELATIONSHIP BETWEEN REMORAS AND GREEN TURTLES*

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In a study combining behavioral, microbiome, and trophic ecology, we describe a unique symbiosis with the green turtle (*Chelonia mydas*). Remoras are a group of fishes uniquely adapted to hitchhike on other marine species using a suction disc that is a modified dorsal fin. Remoras are commonly associated with large hosts such as whales, sharks, dolphins, and multiple species of sea turtles. They are known to scavenge on the prey of their host, making green turtles a peculiar host, as they are primarily herbivorous in adulthood and remoras are not known to consume vegetation. Our study investigates the relationship between green turtles and remoras (Echeneis spp.) in the seagrass meadows of St. Thomas and St. John in the U.S. Virgin Islands where they are abundant. Through direct observation, video collection, and gut microbiome analysis of remoras, we document novel coprophagous activity, determining that their diet almost solely consists of green turtle feces, which they consume straight from the cloaca. Through 16S rRNA sequencing of samples taken throughout the remora gut, we discover that remoras retain microbes present in green turtle feces, including microbes that function to digest plants. We create an ethogram to document the behaviors of remoras and green turtles in the context of their symbiosis. We reveal common behaviors such as a size-based dominance hierarchy among remoras on a single host, behaviors like nipping the cloaca followed by behaviors of agitation from the green turtle, and remora defecation. Through observing this relationship, we describe an addition to the seagrass food web. Instead of a slow decomposition of green turtle feces via detritivores, remoras consume feces and frequently disperse the partially digested (and probably more bioavailable) feces throughout the seagrass meadow. This symbiosis could indirectly contribute to the health of seagrass ecosystems and, therefore, the conservation of green turtles.

SATELLITE TRACKING HIGHLIGHTS NEW YORK COASTAL WATERS AS A CRITICAL DEVELOPMENTAL HABITAT FOR JUVENILE ATLANTIC GREEN SEA TURTLES (*CHELONIA MYDAS*)

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We monitored the post-release movements of 26 juvenile Atlantic green sea turtles (*Chelonia mydas*) rehabilitated at the New York Marine Rescue Center (NYMRC) between 2019 and 2025. Although the presence of green turtles in the temperate western North Atlantic is less frequently studied compared to tropical areas, this species has long used this region as developmental habitat. Recent observations and strandings have prompted greater scientific attention to the importance of these northern waters. Since 1980, NYMRC has responded to 2,511 sea turtles, 15% of which (N = 386) were green sea turtles. Strandings of this species have risen significantly over the past decade, increasing at an estimated rate of 12% per year, from an average of 8 strandings annually to nearly 20 per year ($p < 0.0001$). In 2024, a record 65 green sea turtles stranded, further underscoring the species' growing presence in New York waters. Based on morphometric measurements, stranded green turtles were predominately juveniles, with straight carapace lengths ranging from 26.6-43.4 cm (mean = 29.7 cm). The increase in stranding events, along with rising sightings and successful rehabilitation cases, highlights the need to better understand how juvenile green turtles use local habitats. We used satellite telemetry (Wildlife Computers SPOT tags) to monitor post-release movements, assess survivorship, evaluate habitat use, and movement patterns of rehabilitated juvenile green sea turtles. Tag durations ranged from 23 to 261 days (average 120 days), with turtles spending an average of 81 days (range: 19-140) in local waters before migrating south or offshore. Most turtles exhibited three distinct movement patterns: southern coastal, coastal-offshore and offshore, consistent with movements noted in non-rehabilitated sea turtles. Three tagged individuals were observed post release: one was found deceased due to vessel interaction, one was hooked and released by a recreational fisher, and one restranded cold stunned. Additionally, two rehabilitated turtles were observed by New York residents using drones and underwater cameras. These observations, shared publicly on social media, alerted NYMRC to the turtles' presence and provided insight beyond positional data. These findings enhance our understanding of juvenile green turtle habitat use in nearshore areas of the Western North Atlantic and highlight the ecological importance of New York waters. Given the region's dense human population and high coastal activity, understanding turtle movements is critical for mitigating anthropogenic impacts and informing effective management and conservation strategies. Overall, this study revealed that rehabilitated juvenile green turtles in New York waters are primarily coastal, with core-use areas concentrated in bays and estuaries, suggesting repeated use of localized habitats.

DEFINING THE INTER-NESTING AND POST-NESTING GEOGRAPHIC RANGE OF ENDANGERED GREEN SEA TURTLES IN THE MARIANA ISLANDS*

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Understanding the inter-nesting movement and reproductive migration of sea turtles is crucial for international and local conservation, especially for the data-deficient Central West Pacific (CWP) Distinct Population Segment (DPS) of green sea turtles (*Chelonia mydas*), which are listed as endangered under the U.S. Endangered Species Act. The Mariana Islands, which includes Guam and the Northern Mariana Islands (Saipan, Tinian, and Rota), are the only U.S. territory and commonwealth, respectively, where green turtle nesting occurs in the CWP region. Prior to this 10-year study, data on the spatial range of Mariana Islands nesting females did not exist. We equipped 33 turtles with Argos and Fastloc GPS satellite tags across 14 nesting beaches in the Marianas from 2014 to 2023 to elucidate their inter-nesting movements and post-nesting migrations. We applied a speed, distance, and angle filter and only used high quality locations separated by phase (i.e., inter-nesting, post-nesting migration, and foraging) to obtain biologically sound data. Autocorrelated kernel density estimation (AKDE) was performed using the ctmm package in R to calculate utilization distributions of core areas (50% AKDE) and home ranges (95% AKDE) during the inter-nesting phase. The same package was also used to model post-nesting migration tracks as a continuous-time stochastic process. We also examined migratory patterns across years, islands, and between the peaks and non-peaks of the nesting season. Turtles were tracked for 7,968 days from 2014 to 2023. Satellite tags had an average duration of 241 ± 116 days (range = 88–750; n = 33). Inter-nesting behavior, based on core area size, ranged from sedentary (≤3 km2; n = 17) to mobile (>3 km2; n = 4). Thirty turtles completed long-distance migrations (>150 km) to seven jurisdictions across the Western Pacific, from the Ryukyu Islands in Japan at the northern extent to Indonesia at the southern extent, while the remaining three migrated short distances (≤150 km) to feeding areas in the Marianas. The average cumulative post-nesting migration path length for turtles that migrated long distance was 3,305 ± 997 km (range = 1,526–6,293; n = 30). For the turtles that migrated within the Marianas, the average cumulative post-nesting migration path length was 31 ± 7 km (range = 26–36 km; n = 2). Our findings illustrate the importance of particular nearshore habitats around the archipelago, as well as the need for international collaboration for green turtle management and conservation in the Western Pacific. Overall, this study establishes the first baseline inter-nesting and foraging ground distribution of Mariana Islands nesting green turtles, providing a critical reference point for long-term monitoring to detect future population shifts caused by environmental and/or anthropogenic change.

GREEN TURTLE FORAGING AND AGGREGATING PATTERNS REVEALED BY SEAGRASS MEADOW-CENTRIC TIME-LAPSE CAMERA AND DRONE SURVEYS

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Whereas moderate seagrass grazing of herbivorous animals can provide positive effects on seagrass ecosystems, their overgrazing of seagrass is one possible factor that contributes to seagrass repression. Green turtles (*Chelonia mydas*) are well-known seagrass grazers, and their recent increasing trends may have a negative impact on seagrass meadows. Therefore, foraging ecology of the green turtle is important for understanding their interactions with seagrass meadows and considering sustainability of seagrass ecosystem. Diel cycle and tide level are two potential driving factors of green turtle foraging patterns. To understand these effects, by using time-lapse camera and drone surveys, this study investigated when and how many green turtles come to a seagrass meadow in Ishigakijima Island, Yaeyama Islands, Japan in 2023–2024. The presence or absence of green turtles in time-lapse camera data indicated bimodal diel foraging activities peaked at 6:00–08:00 and 16:00–18:00, as observed in previous studies. In addition, green turtle observation probability increased as tide level increased. The effect of tide level was also supported by drone surveys because high density was observed at high tide level. The results indicate that more green turtles aggregated for foraging to the seagrass meadow when they can access the seagrass at high tide. Furthermore, the green turtle density tended to increase in these two years. The seagrass meadow-centric approach in this study will complement individual-based bio-telemetry and bio-logging techniques for revealing green turtle foraging ecology. The approach will also be important for monitoring herbivores in seagrass meadows and considering their coexistence and conservation management.

TESTING THE PASSIVE DRIFT PARADIGM: EVIDENCE OF ACTIVE DISPERSAL IN POST-HATCHLING LOGGERHEAD SEA TURTLES*

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After emerging from their nests, loggerhead sea turtle (*Caretta caretta*) hatchlings crawl to the sea and swim rapidly offshore, where they remain in oceanic habitats for 7–12 years before returning to neritic waters as larger juveniles. This early oceanic stage, known as the "lost years," has long been assumed to consist of passive drifting with surface currents. However, evidence is growing that post-hatchlings swimming behaviour plays a more active role in their dispersal. To test the "passive drift hypothesis" and assess the influence of currents on post-hatchling trajectories, 19 post-hatchling loggerhead turtles, reared for nine months at the Turtle Point, Stazione Zoologica Anton Dohrn, Naples, were equipped with

miniaturized solar-powered satellite tags and released off Ventotene Island, Tyrrhenian Sea. Turtles were released in three groups spaced 500 m apart, and at each site one pair of surface drifters were simultaneously deployed as passive control. Locations were filtered and interpolated at 12-hour intervals using a continuous-time correlated random walk model. Tracking durations ranged from 3 to 68 days (mean ± SD: 42 ± 19 days). Initial analyses focused on the first two weeks post-release, comparing speed, direction, and separation distances between turtles and drifters. In the coming months, additional analyses will examine post-hatchling orientation in relation to circulation patterns in the Tyrrhenian Sea. Swimming speed did not differ among drifters (One-way ANOVA, $F_{4,125} = 0.012$, $p = 0.999$), therefore, the data were pooled for comparison. Corrected swim speeds of turtles (median = 0.24 m/s, n = 491 steps), calculated as the turtle ground velocities minus surface current speed, were significantly higher than those of drifters (median = 0.18 m/s, n = 135 steps; Mann-Whitney U = 22093, $p < 0.001$), suggesting some active swimming. The distances between drifters were significantly smaller than the distances between each drifter and the turtles (Wilcoxon signed-rank test, V=378, $p<0.001$), showing that drifters remained closer to each other than to the turtles. Turtle headings were predominantly northwest-oriented (mean = 278°, n = 472 steps) with moderate clustering (Rayleigh r = 0.37), whereas drifters headed southeast (mean = 139°, n = 130 steps; r = 0.474). Watson two-sample tests confirmed that turtle and drifter headings were significantly different (U2=0.3, $0.001 < p < 0.01$). Although turtles appeared to swim actively and diverged from drifter paths, visual inspection of trajectories over altimetry data seems to indicate that surface currents still influenced their movements. These results provide first evidence of post-hatchling dispersal from newly established nesting sites in southwest Italy, where post-hatchlings enter a current system whose role in transport to nursery habitats remains uncertain. Further analyses are underway to elucidate how local circulation patterns and active swimming behaviour interact to influence dispersal and access to suitable nursery habitats for offspring from newly emerging nesting sites in the western Mediterranean.

FINE SCALE BEHAVIOR OF LEATHERBACK SEA TURTLES IN THE NEARSHORE WATERS SURROUNDING CAPE COD, MASSACHUSETTS*

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Leatherback turtles are largely considered a pelagic species that inhabit nearshore coastal environments for nesting. Over the last decade, however, several studies have demonstrated a seasonal presence of these large turtles within shallow coastal ecosystems where nesting does not occur. This proximity to shore puts leatherbacks at an increased risk from anthropogenic activities, including fishing, construction, and vessel traffic. As they are an endangered species, understanding leatherback behavior at a fine scale within these habitats would be useful at mitigating threats to species conservation. To accomplish this goal, we deployed short-term high resolution camera tags on approximately 50 leatherbacks across three years in the waters surrounding Cape Cod, Massachusetts. Tags were deployed in three local sites, Cape Cod Bay (CCB), Vineyard Sound (VS), and Nantucket Sound (NS). For most deployments, we recovered temperature and depth data, GPS locations, and video footage. Analysis included characterizing dive behavior based on depth and duration, assessing foraging and breathing events, and swimming speed and direction. Overall, we discovered that leatherbacks in CCB remained in very shallow water and did not forage. Turtles in NS and VS, however, exhibited a rate of foraging (~100-300 jellyfish hr-1) well beyond those calculated for leatherbacks in coastal habitats in Canada (~16 jellyfish hr-1). Over the three years, behavior in NS and

VS remained relatively similar in terms of foraging, dive behavior, and seasonality. This suggests that VS and NS may play an important role for leatherback foraging, potentially driving annual distribution and movement patterns and fuelling future reproductive success for a portion of the northwest Atlantic population.

AI IN THE SKY: EVALUATING THE ACCURACY OF AI TO AUTOMATE MORPHOMETRIC DATA COLLECTION FROM UAV IMAGERY

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Sea turtles remain one of the least studied marine megafauna in their natural habitats, particularly in terms of morphometrics beyond carapace length. Unoccupied aerial vehicles (UAVs) offer a promising, non-invasive method to observe and measure sea turtles in the wild, yet the vast amount of video data generated presents a major bottleneck in analysis. Artificial intelligence (AI) has the potential to streamline video processing and data extraction, but reliable workflows for labeling and accuracy assessment are still under development. This study investigates the accuracy of AI-based morphometric identification of sea turtles filmed in the wild using UAVs. We analyzed existing UAV footage of sea turtles in the Bahamas, captured from altitudes ranging 3 – 30.5 m. Using LabelBox, we labeled eight key morphometric points from a dorsal perspective, including morphometrics from the head, carapace and flipper regions. We then passed the labeled images to DeepLabCut (DLC), a deep convolutional neural network designed for pose estimation, to automatically detect morphometric features in new, unlabeled images. Using 292 labeled images, the DLC model underwent 60,000 training iterations. DLC demonstrated high accuracy in identifying sea turtles within the seascape, with a root mean square error of 3.0 (± 1.7 standard deviation) pixels across all morphometrics, with the lowest error for identifying head width measurement points and the greatest error for posterior point of carapace length. Carapace width was the most reliably detected morphometric (successfully identified in 80% of images), while left front flipper length was the least detected (10%). Pixel RMSE increased with UAV altitude. Glare, turbidity, and animal positioning relative to the UAV often impacted the ability to correct detect measurement points. Our findings highlight both the potential and challenges of using AI to automate morphometric data collection from UAV imagery to study sea turtle morphology. Improving training datasets with clearer, unobstructed images may enhance model performance. Ultimately, integrating UAV and AI technologies can significantly advance ecological research and conservation strategies for sea turtles by enabling efficient, remote data collection in their natural environments.

TWO DECADES OF CITIZEN SCIENCE DATA REVEAL HABITAT USE, POPULATION STRUCTURE, AND MOVEMENTS OF SEA TURTLES IN THE EGYPTIAN RED SEA

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Five species of marine turtles occur in the Egyptian Red Sea, with green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles being the most frequently encountered. Turtlewatch Egypt 2.0 is a citizen science initiative that engages resident and visiting snorkelers and divers to document sea turtle encounters and contribute to long-term monitoring of turtle populations in the region. The project was officially launched in 2011 under the NGO HEPCA (Hurghada Environmental Protection and Conservation Association), which initiated the citizen science effort as a representative of civil society, before later evolving into an independent program. The compiled database integrates photographic and observational records spanning 2002–2025, offering one of the most comprehensive datasets on Red Sea turtles to date. Using photo-identification techniques based on both facial profiles, individual turtles were identified and tracked over time to assess habitat preference, population structure, and short-term movements. In total, 9,145 sightings were reported, including 6,929 green turtles, 2,155 hawksbills, one loggerhead, and one leatherback turtle. For 59 sightings, species identification was not possible due to poor image quality. Observations covered more than 200 sites along the entire Egyptian Red Sea coast, from Dahab in the north to Hamata and Shalateen in the south, including several key islands. Across all records, 870 unique individuals were identified—562 green and 308 hawksbill turtles—observed from one to multiple times over the study period. Habitat preference analysis, using benthic classifications from the Allen Coral Atlas, showed that sightings of both species occurred predominantly over sandy bottoms (39% for hawksbills and 38% for greens). Hawksbill turtles were next most common on rubble substrates (21%), while green turtles were frequently seen over rocky bottoms (21%). Surprisingly, only 15% of hawksbill sightings occurred on coral reefs, and just 5% of green turtle sightings were recorded in seagrass areas. Population structure, based on estimated curved carapace length, was available for 410 green and 164 hawksbill turtles. Adults represented 73% of green turtle and 62% of hawksbill sightings. A clear north–south gradient emerged, with a higher proportion of adults in northern sites (Dahab and Sharm El-Sheikh) and a larger percentage of juveniles and subadults toward the south ($\chi^2 = 119.45$, df = 51, $p < 0.001$ for greens; $\chi^2 = 98.19$, df = 72, $p = 0.022$ for hawksbills). Short-term movement analysis revealed that only 18% of individuals were observed at more than one site. Migrant hawksbills represented 20% of individuals, with an average displacement of 17.7 km and a maximum of 312 km. Migrant green turtles accounted for 19%, with an average movement of 30.0 km and a maximum recorded displacement of 550 km. These findings highlight the critical role of citizen science in filling data gaps on sea turtle ecology in regions with limited research capacity. The results contribute to a better understanding of habitat use and spatial ecology of Red Sea turtles and provide essential baseline information for marine spatial planning and conservation management in Egypt.

CHELONIA MYDAS GRAZES THE AGGRESSIVE MACROALGAE CHONDRIA TUMULOSA AT MIDWAY ATOLL (KUAIHELANI), PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT

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Underwater video recordings and a necropsy of a recently dead adult female confirm that the green turtle, *Chelonia mydas*, readily grazes the aggressive red alga *Chondria tumulosa*. Present in Papahānaumokuākea Marine National Monument since 2016, *C. tumulosa* has demonstrated the capacity to aggressively overgrow live coral and successfully attach to calcareous reef substrate. A group of three turtles was observed grazing with one turtle exhibiting a burst of up to 18 bites of *C. tumulosa*, in a 95 sec interval. Further, upon examination of a freshly dead female turtle of the same species, fragments of *C. tumulosa* were identified in the esophagus, crop and likely also in the feces; in the freshly consumed food matter *C. tumulosa* constituted approximately 25% of plant material and was the same color as the upper canopy tissues we observed being grazed in the reef videos. This evidence, collected within one month's time, demonstrates that this native megaherbivore has the potential to remove substantial *C. tumulosa* biomass and highlights a potential role for *C. mydas* in the control and distribution of *C. tumulosa*.

DIET SELECTION OF SYMPATRIC SEA TURTLES IN THE GULF COAST OF FLORIDA, USA*

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Understanding dietary differences among sympatric marine turtle species, particularly diet selection, provides valuable insights into their ecological roles and the factors that shape critical life history traits. Stable isotope analysis (SIA) is a widely used tool to evaluate marine turtle foraging ecology, but many studies rely solely on consumer tissues, limiting the ability to assess diet composition or selection. To address this gap, this study uses SIA of epidermis tissue from green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), and loggerhead (*Caretta caretta*) turtles alongside SIA of potential prey items in a shared foraging area near the St. Martins Marsh Aquatic Preserve in Florida's Big Bend region. We combined these data with habitat surveys and applied Chesson's selectivity index to evaluate diet composition relative to prey availability. Overall, diet composition differed among turtle species and life stages, with green turtles specializing primarily on plant material, Kemp's ridleys exhibiting a mixed diet dominated by sessile prey, and loggerheads relying heavily on sessile prey but differing in secondary prey between life stages. Mixing model results indicate that green turtles primarily consumed seagrass (37.2 ± 9.1%) and macroalgae (25.3 ± 13.5%), with smaller contributions from green algae (13.0 ± 6.4%), sessile

prey (11.4 ± 10.3%), and mangrove (11.2 ± 5.5%). Sessile prey (37.5 ± 8.7 %) contributed the largest proportion to the diet of Kemp's ridleys, followed by mobile prey (26.2 ± 7.5 %) and macroalgae (24.0 ± 8.2 %). Loggerheads consumed a high proportion of sessile prey for both adults (39.6 ± 4.7%) and subadults (40.3 ± 6.0%). Adults consumed notable amounts of macroalgae (22.3 ± 5.7 %), with a smaller contribution from mobile prey (17.1 ± 4.4 %), whereas subadults incorporated more mobile prey (36.0 ± 18.1 %) and less macroalgae (18.1 ± 7.2 %) into their diet. Selectivity analyses revealed that all turtle species and life stages selected for sessile prey relative to their availability, though the degree of selection for other prey groups varied. Green turtles showed strongest selection for macroalgae and sessile prey, while Kemp's ridley and loggerhead turtles also exhibited strong selection for sessile prey, with weaker selection for macroalgae or echinoderms depending on species and life stage. Ecologically, these patterns emphasize the role of habitat heterogeneity and structural complexity in supporting multiple marine turtle species within a shared foraging ground. The persistence of diverse prey communities appears critical for sustaining sympatric assemblages. More broadly, this work underscores the importance of integrating prey and habitat data into foraging studies to better understand dietary specialization, ecological overlap, and the mechanisms enabling species coexistence across regions.

EFFECTS OF GREEN TURTLE HERBIVORY ON SEAGRASS ECOSYSTEMS: AN EXPERIMENTAL TEST IN THE CONTEXT OF A GLOBAL META-ANALYSIS

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Marine megaherbivores, particularly green turtles *Chelonia mydas*, graze on tropical seagrasses worldwide and play a substantial role in determining the structure and function of these ecosystems. To advance our understanding of the effects of green turtles on seagrass meadows, we (1) conducted an experimental exclusion experiment on turtlegrass *Thalassia testudinum* at 2 green turtle foraging sites in Bimini, Bahamas, and (2) performed a global meta-analysis of 587 comparisons of seagrass response variables from 32 peer-reviewed studies examining the effects of grazing by green turtles via experimental exclosure and/or simulated grazing. In our field experiment, only one turtlegrass parameter responded significantly to the exclusion of turtle grazing: across the entire 3 month exclosure period, only seagrass density was significantly increased in the grazed plots. Across the existing literature, however, excluding green turtles has generally been found to increase seagrass aboveground biomass, shoot morphology, productivity, and metabolic rate, and not significantly affect measures of nutrient content, belowground biomass, or epiphytes. These effects were influenced by seagrass identity and grazing type but not by geographic location (i.e. latitude) or experimental duration. Our synthesis supports the general importance of green turtles in structuring seagrass ecosystems, while our experiment highlights that those effects can be site- and context-dependent, indicating the need for additional factors to be considered when assessing grazer effects on seagrass meadows.

INTEGRATING COMMUNITY PARTICIPATION AND SCIENCE TO IDENTIFY OFFSHORE CONGREGATION AND MIGRATION PATHWAYS OF OLIVE RIDLEY SEA TURTLES ALONG THE NELLORE COAST, ANDHRA PRADESH, INDIA

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The Nellore Coast of Andhra Pradesh, east coast of India, serves as a vital nesting and migratory pathway for Olive Ridley (*Lepidochelys olivacea*) and foraging grounds for Hawksbill (*Eretmochelys imbricata*), and Green (*Chelonia mydas*). Since 2008, TREE Foundation, in collaboration with Andhra Pradesh Forest Department, has implemented a "Community-Based Sea Turtle Conservation Programme" to protect these endangered species and their habitats. The programme engages local fishing communities as Sea Turtle Protection Force members, ensuring effective monitoring of nesting beaches, protection of nesting turtles, safe release of hatchlings and awareness on sustainable fishing practices. Beyond nesting beach protection, recent efforts have focused on studying offshore turtle activity to understand their ecology and spatial use. Based on information from local fishermen, offshore boat-based surveys conducted in Ramachandrapuram, Nellore District, revealed that these nearshore waters function as key turtle congregation zones and migratory corridors for nesting populations migrating between Tamil Nadu, south east coast of India, to the nesting beaches of Andhra Pradesh and the mass nesting beaches of Rushikulya and Gahirmatha in Odisha. Surveys conducted in March 2023 recorded 42 turtles. Two follow-up observations, in February 2024 and 2025 recorded 48 and 70 turtles respectively actively feeding and swimming within 600–800 meters offshore. The methodologies followed and data recorded will be presented in the poster. These findings underscore the ecological significance of the Ramachandrapuram offshore area as a critical habitat that supports pre-nesting, foraging and migratory behaviours. Comparing offshore sightings with nesting data from beaches between Paideru and Penna estuary helps establish correlations between nearshore activity and nesting intensity. The data recorded advocate for the declaration of a 'Seasonal Turtle Protected Area' during the breeding season to mitigate anthropogenic pressures including trawling, nets detrimental to turtles and coastal development. This consolidative, conservation model highlights the importance of combining local knowledge with scientific observation to safeguard sea turtles and marine ecosystems along India's southeast coast.

STABLE ISOTOPE ANALYSIS ($\Delta^{13}C$ AND $\Delta^{15}N$) IN EPIDERMIS AND CARAPACE TISSUES OF GREEN TURTLES FROM TWO FORAGING AREAS IN RIO DE JANEIRO STATE, SOUTHEASTERN BRAZIL

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Stable isotope analysis (SIA) has become a powerful tool in ecological studies for elucidating trophic relationships, resource use, and habitat connectivity. The isotopic composition of carbon ($\delta^{13}C$) and

nitrogen ($\delta^{15}N$) provides insights into both the primary sources of production at the base of food webs and the trophic level of consumers. While $\delta^{13}C$ values typically reflect the origin of organic matter and habitat use (e.g., pelagic vs. benthic or seagrass vs. algal-based systems), $\delta^{15}N$ values increase predictably with each trophic level, allowing inferences about the relative position of organisms within the food chain. In marine turtles, stable isotopes have been extensively used to assess foraging strategies, diet composition, and the influence of environmental and anthropogenic factors on feeding ecology. This study applied carbon and nitrogen stable isotope analyses to epidermis and carapace tissues of green turtles (*Chelonia mydas*) sampled from two coastal foraging grounds in Rio de Janeiro State, southeastern Brazil. Sampling was conducted by the Aruanã Project through intentional captures in the Itaipu Marine Extractive Reserve (RESEX Itaipu, Niterói) and at Marina da Glória (Rio de Janeiro). The objective was to investigate spatial variation in feeding ecology and trophic structure to inform conservation and management strategies for this endangered species. Results revealed significantly higher $\delta^{15}N$ values in turtles from RESEX Itaipu (10.9 ± 2.2‰ in epidermis; 11.8 ± 2.1‰ in carapace) compared to individuals from Marina da Glória (7.6 ± 1.3‰ in epidermis; 9.0 ± 0.8‰ in carapace), indicating a higher trophic position in the RESEX aggregation. This enrichment likely reflects the consumption of higher-trophic-level prey associated with the availability of artisanal fishing discards. Isotopic mixing models suggested that mussels and fish contributed approximately 60% of the diet, while algae represented about 20%. In contrast, $\delta^{13}C$ values did not differ significantly between regions (RESEX Itaipu: −15.4 ± 0.8‰ in epidermis; −16.2 ± 1.4‰ in carapace; Marina da Glória: −15.5 ± 0.8‰; −16.3 ± 0.9‰), suggesting similar baseline carbon sources and primary productivity across sites. The nitrogen enrichment pattern indicates potential differences in nitrogen cycling or trophic pathways between the areas, which may be influenced by anthropogenic nitrogen inputs or variations in food web complexity. These findings highlight the effectiveness of stable isotope analysis in detecting fine-scale spatial differences in trophic ecology and the potential influence of human activities on foraging habitats of *C. mydas* along urbanized coastlines. By integrating isotopic baselines, contaminant data, and long-term monitoring, future research can enhance understanding of nutrient dynamics, habitat use, and the ecological role of green turtles in coastal ecosystems, ultimately supporting evidence-based conservation management in Brazilian waters.

DEVELOPING INTEGRATED SPECIES DISTRIBUTION MODELS OF NORTHWEST ATLANTIC SEA TURTLE POPULATIONS USING SPATIOTEMPORAL MODELS*

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Understanding the distribution of marine turtle populations is crucial for their conservation, as it provides insight into possible conflicts with potentially detrimental human activities. Species distribution models (SDMs) have been essential for this purpose. Over the past two decades, the underlying mathematical frameworks for these models have rapidly evolved, now allowing for the integration of diverse data types and accounting for spatiotemporal autocorrelation. While distribution models have been developed for sea turtle populations along the East Coast of the United States, they have relied solely on data from aerial and shipboard surveys. Here, we present a method to advance these efforts by developing integrated SDMs that 1) incorporate location data from both satellite transmitters and fisheries observer programs and 2) account for spatiotemporal autocorrelation. To integrate these distinct data types, we used a joint-likelihood

approach with Bayesian inference through Integrated Nested Laplace Approximation (INLA). This framework uses a stochastic partial differential equation (SPDE) method to model spatiotemporal autocorrelation by approximating Gaussian Markov random fields (GMRFs) which reflect the assumption that conditions at nearby locations are more similar than at distant ones. To account for seasonal variation, we fit a unique GMRF for each month of the study period, structured to follow a first-order autoregressive pattern. The final models relate a suite of environmental parameters to the probability of sea turtle presence across the study area, which can be used to create predictive distribution maps for each month of the year. These maps will then be used to assess the overlap between estimated sea turtle distributions and fishing effort, vessel activity, and offshore development.

STALKING THE SOCIAL LIVES OF SEA TURTLES: INSIGHTS INTO INTER- AND INTRASPECIFIC INTERACTIONS AND THEIR ASSOCIATED ENERGETIC COSTS*

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Species interactions are important drivers of population and community structure. Investigating interactions in individuals, particularly the energetic costs associated with different types of interactions, can provide insights into when, why, and how they interact. Sea turtles are elusive, motile animals which spend most of their time underwater and have long been thought to be solitary. However, recent advancements in methodologies for observing sea turtle behaviors have revealed a variety of inter- and intraspecific interactions, ranging from social interactions to aggressive contests. Still, our understanding of how sea turtles interact remains limited. To explore this knowledge gap, we deployed animal-borne biologging devices (CATS Cameras), equipped with an HD camera and tri-axial accelerometer, on 33 sea turtles of three species [24 loggerhead (*Caretta caretta*), 6 green (*Chelonia mydas*), and 3 Kemp's ridley (*Lepidochelys kempii*)] at a coastal foraging ground in Florida's Big Bend (USA). We annotated video footage for an array of behaviors, from which interactions with other turtles were isolated and categorized into one of three types: passive, active, or aggressive. Dynamic body acceleration (DBA; a proxy for energy expenditure) was computed from the acceleration data and aligned with the behavioral annotations to generate time budgets and estimate energetic costs of different behaviors. Loggerhead and green turtles varied significantly in the proportion of time spent on different behaviors (GLMM, excluding Kemp's ridleys; Species x Behavior: $\chi^2 = 13.2$, df = 5, $p = 0.02$). Loggerheads (57.2 ± 4.7%) and Kemp's ridleys (63.1 ± 8.3%) spent most of their time swimming, while greens spent most of their time resting (52.9 ± 12.6%). All three species spent <1% of their time interacting with other turtles, but we still recorded 56 interactions across 23 of the 33 deployments. Loggerheads exhibited both intraspecific (n = 26) and interspecific (green = 14, Kemp's ridley = 2) interactions. Greens solely exhibited intraspecific interactions (n = 12), and the single interaction for a Kemp's ridley was with a green turtle. DBA varied across behaviors and interaction types: passive interactions were the least costly and most common (loggerheads = 54.8%, n = 23, mean DBA/interaction = 0.21 ± 0.02 m/s2; greens = 53.8%, n = 7, mean DBA/interaction = 0.39 ± 0.11 m/s2; Kemp's = 100%, n = 1, mean DBA = 0.34 m/s2). Several instances of intraspecific aggression were observed for loggerheads (26.2% of interactions; n = 11), and the mean DBA of those interactions (0.36 ± 0.03 m/s2) was significantly higher than that of resting, foraging, and passive interactions (only loggerheads; GLMM: Interaction Type: $\chi^2 = 8894.0$, df = 6, $p < 0.0001$). These results present novel information regarding species interactions and their associated energetic costs for three sympatric sea turtle species, providing insights into community dynamics at a critical foraging ground.

SATELLITE TAGS REVEAL MIXED RESIDENT AND MIGRATORY STRATEGY IN BREEDING MALE GREEN TURTLES*

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Understanding how adult male green turtles use space (horizontally and vertically) is essential for protecting critical habitats, designing marine protected areas, and reducing risks from vessel strikes and bycatch. Males are understudied because generally they do not come ashore and are therefore more difficult to observe, creating gaps in movement ecology. We tracked adult males from a South Atlantic breeding site to test whether multiple post-breeding movement strategies occur and how they differ in space use and diel activity. We instrumented 19 adult males (20 deployments) at Fernando de Noronha, Brazil, combining Fastloc-GPS and time-depth recorders. Locations were regularized to 12-hour intervals to align with dive data. Latent behavioral states were estimated using displacement, step length, and turning angle with a mixed-membership movement model (M4) that segments tracks and clusters segments. We interpreted behavioral states as breeding-ground area-restricted search (ARS), migration (directed travel), and mainland ARS, and classified individuals as resident-breeders or migrant-breeders based on whether they transitioned from breeding-ground ARS to migration. We delineated utilization distributions (UDs) of range-restricted movements with autocorrelated kernel density estimation (AKDE; 50% and 95% contours) and described migratory corridors with dynamic Brownian bridge movement models (dBBMMs). Diel differences in step length and dive activity were evaluated with permutation and rank-based tests, and UD ranges were summarized with meta-analytic estimates. Two contrasting post-breeding strategies emerged. One-fifth of males were resident-breeders, remaining near the breeding area and occupying small home ranges (mean 95% UD ~2 km²; typically <3 km²). These turtles showed the lowest dive rates and no deep dives; daytime activity exceeded nighttime, and space use remained inside the no-take MPA mainly shoreward of the 10 m isobath. Migrant-breeders used larger breeding-ground ARS ranges around the archipelago (mean 13 km2) with strong core overlap within ~500 m of major nesting beaches. They then migrated 330–1,170 km to neritic habitats along the northeastern Brazilian shelf over ~4–26 days. We also partitioned migration into island shelf, oceanic crossing, and continental shelf segments to quantify time and distance in each. Migration featured the longest step lengths and an alternation between shallow daytime dives (often 0–5 m) and deeper nighttime dives (commonly 20–40 m and beyond). In mainland ARS, UDs varied widely (meta-analytic mean ~117 km2; range about 4 to 990 km2), overlap among individual was minimal, and several turtles used multiple, distinct patches. These strategy differences likely reflect trade-offs: resident-breeders minimize travel costs and may maximize mating opportunities by staying near breeding hotspots, whereas migrant-breeders may improve body condition at distant mainland habitats but face greater exposure to anthropogenic risks during transit and on the shelf. Management should maintain strong protection near breeding hotspots where resident-breeders and migrant-breeders concentrate, evaluate seasonal vessel-speed management and traffic lanes around the archipelago, and incorporate corridors and mainland shelf habitats into spatial planning where overlap with shipping, fisheries and other threats is high. Given projected declines in male production with warming sands,

documenting fidelity and return migrations—and linking strategies to reproductive success—should be a priority.

ENVIRONMENTAL PREFERENCES AND JURISDICTIONAL DISTRIBUTION OF JUVENILE LOGGERHEADS IN THE EASTERN NORTH PACIFIC*

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While the basin-scale movements of North Pacific loggerheads (*Caretta caretta*) are well documented, habitat use by juveniles recruiting into coastal zones of the eastern North Pacific (ENP), including the exclusive economic zones (EEZs) of Mexico and the United States (U.S.), remains poorly understood. These areas represent critical developmental habitats where turtles encounter dynamic environmental conditions, fisheries interactions, and management frameworks. In this study, we used satellite telemetry data from 53 juvenile loggerheads (2023-2025) to characterize seasonal environmental envelopes based on sea surface temperature (SST) and chlorophyll-a (chl-a). Juveniles were found to occupy waters with a mean SST of 17.4°C (10-90th percentile: 15.4-19.9°C) and mean chl-a concentrations of 0.14 mg/m3 (10-90th percentile: 0.07-0.22 mg/m3). These thresholds were applied to a recent period (2014-2025) of environmental data, an era of anomalously warm ocean conditions, to summarize seasonal patterns of potential loggerhead habitat across jurisdictions. Suitable habitat showed seasonal shifts across EEZs, with 2-31% of the U.S. EEZ and 1-13% of the Mexican EEZ containing environmentally suitable habitat across the year. Overall, the majority of environmentally suitable habitat occurred in ABNJ (86%), compared to within the U.S. (6%) or Mexican (8%) EEZs, underscoring the importance of emerging high seas governance frameworks, such as the biodiversity beyond national jurisdiction treaty, for comprehensive conservation. Together, these findings highlight the transboundary nature of juvenile loggerhead habitat in the ENP and emphasize the importance of adaptive governance strategies to conserve this endangered population in a rapidly changing ocean.

FROM COSTA RICA TO THE SARGASSO SEA: TRACKING "LOST YEARS" SEA TURTLES REVEALS DISPERSION ROUTES AND THE LONGEST RECORDED MOVEMENT OF A CRITICALLY ENDANGERED HAWKSBILL (*ERETMOCHELYS IMBRICATA*)*

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During the early oceanic life stage—known as the "lost years"—sea turtle hatchlings disperse widely across oceanic habitats, experiencing high mortality and limited detectability. Although understanding of the biology and ecology of sea turtles during the lost years is crucial for effective conservation, data from the western Caribbean remain absent. Since 2022, the nonprofit Turtle Love has collaborated with artisanal fishers from Costa Rica's Caribbean coast to document lost year sea turtles associated with Sargassum rafts off Tortuguero, the largest green turtle (*Chelonia mydas*) rookery in the Atlantic. Fishers provided sighting coordinates and assisted with the capture of turtles found among drifting Sargassum habitats. Over this period, more than twenty "lost year" turtles—greens, hawksbills (*Eretmochelys imbricata*), and loggerheads (*Caretta caretta*)—were documented, with curved carapace lengths ranging from 10 to 30 cm, consistent with early pelagic juveniles. In 2024, a partnership between Upwell, the Archie Carr Center for Sea Turtle Research, and Turtle Love enabled the deployment of satellite transmitters on nine turtles (six greens and three hawksbills) released at their capture sites, within 30 km offshore from Tortuguero. Tracking data revealed three distinct dispersal patterns: (i) five turtles remained within the southwest Caribbean gyre, exhibiting localized movements among Costa Rica, Nicaragua, and Panama, before drifting past Tortuguero approximately two weeks after release; (ii) one hawksbill moved northward against prevailing currents, with its track ending near known juvenile habitats for this species off southern Nicaragua; and (iii) two individuals—one green and one hawksbill—dispersed eastward toward the South American coast, following surface currents. The green turtle's tag ceased transmitting approximately 500 miles south of Jamaica, after it had moved northward from Colombia. Remarkably, the hawksbill traveled more than 6,000 km over six months, initially following a path similar to that of the green turtle before passing through the Yucatán Channel, riding the Loop Current into the Gulf of Mexico and around the Florida peninsula, continuing on the Gulf Stream along the U.S. East Coast to North Carolina's Outer Banks, and finally meandering east into the Sargasso Sea before transmissions ended. This represents the longest movement recorded for the species and the first documented case of inter-basin dispersal of a sea turtle from Central America to the Sargasso Sea. Our study provides the first direct observations and satellite tracking of "lost year" sea turtles in the western Caribbean, highlighting the role of Sargassum habitats off Costa Rica as critical developmental grounds linking Central American rookeries to North Atlantic developmental habitats. The integration of fisher knowledge with satellite telemetry proved crucial for locating and monitoring juveniles in remote oceanic habitats. Ongoing efforts include additional tagging, passive drifter deployment, and genetic analyses to elucidate natal origins and connectivity. These findings emphasize that pelagic habitats, such as floating Sargassum rafts, are essential components of sea turtle conservation—and that bridging local knowledge with cutting-edge technology can reveal the oceanic pathways linking western Caribbean Sea turtle rookeries to developmental habitats thousands of miles away.

IMPACTS OF SALINITY ON HABITAT USE OF SEA TURTLES IN COASTAL LOUISIANA*

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Sea turtles occupy dynamic coastal habitats where environmental variability, particularly salinity, may influence distribution and habitat use. Habitat restoration and changes in freshwater input into marine ecosystems are likely to alter salinity profiles of inshore and nearshore habitats. To investigate habitat use relative to salinity in Louisiana State waters, we conducted satellite tagging of sea turtles within the Chandeleur Sound and Lake Borgne, Louisiana using Wildlife Computers CTD tags that record salinity measurements. Tagging and subsequent tracking revealed that all turtles utilized areas within Chandeleur Sound, while none were captured or observed using Lake Borgne. Salinity data indicated that Lake Borgne routinely exhibited very low salinity levels, suggesting a potential exclusion of sea turtles from this area. Mean salinity values from turtle tags ranged from 13 to 29 parts per thousand (ppt), with an overall salinity recorded by the satellite tags ranged across the study area from 1 to 43 ppt. These findings suggest that sea turtle habitat use in Louisiana waters is associated with moderate to higher salinity environments and that low-salinity conditions, such as those in Lake Borgne, may limit habitat suitability. Continued monitoring will improve understanding of environmental drivers influencing sea turtle distribution along the northern Gulf of America.

BEHAVIORAL ANALYSIS OF POST-REHABILITATION SEA TURTLES IN THE EASTERN MEDITERRANEAN MONITORED USING SATELLITE TRACKING*

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The loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles complete their life cycles in the Mediterranean, undertaking resource-driven migrations between developmental, foraging, and breeding habitats. Their longevity, extensive movements, and use of diverse habitats make them highly vulnerable to anthropogenic pressures. Intensive poaching in the 20th century caused severe population declines, and current populations continue to face significant threats and remain conservation-dependent. Rehabilitation of injured individuals is one vital conservation tool, supporting the persistence of small, threatened populations. This study examines the post-rehabilitation readaptation of sea turtles released from Israel Sea Turtle Rescue Center (n=76), quantifying and comparing their behavior and habitat-use with a "control group" of healthy nesting females (n=22) and individuals reported in the literature. Six major injury categories were analyzed—carapace fracture, drowning, fishing gear entanglement, head trauma, hook injury, and soft tissue trauma—to assess how injury type influences post-release performance. In total, 98 turtles were tracked using satellite transmitters, resulting in 24,900 tracking days and covering 316,515 km. Behavioral assessments were conducted across species, sex, life stage, and injury category. Routes were classified into residency and migration periods using segmented regression applied to individual displacement plots. For each period, spatial and behavioral metrics—including home range, straightness index, continental shelf use, speed, submergence behavior, and survival rates—were quantified. Survival

rates were estimated from telemetry data using established survival estimators, based on prolonged dry-sensor signals with terrestrial locations, and direct observations where available. A novel approach for submergence analysis was developed to detect anomalous and seasonally driven behavioral patterns. Results revealed high estimated annual mortality rates in both rehabilitated and nesting turtles: 38% for green turtles and 21.8% for loggerheads, and 29% among females of both species. Rehabilitation was highly successful– most individuals across injury categories displayed normal post-release behavior, excluding those with head trauma. Several rehabilitated turtles were tracked during breeding activity, and amputees exhibited normal movement patterns, demonstrating notable resilience. Behavioral analyses showed high plasticity in trajectories and home range, within species, sexes and life stages. Nesting females migrated from Israeli beaches either toward North Africa or within the Levant Basin, exhibiting two distinct distance scales (19–327 km vs. 878–2215 km), while rehabilitated turtles remained within the Levant Basin. Israel's coastal and marine habitats were found to be vital areas for both nesting and rehabilitated turtles, throughout their life cycles. This study underscores the pivotal role of rehabilitation in sea turtle conservation and introduces quantitative tools for evaluating post-release adaptation. The integrative behavioral framework developed here strengthens our understanding of recovery potential in rehabilitated sea turtles and informs region-specific conservation management across the Mediterranean.

VISUAL AND METABARCODING CHARACTERIZATION OF "LOST YEARS" DISPERSAL STAGE SEA TURTLE DIETS*

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Sea turtle diet characterization is valuable for examining foraging behavior, habitat, and potential anthropogenic interactions—information that can be used to improve regional and ecosystem management approaches. Diet data are also critical to understanding the timing and variation in epipelagic to nearshore ontogenetic shifts in sea turtles. Historically, visual identification methods have been used to identify taxa in sea turtle diet samples, but DNA metabarcoding offers a complementary approach that can better identify less conspicuous and more digested or degraded food items. We collected esophageal lavage samples from 31 "lost years" dispersal stage sea turtles (14.7-27.2 cm straight carapace length, mean: 18.5 +/- 2.9 cm SD) captured offshore in the northeastern Gulf of Mexico during 2021-2022: 24 green turtles (*Chelonia mydas*), 5 Kemp's ridleys (*Lepidochelys kempii*), and 2 loggerheads (*Caretta caretta*). Sample collection, handling, and storage protocols were developed to minimize cross-contamination between samples. We used a two-pronged approach, comprised of visual identification under a dissecting microscope and DNA metabarcoding with 18S and CO1 primers, to characterize diet composition. Green turtles and Kemp's ridleys frequently ingested large amounts of Sargassum sp., which was typically covered in encrusting bryozoans, as well as occasionally by other sessile invertebrates. We hypothesize that the turtles were targeting the bryozoans, hydroids, and/or mobile organisms associated with Sargassum mats. All three turtle species consumed gelatinous animals and what appeared to be fish eggs (supported by fish species identified through metabarcoding). All species also consumed crustaceans, including copepods and small crabs and shrimp. Macroalgae were ingested by all species, and one green turtle consumed seagrass. Observed macroalgae was largely attached to Sargassum, but nearshore marine plants consumed by a total of two green turtles (seagrass, red macroalgae) suggested some coastal foraging and subsequent movement back offshore to the capture sites. Additionally, two green turtle and one Kemp's ridley lavage sample contained anthropogenic debris, highlighting a threat faced by surface-feeding immature turtles. This

project expands upon limited existing knowledge of small immature sea turtle diets and is the first to integrate metabarcoding for wild-caught dispersal stage sea turtles. Conservation, management, and recovery of sea turtles will be enhanced through a better understanding of diets at all life stages, plasticity in timing of ontogenetic shifts, and differences and similarities among species, as well as their ties to offshore and nearshore habitats and human activities.

MATERNAL AGE AFFECTS MAGNETIC NAVIGATION RESPONSES IN HATCHLING LOGGERHEAD TURTLES (*CARETTA CARETTA*)*

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Hatchling loggerhead sea turtles (*Caretta caretta*) in the southeastern U.S.A. emerge from their nests and begin a multi-year migration through the warm-water currents of the North Atlantic Subtropical Gyre. Hatchlings have a guidance system in which regional magnetic fields serve as open-sea navigational markers and elicit directional swimming that facilitates movement along the migratory pathway. Because this system is functional when hatchlings emerge from the nest, it appears to be inherited, but the mechanism of inheritance (genetic, epigenetic, or both) is unknown. In addition, Earth's magnetic field constantly changes, and the magnetic fields associated with particular geographic regions shift with time. Because loggerheads reproduce over several decades, nesting populations can include mothers that encountered a range of different magnetic conditions as hatchlings. Young mothers, because their trans-Atlantic migration is more recent, are likely to have encountered magnetic fields closely resembling those that currently exist, while older mothers may have encountered fields that differ substantially. To investigate whether the age of mothers affects the magnetic navigation responses of hatchlings, we conducted experiments at Jekyll Island, Georgia, USA, where a long-term saturation tagging program has compiled detailed individual histories of nesting loggerheads. Using a computerized magnetic coil system, we exposed hatchlings with mothers of different ages to magnetic signatures that exist at two different locations on opposite sides of the gyre, which should elicit opposite swimming directions. In both magnetic fields, hatchlings from young females oriented in directions consistent with their migration, whereas hatchlings from older females were not oriented as a group. These results suggest that, as a group, hatchlings from older mothers had not inherited directional responses to magnetic fields that are likely to enhance survival, but that hatchlings from younger mothers had. Notably, several metrics of hatchling viability (hatching success, the presence of scute anomalies, and an effective righting response time) did not differ between hatchlings from young and old females, suggesting that the difference in magnetic orientation is unlikely due to maternal senescence leading to production of non-viable hatchlings. One possibility is that older females are sometimes unable to transmit useful magnetic responses to their offspring because, during periods of relatively rapid field change, the responses that they themselves inherited (either genetically or epigenetically) are eventually rendered obsolete by magnetic field drift. If so, then hatchlings from older females may be at a higher risk of deviating from the typical migratory route.

MICROBIAL DYNAMICS AND SITE FIDELITY IN *CHELONIA MYDAS*FROM AN URBAN COASTAL ENVIRONMENT

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Monitoring sea turtles in urbanized coastal areas provides essential information on habitat use, growth, and health conditions of these animals. Recapturing individuals over time allows us to understand patterns of residence, site fidelity, and possible physiological changes associated with environmental factors. This study aimed to evaluate data on the microbial composition of *Chelonia mydas* recaptured over three consecutive years at Marina da Glória, located in Guanabara Bay (Rio de Janeiro, Brazil)—a coastal environment characterized by intense anthropic activity and contaminant input. Annual turtle capture and tagging campaigns were conducted between 2022 and 2024. Recaptured individuals underwent standard biometry (carapace length and width, weight, and body condition), and biological samples were collected for analysis of the associated microbiota using next-generation sequencing (NGS) of the 16S rRNA gene. To date, we have sequenced three animals, and the analyses have allowed us to compare and investigate possible changes in the structure of the microbial community. The results indicated the presence of resident individuals recaptured in multiple consecutive years. The microbial composition proved to be relatively stable between recaptures, with a predominance of the phylum Proteobacteria, with an increase in the proportion of abundance in the last year (2024) of the phyla Campylobacter, Desulfobacterota, and Firmicutes. However, variation was observed in some samples associated with periods of increased pollutant input and an increase in potentially opportunistic bacteria. These findings suggest that, despite the environmental pressures of Guanabara Bay, resident turtles are able to maintain a balanced microbiota, possibly reflecting mechanisms of adaptation or resilience to local conditions. The integration of biometric and microbiological data provides a comprehensive view of the health of *C. mydas* populations, reinforcing the importance of long-term monitoring in impacted coastal areas. In addition, the study contributes to the application of the One Health approach, which recognizes the interconnection between animal, human, and environmental health. Understanding how the microbiota is structured and responds to environmental factors is essential for assessing the role of turtles as bioindicators and for supporting conservation actions in marine ecosystems under urban influence.

INTEGRATING MOVEMENT, DIVE BEHAVIOR, AND HAULOUT EVENTS TO MAP LEATHERBACK TURTLE MIGRATION AND FORAGING HABITAT IN THE SOUTH ATLANTIC*

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Sea turtles are migratory species that rely on a combination of coastal and oceanic habitats throughout their life cycles. Our ability to define migration patterns and foraging areas is fundamental for designing conservation strategies and effective policies to mitigate the impact of anthropogenic threats. Satellite

telemetry is a powerful technique to generate high-quality data on animals' locations and a multitude of diving profile parameters. State-space models have evolved over the years and are effective for the estimation of behavioral states. However, for species like the leatherback turtle (*Dermochelys coriacea*), whose prey can move dynamically with the oceanic currents, the definition of behavioral states is not as clear as for other species. Here, we present an innovative approach that integrates telemetry data (horizontal and vertical movements) to more accurately distinguish behavioral states, especially migration and foraging behaviors. During the 2024 nesting season, seven nesting leatherback turtles were instrumented with SPLASH10-F-295 tags from Wildlife Computers in Comboios Beach, Espirito Santo, Brazil. Haulout events, validated by cross-referencing three data sources (i.e., telemetry csv files DDN/DryDeepNeither, FastGPS and HaulOut) were combined with nesting beach patrolling records to inform nesting events. We further used a state-space model to regularize tracks in 6-hour intervals using the package aniMotum, matching the dive profile summaries. Latent behavioral states were estimated using displacement, step length, distance from the coast, turning angle, maximum dive depth and nesting events with a mixed-membership movement model (M4 package) that segments tracks and clusters segments. The proportion distribution within each cluster was inspected for biological interpretability, and those exhibiting similarities were merged, resulting in the estimated latent behavioral states across track segments. Results from M4 were compared with the behavioral index from the move persistence model (aniMotum) using multiple cutoff thresholds. Results demonstrate clearer spatial and temporal delineations of migration and foraging areas from M4 model compared to fixed move persistence index cutoffs. We were able to clearly identify distinct migrating patterns, one mostly over the continental shelf between southeastern Brazil and the Plata River estuary between Uruguay and Argentina, and another in oceanic waters towards Tristan da Cunha. We also identified distinct foraging behaviors based on maximum dive depths, including shallower (within 50 m) and deeper (between 100-800 m). Three foraging areas were delineated: 1) over the southeastern Brazilian continental shelf, between Rio de Janeiro and Santa Catarina states, 2) over the continental shelf around the Plata River estuary, and 3) west of the Tristan da Cunha Island. This methodological advancement provides a scalable and transferable framework for sea turtle research worldwide. Beyond improving the resolution of behavioral studies, it offers practical implications for management, including more precise identification of habitats for protection, potential overlap with threats (e.g., fishing effort, industrial activities), and enhanced capacity to evaluate the effectiveness of conservation measures over time. By combining movement and dive data in a cluster-based framework, our approach goes beyond the binary output of traditional state-space models, identifies multiple behavioral states, clarifies migration routes and foraging hotspots, and directly supports spatial management of leatherback turtles.

SEA TURTLE SURVEYS AND SATELLITE TRACKING IN PEARL HARBOR, O'AHU, HAWAI'I, USA*

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Pearl Harbor is a geographically protected lagoon located on the Hawaiian island of O'ahu. For approximately the past 120 years, Pearl Harbor has been the site of the largest U.S. Joint Air/Navy base in the Pacific Ocean. Despite substantial environmental degradation, Pearl Harbor continues to be a resource rich habitat of important marine species. These include green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles. The Navy is required to manage and protect sensitive biological resources mandated by the Sikes Act of 1960, and has conducted various visual surveys of sea turtles within Pearl Harbor. Although the previous surveys provide important insights into the distribution of these turtles, due to the limitation of their non-capture approach, detailed information on sea turtle movements,

spatial ecology and habitat use remains lacking. To fill these data gaps, NOAA was tasked with conducting fieldwork to better understand sea turtle movement ecology in Pearl Harbor. In this study we outline the methods and preliminary results of this research, which represents the first attempt to satellite track sea turtles in Pearl Harbor. Given both the military relevance of the area and the ESA threatened or endangered status of the sea turtles, this study has important implications to future development and management efforts in the region. Snorkel survey transects were conducted using a small boat along coastal waters within Pearl Harbor. Whenever feasible, turtles were captured while freediving and immediately brought up to the surface and lifted into the boat to be processed following standard protocol. Satellite tags (Wildlife Computers SPOT and SPLASH tags) were applied with fiberglass and two-component epoxy, and covered with anti-fouling paint. During six survey days, 115 turtles were encountered, 85 of which were solely observed, and 30 were captured. One of the encounters was a hawksbill turtle, while all others were green turtles. All 30 captured turtles were green turtles, 22 of which were equipped with satellite tags. The average tag duration was 135.8 days (SD = 80.1 days), with a minimum of 13 days and a maximum of 295 days. Two tracked turtles fully exited Pearl Harbor; one large sub-adult made stops on Maui, Moloka‘i, Kaua‘i, and Ni‘ihau, and settled on the southern coast of Kaua‘i. The other, an adult female, migrated to Kapou (Lisianski, ~1700km), making this the first Kapou migration tracked using telemetry from the Main Hawaiian Islands. We calculated and analysed the home range of turtles that remained within Pearl Harbor to better understand habitat use in that area. The average core home range for all turtles was 1.1 km2 (sd = 1.4 km2; range = 0.1 – 5.6 km2), while the average overall home range was 5.7 km2 (sd = 7.5 km2; range = 0.3 – 25.2 km2). These estimates suggest that while many turtles remain highly localized, especially around key foraging and resting structures, they still utilize a wider portion of the harbor over time. These results will help in the planning of upcoming military installation expansion projects and conservation efforts.

ASSESSING THE IMPACTS OF LONG-TERM SATELLITE TAGGING ON GROWTH RATES OF IMMATURE HAWKSBILL TURTLES

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Animal-borne devices such as transmitters, data loggers, and identification tags are widely used across taxa to address key biological and ecological questions. However, these devices can sometimes affect animal behaviour and fitness, making it essential to assess their potential impacts across species and life stages. In this study, we evaluated whether long-term satellite tagging influences the growth and/or condition of immature hawksbill turtles (*Eretmochelys imbricata*) at a foraging site in the Indian Ocean. Between 2018 and 2021, we captured hawksbill turtles at Turtle Cove, in the south of Diego Garcia lagoon, Chagos Archipelago, and fitted 25 individuals with Fastloc-GPS satellite tags. Tagged turtles had a mean straight carapace length (SCLn-t) of 55.3 ± 6.9 cm (range = 47.9-69.5 cm; N = 21). We recaptured 12 tagged individuals between 2021 and 2023 and removed 11 tags after 2-3 years of attachment. From capture-mark-recapture, we estimated growth rates of 54 individuals (mean SCLn-t range = 33.3-69.4 cm), of which 10 were tagged and 44 were untagged individuals at liberty for 730-1095 days. Additionally, we conducted a literature search for studies investigating the potential effects of satellite tag attachment on sea turtles. Growth rates declined exponentially with increasing turtle size for tagged and untagged individuals,

consistent with expected ontogenetic patterns. Importantly, we found no significant difference in growth rates or body condition between tagged and untagged turtles. Visual inspection revealed no evidence of carapace damage at the attachment sites. We suggest that satellite tagging did not affect growth at this site because hawksbill turtles in the lagoon tend to maintain small home ranges and are benthic foragers that feed on sessile prey, reducing energetic costs. However, effects could differ for species or populations that migrate long distances or carry larger devices. From our review, we identified seven papers, four of which focused on turtles in the wild and three on those in captive conditions, reporting the effects of satellite tagging on sea turtles using an experimental approach (e.g., tagged vs. untagged). All studies assessing tag effects on free-living turtles were conducted on adult females, with most focusing on leatherbacks. We found no studies investigating the effects on free-living immature turtles of any species. Our findings support the safe and effective use of satellite tags for monitoring the space use of immature hawksbill turtles at these foraging grounds. We encourage researchers to apply best-practice attachment methods and continue assessing potential impacts of tracking technologies across species, life stages, and habitats. By providing evidence that satellite tagging does not adversely affect hawksbill turtle growth in this environment, this study contributes to the broader understanding of how biologging tools can be used responsibly in sea turtle conservation.

SEA TURTLES SWIM NEAR THE SURFACE ON LONG JOURNEYS*

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Theory predicts the most cost-efficient depth to swim at for air-breathing animals in transit is around three times their body depth. Any closer to the surface creates surface waves, generating 'wave drag', which means energy is diverted into wave formation instead of propulsion. Much deeper, and vertical travel back and forth to the surface for every breath is unnecessarily long. So to minimise drag and maximise horizontal distance covered, a travel depth of three times the body diameter of the animal is optimal. Humans and other semi-aquatic animals often swim at the surface which is energetically inefficient, but for fully marine animals undertaking seasonal migrations, it could be predicted that they should travel at optimal depths to minimise the cost of transport on long journeys. Three-dimensional space use is often well studied in foraging sea turtles and during internesting intervals. But for species that don't feed en route, depth use during long-distance migration remains poorly understood, largely due to limited depth resolution of satellite tags near the surface. In fact, the top few metres of depth data for diving animals are routinely disregarded, and so shallow diving is rarely recorded. We studied satellite-relayed depth use in post-nesting green turtles, and found a clear switch from deep to shallow dive patterns during daytime travel in migratory phases compared to pre- and post-migratory dives. Green turtles spent 80% of their diurnal time at depths less than 5 m when crossing the open sea, compared to >60% of time at depths greater than 5 m day and night during pre- and post-migratory phases. We corroborated this with fine-scale dive profiling from a displacement experiment where loggerhead turtles were moved offshore from their nesting beach, so that high-resolution logging devices could be retrieved after their journey back to shore. The equipped loggerheads swam at mean depths of around 1 m during active travel dives, interspersed with occasional midwater resting dives. Mean dive depths were 2.5–4.6 times the estimated body diameter for each

individual. We compared our sea turtle data with high-resolution dive data from little penguins commuting to a prey patch, and with broader data from the literature for further sea turtle, penguin and whale species during travel dives (when not feeding), and found that swim depth during travel follows an allometric pattern with body size across these diverse groups, as predicted by physics theory in the 1960s, being around three times the body diameter of the animal. Near surface swimming is therefore likely used broadly across non-foraging diving animals when in transit in order to minimise the cost of transport. This puts many migrating species at increased risk from shipping, but also offers predictive insight into vertical habitat use during migratory movements, informing marine spatial planning and fisheries mitigation for species with seasonal movements.

THE VALUE OF SATELLITE TRACKING ACROSS MULTIPLE YEAR COHORTS

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While satellite tracking is widely used to identify areas of conservation importance, whether there is a need to continue tag deployments across many years is unclear. We show that destinations of migrating animals from the same breeding population can differ significantly across years and hence we highlight the value of multi-year tracking studies. Between 2012 and 2024, we used Fastloc-GPS Argos and Iridium tags to track 58 green turtles (*Chelonia mydas*) from their nesting sites in the Chagos Archipelago. If tracking had taken place in a single year, the number of countries used as foraging destinations could have been hugely underestimated (n=1 country in 2024 versus 7 countries across years). Overall, 47% of tracked individuals foraged in the Seychelles, which likely hosts hundreds of thousands of foraging turtles across age-classes. Further, the importance of foraging in areas beyond national jurisdiction (ABNJs) was only revealed by tracking over multiple years. Across years 9% of tracked individuals foraged on the Saya de Malha Bank, a remote ABNJ, equating to likely >1,000 adult females and >10,000 green turtles using this foraging area. This cumulative insight from multi-year tracking likely applies broadly to capital breeders where there is environmental variability across the foraging range.

TRACKING TUMORS: FIRST REPORT OF FIBROPAPILLOMATOSIS IN CURAÇAO, HABITAT USE AND TRACE METAL ANALYSIS

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Fibropapillomatosis (FP) is a neoplastic disease affecting sea turtles globally, often linked to environmental degradation and anthropogenic stressors. Although FP has been documented across much of the Caribbean, its occurrence in Curaçao had not been scientifically confirmed until now. This study presents the first documented evidence of FP in green sea turtles (*Chelonia mydas*) inhabiting Curaçao. From June 2023 to February 2024, we captured eight green sea turtles in Caracas Bay, visually assessed them for FP, flipper-tagged them, and fitted them with very high frequency (VHF) transmitters. The turtles, five sick and three

healthy, were tracked to investigate movement patterns and identify essential foraging habitats. VHF telemetry proved effective in Caracas Bay's low-visibility, high-boat-traffic conditions. Tracking data revealed strong site fidelity, with turtles repeatedly using the marina and adjacent shallow seagrass beds as primary foraging areas, while resting mainly outside the marina. To assess potential environmental correlates of disease exposure, we analyzed copper (Cu) and lead (Pb) concentrations in seagrasses and seaweeds from five bays around Curaçao that span a gradient of human influence. Trace metal concentrations varied significantly by location, with the highest levels of Cu and Pb observed in Caracas Bay and the lowest at a remote eastern site. Although all concentrations remained within low parts-per-billion (ppb) ranges typical of background conditions, the connection between turtle foraging areas and elevated trace metal levels suggests the potential for chronic exposure through habitat use. Our results identify Caracas Bay as an ecologically important feeding ground for *C. mydas*. The emergence of FP on Curaçao underscores the need for sustained health monitoring and comprehensive environmental assessments to investigate how trace contaminants and other stressors may contribute to disease dynamics. Future work will expand island-wide population monitoring using Passive Integrated Transponder (PIT) tagging coupled with telemetry and environmental sampling to support long-term conservation strategies for green sea turtles and their critical habitats in Curaçao.

NEW INSIGHT ON THE GREEN SEA TURTLES OF THE SAN GABRIEL RIVER IN SOUTHERN CALIFORNIA, USA*

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Green sea turtles in the eastern North Pacific, particularly those in Southern California waters, have been well studied since the 1990s. Two main foraging areas, San Diego Bay and waterways of Long Beach, have served as the primary survey areas of this population for researchers from NOAA, the US Navy, and local partners. These estuary settings are typical habitats for turtles, despite being adjacent to urban areas. Yet a unique habitat, the San Gabriel River (SGR) in Long Beach has been monitored by NOAA and the Aquarium of the Pacific (AOP) for nearly 20 years, and has recently experienced a boom in the number of turtles aggregating in this extremely altered urban setting. Here we present the latest findings from recent capture surveys in the upper SGR in 2024 and 2025, and how the understanding of movement and habitat use have been complemented by the longer-term observation program by community scientists from the AOP. The SGR stretches 6-km inland, passing an active power plant and under freeway overpasses, until the riprap-fortified river abruptly shifts to a concrete culvert, where turtles have been sighted since the early 2000s. NOAA conducted boat-based surveys from 2010-2014, and the AOP initiated their observation program in ~2010. In ~2020, AOP launched a Photo Identification project using the online platform, Internet of Turtles, and has since compiled a large catalog of SGR turtles. In 2023, AOP researchers alerted NOAA scientists about a sharp increase in the number of turtles in the upper river (20+), and then in 2025, over 100 turtles were reported! This extraordinarily high concentration of turtles provided a rare opportunity to study these animals, and NOAA and partners conducted the first ever land-based survey capture effort in October 2024 and again in September 2025. Here, three and then eight green turtles (CCL range: 57.1 to 89.2 cm) were captured, tagged, and sampled. During the surveys, simpler net-based capture techniques were tested and developed that eliminated the need for a boat, making the captures less

equipment-intensive and more efficient. Aerial support was also provided by a NOAA UAS (drone) to help guide capture efforts, while also surveying the behavior and abundance of the turtles. Some preliminary results show: abundance estimates at over 100 individual turtles of a wide size range (~45-90 cm CCL); multi-year residency duration confirmed by photo ID, year-round use of the habitat with increased numbers during the summer and fall; primary foraging on floating green algae flowing from upriver; entanglement in fishing line and debris does occur, and tagged turtles show short-term (days) movements away from the upper river during and following large rain events, consistent with visual observations. The findings from these collaborative efforts is important and timely, as this area directly overlaps with pending freeway infrastructure repair work that will require major river diversion and disruption to this unique foraging habitat. The information on the movement and abundance of turtles in this area is required from NOAA to ensure the safe completion of this essential infrastructure work.

TESTING LEARNED MIGRATION GOAL THEORY: DO OCEAN CURRENTS DEFINE WHERE SEA TURTLES FORAGE?

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Marine turtles have a complex life cycle with ontogenetic habitat shifts sometimes driven by large-scale migrations. In early life, hatchlings have limited swimming ability and are assumed to drift passively into the open ocean. Their paths, mostly shaped by oceanographic fronts and currents, lead them towards foraging grounds. As sea turtles grow, their swimming ability improves, and they gain more control over their movements. Nonetheless, oceanographic factors still influence the distribution of juvenile and adult sea turtles. To describe this, some authors proposed the Learned Migration Goal (LMG) theory that suggests that adults may return to the same foraging areas they used as hatchlings, when their movements were restricted by currents, instead of exploring new places as their swimming improves. Although it is widely accepted as an explanation for distribution patterns, this theory has not been statistically tested. In this study, we genotyped or compiled data from multiple Mediterranean foraging grounds from Clusa et al. (2014), Rees et al. (2017), Turkozan et al. (2018), and Vela-Garcia et al. (in prep) for loggerhead turtles (*Caretta caretta*) from 7 foraging areas on the mitochondrial DNA D-loop control region and from Tikochinski et al. (2018), and Vela-Garcia et al. (in prep) for green turtles (*Chelonia mydas*) from 2 foraging areas on mitochondrial short tandem repeats (STRs). With this information, we assessed the composition of these foraging areas with the Mixed Stock Analysis (MSA) technique. Afterwards, we compared the juvenile and adult composition obtained from MSA with the hatchling composition as inferred by Casale & Mariani's (2014) particle dispersal models. We performed a Fisher test on genetic data (MSA) and the composition predicted by both dispersal models to test the LMG theory and determine if the composition of juvenile and adult sea turtles on foraging grounds matched that of hatchlings. Our results revealed strong heterogeneity in the foraging ground composition in both species, consistent with the major current patterns and uneven nesting population sizes. However, significant differences were

found in almost all cases between the observed foraging ground composition (inferred using genetic analyses) and the expected composition (inferred with particle simulations), suggesting that sea turtles' distribution patterns cannot be explained solely by passive drift during early life stages. Therefore, our results highlight that other factors may influence how individuals recruit foraging grounds as adults, for example, the role of magnetic orientation. When hatchlings detect the intensity and inclination of the magnetic field, they develop a large-scale coordinate magnetic map to use in long-distance migrations, which result in directed hatchling movements that can be tested empirically. Thus, the combination of the magnetic map and their limited swimming ability allows hatchlings to engage in some active swimming during migration, which can slightly alter their trajectories. Likewise, individuals could remember the sites visited while constrained by the current systems as hatchlings but actively swim to select the optimal sites when maturing. Consequently, a combination of passive drifting and active swimming is the most likely explanation for the observed composition of sea turtle foraging grounds in the Mediterranean.

RIDING WITH THE TURTLES: DIVERSITY OF EPIBIOTIC MEIOFAUNA IN FORAGING AREAS OF *CHELONIA MYDAS*

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Sea turtles exhibit a complex life cycle that includes migrations and alternation of habitats across different life stages. This characteristic, combined with the presence of a rigid carapace, provides a suitable substrate for epibiont colonization. Although epibiosis in sea turtles has gained relevance within the scientific community, most studies focus on macroepibionts from animals collected in reproductive areas. To advance this field of study, the present research aimed to characterize the epibiotic meiofauna associated with green turtles (*Chelonia mydas*) in two foraging areas in the state of Rio de Janeiro, Brazil. Individuals were intentionally captured in May 2025 during research activities of the Projeto Aruanã at two sites: Itaipu Beach (Niterói, RJ) and Marina da Glória (Rio de Janeiro, RJ). Of the turtles captured in Itaipu (n = 23) and Marina da Glória (n = 22), nine individuals from each site had the posterior portion of their carapaces scraped to collect epibionts. Scraping was performed using a soft resin spatula and sponge. Samples were preserved in 10% diluted formalin and sieved through 1 mm and 38 µm meshes to separate macrofauna and meiofauna, respectively. Meiofauna extraction was carried out through decantation and centrifugation using a high-density solution, followed by sorting. From an analyzed total area of 0.67 m² (18 turtles), 3,242 meiofaunal individuals were recorded: 2,824 nematodes, 237 decapods, 110 copepods, 21 turbellarians, 17 polychaetes, 14 ostracods, 14 mites, 4 tardigrades, and 1 tanaidacean. The nine meiofaunal taxa occurred in both locations. Meiofaunal (16.1 ± 7.9 vs. 0.8 ± 0.2) and nematode (15.5 ± 7.9 vs. 0.2 ± 0) densities were significantly higher on turtles from Marina da Glória ($p = 0.04$). These results suggest that local environmental quality influences the presence of meiofaunal epibiont, as Marina da Glória is inside Guanabara Bay, whereas Itaipu is an inlet situated outside of the bay and exhibits better environmental conditions. Guanabara Bay is the second largest bay in Brazil and is characterized by intense anthropogenic activity, including ports, industries, oil refineries, and the direct discharge of untreated

sewage. In contrast, Itaipu is under greater influence of oceanic waters and is part of a sustainable-use conservation unit (RESEX Marinha de Itaipu).

DIRECTED MIGRATORY MOVEMENTS AND FORAGING STOPOVERS DURING POST-NEST MIGRATIONS OF LOGGERHEAD AND GREEN TURTLES FROM SOUTHWEST FLORIDA, USA

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Understanding the strategies sea turtles use to maximize energy efficiency during post-nesting movements can aid in predicting how these species may respond to environmental change. To investigate these strategies, we examined post-nesting movements of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles nesting on Sanibel and Keewaydin, Florida (USA), two barrier islands located in the Gulf of Mexico. Our analyses focused on the migratory phase between the last nest of the season and the arrival at the primary foraging habitats. During these migrations we observed two types of movement behavior: directed migratory movement, and "foraging stopover" behavior (characterized as localized foraging while in transit). We applied switching state-space models (SSMs) to satellite-tracking data from four loggerheads (one tagged in 2020, three in 2025) and nine green turtles (tagged 2017–2019) to estimate daily locations and classify migratory behavioral states as either "directed movement" or "foraging stopover." These classifications allowed us to identify foraging events, quantify the proportion of time spent foraging during migration, calculate migration durations and migratory distance traveled, and assess inter- and intraspecific variability in migratory strategies. Although sample sizes differed between species and tagging occurred across multiple years, consistent analytical methods were applied across all individuals, allowing for comparative assessment of migratory strategies despite temporal and sample-size variability. Additionally, the three loggerheads tagged in 2025 were equipped with depth-recording satellite transmitters, enabling us to assess dive behavior during the migratory phase and after the arrival at the primary foraging habitats. Eight out of the nine green turtles exhibited some degree of foraging during migration, whereas three of the four loggerheads migrated exclusively via directed movement, even when undertaking relatively long migrations (~200-600km). Across all individuals, the proportion of time spent in foraging stopovers showed positive but non-significant correlations with both migration duration (Spearman rank correlation, $\rho = 0.40$, $p = 0.17$) and total distance traveled (Spearman rank correlation, $\rho = 0.23$, $p = 0.45$). When examined qualitatively by species, green turtles tended to have a higher proportion of time spent foraging during longer and farther migrations, whereas loggerhead turtles generally exhibited directed migration with little to no foraging, regardless of migration duration or distance. Notably, the only loggerhead that engaged in foraging during migration experienced the shortest migration (~26km), with foraging limited to one stopover days before arriving at the primary foraging habitat, suggesting opportunistic rather than effort-driven foraging. Assessment of the loggerhead dive behavior revealed that during active migration, the turtles exhibited an increased dive frequency at varied maximum depths. Once they reached their primary foraging habitat, their dive frequency decreased and their maximum dive depth stayed relatively consistent over time, indicating potential behavioral adjustments in energy use related to benthic foraging and depth differences between migratory routes and foraging grounds. Collectively, these results provide insights into how loggerhead and green turtles may differ in post-nesting movement strategies and how behavioral plasticity may influence their resilience to changing ocean conditions.

BODY MASS AND WATER TEMPERATURE REGULATE SEAGRASS CONSUMPTION IN GREEN TURTLES (*CHELONIA MYDAS*)

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Over recent decades, rapid increases in green turtles (*Chelonia mydas*) populations has been reported worldwide, and intensive grazing by these turtles causes a degradation or collapse of seagrass meadows. In Japan, similar loss of seagrass habitats due to green turtle overgrazing has been observed in several coastal areas around Okinawa. Developing appropriate conservation and managements strategies for seagrass ecosystems is essential to maintain a balance between green turtle populations and seagrass biomass. To estimate the carrying capacity of the seagrass meadows, it is necessary to evaluate the daily consumption of seagrasses by green turtles. Since green turtles are ectotherms, moreover, their feeding rates are expected to fluctuate with environmental temperature. This study aimed to quantify the daily intake of seagrass by green turtles and determine how consumption is regulated by body weight and water temperatures in captivity settings. Feeding experiments were conducted on in the Yaeyama Field station, Japan Fisheries Research and Education Agency, in Ishigaki Island, Japan (24.44°N 124.22°E). Eight individuals were captured by a local fisherman and temporarily held in outdoor tanks before feeding trials. The straight carapace length and body weight ranged from 31.3 to 70 cm and 3.84 to 48.0 kg, respectively. A total of 13 feeding trials were conducted from October 2024 to October 2025 across a range of water temperatures (19.2–28.8 ℃). In each trial, a single turtle was placed in an experimental tank (4 m in length, 1.43 m in width, and 0.68 m in depth) and provided with two dominant seagrass species, *Cymodocea rotundata* and *Thalassia hemprichii*, which are commonly consumed by green turtles around Ishigaki Island. Since turtles primarily graze seagrass leaves under natural environment, rhizomes, roots and sheaths were removed and only leaf blades were used in feeding trials. Seagrass blades were attached to the plastic mesh frame by cable ties and placed on the bottom of the experimental tank. Each trial was conducted after confirming voluntary feeding on the seagrass in the experimental tank over several days. The amount of seagrass consumption was calculated as the difference between the initial and remaining wet weight after 24 hours, and then converted to dry weight. Seagrass consumption was significantly and linearly correlated with turtle body mass under similar thermal conditions. Furthermore, consumption increased markedly with rising water temperature, particularly above 27 ℃. These results demonstrate that both body mass and water temperature are key determinants of seagrass intake in green turtles. Additional findings from ongoing experiments will also be presented.

Nesting Biology

HONU RESILIENCE: REPRODUCTIVE BEHAVIORS MAY BUFFER IMPACTS OF CLIMATE WARMING IN THE WORLD'S HIGHEST-LATITUDE GREEN TURTLE (*CHELONIA MYDAS*) POPULATION

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Anthropogenic climate change impacts wildlife on a global scale. For sea turtles, which rely on terrestrial habitats for reproduction and exhibit temperature-dependent sex determination, there is widespread concern that warming sand temperatures may drive sex-ratio skew and eventual population collapse. Breeding sex ratio (BSR) is a key parameter for modeling population viability and informing management decisions, but is poorly understood for many sea turtle populations. Importantly, reproductive behaviors (e.g., sex-specific differences in remigration interval, polygamy, paternal contribution modes) can alter BSR and potentially buffer against the negative effects of sex ratio skew, but are challenging to robustly quantify in larger, wild populations. Hawaiian green turtles, or honu, comprise an ideal study system for quantifying how reproductive behaviors affect BSRs as honu have been extensively monitored for decades and are one of the few green turtle populations that exhibits male basking behavior, thus facilitating bio-sampling of males. It is also the highest latitude nesting rookery of green turtles globally, making it a potential key refugia population for the species. Here, we quantified honu mating strategies and BSR using 2,470 hatchling samples with known mothers (n=147 females) and males sampled while basking on the nesting beach (n=136) over a 3-year breeding cycle (2021-2023). Using a high-throughput Single Nucleotide Polymorphism panel we developed for genotyping and pedigree reconstruction, we found that the current BSR in honu is male-biased (1.00F:1.86M). The male-biased BSR in honu is likely due at least in part to complex reproductive behaviors, including high rates of multiple paternity (>65% of all nests), more frequent breeding by males, and substantial polygyny within a breeding season. We provide the first genetic evidence to our knowledge of male green sea turtles siring offspring in consecutive years as well as providing genetic evidence of polygyny, which has been rarely documented for green turtles. These findings collectively support that a 1F:1M sex ratio may not be required for population sustainability, and the reproductive behaviors identified here are likely positive indicators for the persistence of honu as nesting beaches continue to warm. However, continued monitoring is needed to understand possible impacts of time lags; because sea turtles are long-lived and reach sexual maturity around 25 years old, adult BSR does not necessarily reflect the current primary sex ratio, which is unknown for honu. Monitoring is also required to assess emerging environmental and human-caused threats on population persistence. Our study provides critical but previously unknown metrics that will be used to build more robust population viability models for honu and adds to the limited knowledge of reproductive strategy and adult sex ratios in green sea turtles.

THREE DECADES OF NESTING HAWKSBILL (*ERETMOCHELYS IMBRICATA*) AND GREEN (*CHELONIA MYDAS*) SEA TURTLE MONITORING ON MAUI, HAWAIʻI, USA

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Hawaiʻi Wildlife Fund

The Hawaiian Archipelago supports one of the smallest and most geographically isolated populations of the critically endangered hawksbill sea turtle (*Eretmochelys imbricata*), coexistent with the more common green sea turtle (*Chelonia mydas*). Hawaiian hawksbills are especially vulnerable to anthropogenic threats such as habitat degradation, anthropogenic disturbance, and climate change; all of which heighten the risk of local extirpation for hawksbills and cast uncertainty over the future of green turtles. The long-term monitoring and protection of nesting females, nests, and nesting habitats remain essential to the recovery and long-term viability of sea turtle populations throughout the Hawaiian Islands. While the majority of green turtles nest in the Papahānaumokuākea Marine National Monument, the amount of nests laid in the Main Hawaiian Islands (where Hawaiian hawksbills exclusively nest) are increasing, including on Maui. Maui gets a small fraction of nesting female hawksbills compared to Hawaiʻi Island and Molokaʻi, but these individuals still contribute to the genetic success of the population. Maui's first hawksbill nest was documented in 1991, and in response to increasing threats, Hawaiʻi Wildlife Fund (HWF) and partner agencies established the Hawksbill Recovery Project in 1996. For nearly three decades, this program has focused on research, community outreach, and the protection of nesting females, hatchlings, and critical coastal habitats. These sustained efforts, supported by fieldwork and strong community engagement, have produced an extensive long-term dataset on Maui's nesting hawksbills and green turtles (once the first green nest was documented in the year 2000). Monitoring is conducted through volunteer-based dawn patrols, night patrols, and 24-hour nest watches during hatchling emergence periods. HWF also leads habitat restoration initiatives aimed at improving nesting and hatchling success, including dune restoration, coastal light reduction, and community education to mitigate human disturbance. Since 1996, these efforts have resulted in the documentation of 25 nesting beaches, the tagging of 13 individual hawksbills (11 with satellite transmitters), with an 18.9 day average inter-nesting interval. Monitoring of 0–13 hawksbill nests per season ($n = 118$), laid by up to 3 females annually, yielded an average clutch size of 179.7 eggs (maximum 249 eggs) and produced 11,925 live hatchlings. The mean annual hatchling success was 54.5%. A linear regression analysis revealed a significant positive correlation in mean annual hatchling success over time ($p = 0.021$, $p < 0.05$), suggesting improving survival rates. However, the small sample size limits broader generalization. No significant trends were observed in the annual number of nesting females, nests, or hatchlings on Maui since 1996, though there is evidence of an increase in neophyte turtles; an encouraging sign of population recruitment. Nevertheless, HWF continues its multi-faceted conservation efforts to improve the survivability of nesting and hatchlings by refining management strategies informed by ongoing research, with the overarching goal of supporting the regional recovery of these two species.

SIGNS OF HOPE FOR THE LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) IN ECUADOR: REPRODUCTIVE ACTIVITY AND NESTING AMIDST OCEAN WARMING AND BYCATCH STRANDINGS

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The leatherback sea turtle (*Dermochelys coriacea*) is categorized as Vulnerable globally, with a declining population; however, several subpopulations in the Pacific and Southwest Atlantic are Critically Endangered. In particular, the eastern Pacific (EP) leatherback subpopulation nesting along the Pacific coast of the Americas region has declined significantly over time. The EP subpopulation is endangered due to low population numbers and faces several environmental threats (e.g., bycatch/entanglements, plastic pollution, degradation of nesting beaches, ocean warming), which affect its long-term survival. In January and February 2021, the emergence of ~50 hatchlings and an adult reproductive female of leatherback sea turtle observed in Ecuador's central coast signaled the newest occurrence of nesting activity long after the first documented observations reported in the early 1980s. Several research gaps and questions remain regarding the current population status of the leatherback sea turtle, as well as knowledge about the nesting population and reproductive activity of this species in coastal Ecuador in the face of anthropogenic impacts and ocean warming. To contribute to our understanding of recent nesting activity and strandings by this endangered sea turtle species in the face of environmental stressors in Ecuador, the objectives of this research work were envisioned to 1) contribute with an analytical appraisal on reproductive females occurrence of *D. coriacea*, and its nesting activity influenced by El Niño and La Niña episodes from 1980 to 2021; 2) describe the photo-documentation of the newest record of a large reproductive female leatherback and the first field observations of leatherback neonates in early 2021 at new locations of Ecuador's central coast; and, 3) provide a brief assessment of leatherback strandings in tandem with small-scale (artisanal) fisheries interactions and the impact of sea surface temperature (SST) anomalies along the Ecuadorian coast over the period 2011-2018. Insights on conservation efforts for the long-term protection of the species are also recommended. The records of at least 11 adult or reproductive females (estimated mean length: 1.74 m, ranging 1.35─~2.0 m, n = 5) over the 1980─2026 period in tandem with prior and new evidence of nesting activity (observations of nesting tracks, eggs deposition into nests and neonates' hatching), including nests' clutch sizes ranging 70 to 138 eggs during the period December 2013 to January

2026 along coastal Ecuador, suggest that the EP leatherback reproductive occurrence and output may be gradually increasing during cooler, more productive La Niña events in the last two decades, while withstanding intense and more frequent the El Niño Southern Oscillation (ENSO) episodes due to ocean warming due to increasing SST anomalies. Yet, a relatively high frequency of strandings (3.25 strandings/year), including 26 stranded individuals (CCL ranging 108─150 cm), with ~50% of leatherback mortality being associated with bycatch, entanglements, and other anthropogenic activities (e.g., inflicted force trauma, leatherbacks' human consumption and illegal poaching), was also reported from 2011─2018. Ongoing monitoring and concerted conservation efforts, along with coastal community-based interventions, bycatch mitigation, and effective coastal zone management to protect nesting beaches, are crucial for the long-term survival of leatherbacks in the southeastern tropical Pacific.

EXPLORING MATERNAL EFFECTS: THE ROLE OF TRACE ELEMENTS AND FEMALE IDENTITY ON THE HATCHING SUCCESS OF LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*) IN MEXICO

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Several factors influence hatching success in leatherback turtles (*Dermochelys coriacea*), including maternal identity and exposure to trace elements that can be transferred to eggs during reproduction. In this study, we evaluated the relationship between trace element concentrations in egg contents, female reproductive identity (neophytes vs. remigrants), and reproductive success parameters in a critically endangered eastern Pacific population. One egg from each of 34 nesting females (16 neophytes and 18 remigrants) was collected during the 2023–2024 nesting season from three index nesting beaches along the Mexican Pacific. Concentrations of Zn, Cd, Hg, Pb, Cu, and As were quantified, and their relationships with apparent infertility, embryonic mortality, and hatching success were assessed. Trace element concentrations differed between female identities. Mercury concentrations were higher in eggs from remigrant females (ANOVA, $p = 0.027$); however, mercury levels showed no significant relationships with hatching success ($p = 0.752$) or apparent infertility ($p > 0.05$). In contrast, zinc concentrations were higher in neophyte females (ANOVA, $p = 0.003$). In remigrants, zinc was negatively associated with apparent infertility ($p < 0.01$) and positively associated with hatching success ($p < 0.01$), suggesting a potential role of this essential element in supporting embryonic development. Additionally, cadmium concentrations were positively associated with female body size (curved carapace length) in remigrants ($p = 0.033$), indicating greater accumulation in larger females. Overall, these findings indicate that maternal identity influences the bioaccumulation and transfer of trace elements to eggs and that individual elements may have contrasting effects on reproductive outcomes. Incorporating maternal traits and contaminant exposure into hatchery monitoring programs may improve conservation and management strategies for this critically endangered population.

EMERGING LOGGERHEAD SEA TURTLE NESTING IN THE WESTERN MEDITERRANEAN: THERMAL SUITABILITY AND MANAGEMENT CHALLENGES*

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Nesting activity of the loggerhead turtle (*Caretta caretta*) is increasing across the western Mediterranean, associated with the progressive rise in temperatures driven by climate change (Hochscheid et al., 2022). In 2025, Spain recorded a historic peak of 33 nests, confirming a clear upward trend in reproductive activity. These newly established nesting areas at higher latitudes are expected to play a key role in producing male hatchlings, which are essential for maintaining balanced sex ratios and ensuring the long-term resilience of Mediterranean populations. Given this emerging phenomenon, extensive research has been conducted along the Spanish Mediterranean coastline to assess the beach suitability for nesting and to provide a scientific basis for adaptive coastal management in response to this new scenario. Between 2023 and 2025, one hundred beaches were surveyed to assess physical and anthropogenic characteristics. Sand temperature was monitored at typical nesting depth (40cm) using automated dataloggers, following previous studies (Cardona et al., 2023), while granulometric composition, sand colour, and moisture content were analysed to determine their influence on thermal and hydric properties of the substrate and subsequent incubation success potential (Foley et al., 2006; Lolavar et al., 2020). In addition, for a subset of fifteen representative beaches in the northern area, measurements of artificial light at night (ALAN) were conducted, a known driver of behavioural disruption in nesting females and hatchlings (Stanley et al., 2020). All the studied beaches exceeded the minimum incubation threshold of 25 °C during the nesting season, confirming that the entire Spanish Mediterranean coast is now thermally suitable for successful incubation. However, clear spatial variability was detected: northern beaches in Catalonia, such as Grifeu (Llançà), reached mean values of 29–30 °C between June and August — values previously unrecorded in this area, reflecting a clear warming trend — while some beaches further south displayed lower values. These findings confirm that most Spanish Mediterranean beaches currently present conditions compatible with successful incubation, although local variability persists due to differences in sediment structure, albedo and moisture regimes (Patiño-Martínez et al., 2022). Moreover, light-pollution surveys revealed significant differences between sites. The Ebro Delta Natural Park displayed the best night-sky quality (> 21 mag arcsec^{-2}; < 0.1 lux), coinciding with a historical record of six nests in 2025 and hatching success exceeding 90%. Conversely, luminance values of up to 3.5 lux were recorded at several urban beaches, levels that can interfere with hatching orientation. Overall, these results confirm that rising thermal regimes are making the Spanish Mediterranean increasingly relevant for the reproduction of *C. caretta*. However, this emerging nesting pattern requires adaptive management to reconcile intensive coastal use with conservation objectives. To ensure the demographic resilience of the species under future climate scenarios, it will be

essential to maintain a network of suitable nesting beaches across different latitudes and thermal profiles. Priorities include identifying and protecting low-impact beaches, mitigating artificial illumination and monitoring sand temperature and sediment characteristics in the long term, to support evidence-based decision-making and ensure the sustainable coexistence of tourism and sea turtle nesting across the Mediterranean.

IN-NEST VOCALIZATIONS OF OLIVE RIDLEY TURTLES: USING MACHINE-LEARNING TOOLS TO FURTHER REVEAL THE ROLE THAT VOCALIZATIONS PLAY IN SYNCHRONIZING HATCHING AND EMERGENCE

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All seven extant sea turtle species vocalize as late-stage embryos and hatchlings; however, the ecological function of these vocalizations remains under debate. Competing hypotheses state that 1) vocalizations may serve as a cue to facilitate the synchronization of hatching or nest emergence or 2) vocalizations are a by-product of turtle movement and play no relevant ecological role. If the first hypothesis is true, we would expect vocalizations to pre-empt movements within the eggs while under the second hypothesis, we would expect vocalizations and movements to occur synchronously. To assess for variation in the timing of vocalizations and turtle movements, we placed microphones in two olive ridley (*Lepidochelys olivacea*) turtle nests in a hatchery at Playa Grande, Costa Rica. Specifically, we placed two acoustic microphones per nest, one on each side, allowing us to measure vocalizations across space, and placed an additional contact microphone in each nest to quantify sea turtle movement. Audio data were recorded continuously over the 9 to 10 days before hatchlings emerged from the nest and analyzed using a machine-learning tool hosted on BirdNET. Vocalizations began between four and five days before nest emergence, while hatchlings began moving just two days before emergence. These provides evidence against the second hypothesis, suggesting that vocalizations may serve as a cue for hatchling movement. Additionally, we observed that embryonic vocalizations were concentrated in specific time periods throughout the day whereas movements were not related to time. Finally, vocalizations apparently appeared to spread from one side of the nest to the other, suggesting lateral communication provoked by vocalizing embryos in close proximity. While the sample size of our study was low (N = 2), we illustrate how machine-learning tools could reduce the effort associated with analyzing acoustic data and thus unable future studies with larger sample sizes. Nevertheless, our study provides interesting insights that support that role that vocalizations may play in synchronizing nest emergence.

HANDLING TIME DURING NEST RELOCATION INCREASES THE RISK OF CONGENITAL MALFORMATIONS IN THE KEMP'S RIDLEY SEA TURTLE (*LEPIDOCHELYS KEMPII*) EMBRYOS*

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The Kemp's ridley turtle (*Lepidochelys kempii*) is a rare species endemic to the Gulf of Mexico and the most endangered sea turtle worldwide. Nest relocation is a long-standing conservation strategy to prevent sea turtle nest loss due to anthropogenic and natural causes. Artificial incubation environments — hatcheries or relocated nests— alter temperature, moisture, gas exchange, and microbial balance, causing embryonic stress. In situ nests show lower congenital malformation (CMs) frequencies and mortality than artificially incubated nests. Nests containing malformed organisms exhibit higher mortality and reduced incubation success, suggesting an effect of intrinsic incubation factors, likely linked to maternal condition or nest microenvironment. We established a baseline CMs prevalence of 3.7% for the Kemp's ridley turtle at Rancho Nuevo, Tamaulipas, Mexico, higher than that reported for other sea turtle species (0.2–2%) under different nest management strategies. Despite several decades of intensive nest relocation, no study has experimentally quantified if handling time during relocation influences embryonic development or CMs prevalence. We evaluated the effects of nest management and handling time on embryonic development of the Kemp's ridley turtle during the 2019 nesting season at Rancho Nuevo. We examined 202 in situ and 277 hatchery nests to compare hatching success, emergence success, mortality, and CMs prevalence. We selected 107 hatchery nests to test the effects of handling time, divided into four treatments determined by the time elapsed between oviposition and reburial: EH1 (1h), EH3 (3h), EH5 (5h), and EH7 (7h). The effects of handling time treatments on hatching success, emergence, mortality, and CMs prevalence were tested using generalized linear models with either binomial or Poisson distributions. Hatchery nests showed higher mortality and lower hatching and emergence success than in situ nests. In both management types, nests containing malformed embryos exhibited higher mortality and lower incubation success than nests without CMs. Handling time significantly influenced embryonic development; longer delays between oviposition and reburial increased mortality and reduced hatching and emergence success. CMs occurrence also rose with handling duration, predominantly Schistosomy, a severe fissure of the ventral or midventral abdominal wall in which, depending on its extent, organs may be exposed. Our results show, for the first time, that egg handling before reburial disrupts early embryogenesis, increasing the risk of developmental failure and CMs. We reveal a previously untested link between nest handling time and embryonic development in sea turtles. Earlier research suggested that artificial incubation environments may alter physical and chemical nest conditions. We extend these observations by identifying handling time as a critical factor affecting developmental outcomes, particularly the occurrence of Schistosomy. Given the size of nesting beaches such as Rancho Nuevo (35 km), reducing handling time may not be feasible; a cost-benefit assessment is recommended. Standardized CMs recording should become a biological indicator of management effectiveness and embryo health. Monitoring the frequency and types of CMs across seasons and nest management practices provide early warnings of developmental stress and serve as a tool to evaluate and optimize conservation strategies for the critically endangered *Lepidochelys kempii* and other sea turtle species worldwide.

MORPHOMETRIC AND REPRODUCTIVE VARIATION IN NESTING FEMALE BLACK SEA TURTLES (*CHELONIA MYDAS* AGASSIZII) FROM THE MICHOACAN, MEXICO POPULATION

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The black sea turtle (*Chelonia mydas* agassizii) population that nests in Michoacan, Mexico, was severely threatened by the harvest of breeding adults and the harvest of almost all of its nests in the 60's and 70's, which caused a serious decline in its population, causing a demographic bottleneck. Currently, due to multiple conservation actions, the black sea turtle (C. m. agassizii) population in Michoacan has recovered significantly; however, this recovery has had repercussions on life history traits. In this work, variations in body size, body weight and clutch size are studied and compared with data obtained during the decline stage (1985-2002). It is observed that in the recovery phase the body size of the nesting females has been reduced and has had consequences on the clutch size, now the number of eggs per nest is lower compared to the clutch size of the decline phase. The results obtained in this work indicate that in the decline stage (1985-2002, n=524) the average size of curved carapace length (CCL) was 86.4 cm, with a minimum size of 63.0 cm and a maximum of 110.0 cm, with an average weight of 63.0 kg (min. 31.0 kg; max. 111.0 kg, n=97 females) and with an average clutch size of 77.0 eggs per nest (min. 27.0; max. 153, n=90 females). While in the recovery stage (2023-2024, n=524) the average size (LCC) was 81.2 cm (min. 66.5 cm; max. 103.5 cm) with a body weight of 46.6 kg (min. 31.9; max. 65.2 kg, n= 97 and an average clutch size of 63.0 eggs per nest (min. 28; max. 106). The reported traits and the analysis between morphometric and reproductive variations indicate that the black turtle population nesting in Michoacan presents lower values of body size and clutch size compared to previous studies, and it was also found that there are significant differences in both body size and clutch size between both periods. This could be due to the increase of female recruits in the breeding population, sexual maturity at a smaller size, a lower growth rate after sexual maturity or lower adult survival.

TEMPORAL PLASTICITY IN NESTING WILL NOT BE SUFFICIENT TO OFFSET RISING TEMPERATURES UNDER FUTURE CLIMATES IN GREEN TURTLES

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Rising global temperatures associated with climate change pose a major threat to the persistence of sea turtle populations over the coming century. Developing sea turtle embryos are particularly vulnerable because they incubate without parental care or behavioral buffering mechanisms against unfavorable conditions. Given the narrow thermal tolerance thresholds for successful embryo development, projected temperature increases are expected to increase embryonic mortality. Similarly, because all sea turtle species exhibit temperature-dependent sex determination (TSD), warming is predicted to produce increasingly female-biased sex ratios. One potential adaptive response to climate warming is plasticity in nesting phenology, shifting the timing of nesting to maintain optimal developmental conditions. To evaluate the impact of nesting timing on thermal conditions, we deployed temperature loggers within nests of green turtles (*Chelonia mydas*) at Fernando de Noronha over four nesting seasons (2019–2023). We focused on repeat-nesting females to assess how the timing of nesting influences nest thermal environments, hatching success, and sex ratios, and how these vary over the nesting season. Empirical measures of hatching success at this site are high (>75%) across the nesting season, showing limited correlation to nest temperature. In contrast, embryological models suggest that sex ratios are already strongly female-biased (>90%), although nests laid later in the season produce relatively more males (15-40%). Nests of females that laid multiple nests across the season showed similar trends, suggesting that later nesting contributes to higher male production within individuals as well as at the population level. To predict future rookery production, we used a mechanistic microclimate model incorporating metabolic heat production to simulate nest temperatures from 1980-2020, and to forecast conditions for 2040-2100. Climate projections assumed a 1% annual increase in atmospheric CO_2. We modeled hatching success and sex ratios for each day of the year and scaled these results to a generalized nesting distribution for Fernando de Noronha. Model outputs assuming current nesting phenology indicate that while interannual variability in hatching success will persist, mean success is projected to decline to 40-50% by 2100. Sex ratios, already heavily skewed toward females, are expected to consistently exceed 95% female production by the end of the century. To sustain current levels of hatching success, our models suggest no substantial shift in nesting timing is needed before 2060. However, after this point, a 7-15-week advancement of the nesting season would be required. For sex ratios, phenological shifts would need to begin immediately, also increasing to approximately 15 weeks by 2100. Shifts towards earlier nesting was not an effective mitigation strategy in our models. Overall, our findings suggest that while nesting phenology shifts could temporarily buffer populations against rising

temperatures, substantial shifts forward, up to four months by 2100, will be necessary to sustain current levels of both hatching success and sex ratios favorable for population persistence.

COMPARING MODELLED HATCHLING SEX RATIOS TO ACTUAL SEX RATIOS IN FIELD NESTS

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Sea turtle nesting beach managers and other biologists are interested in knowing sea turtle hatchling sex ratios, particularly in the light of increasing sand temperatures. However, this cannot be directly determined with current methods, so indirect methods are used which use nest or sand temperature during the sex determining period (SDP), combined with the relationship between temperature and hatchling sex ratio determined from laboratory constant temperature experiments. Here we compare hatchlings sex ratios predicted from modelling using nest temperature during SDP with the sex ratio determined directly by histological examination of gonads from hatchings sampled from nests. We sampled 27 green turtle nests (10 hatchlings per nest, for a total of 270 hatchlings) laid on Heron Island in the southern Great Barrier Reef over the 2020 - 2021 and 2022 - 2023 seasons. We found that modelling sex ratios was a poor fit to actual sex ratio data, with modelling generally underestimating the proportion of males in the nest compared to empirical data. We discuss reasons why this might be so including the fact that in natural nests the temperature is continuously changing during the SDP whereas the modelling is based on constant temperature incubation. These results indicate from a conservation management that the strong female hatchling bias predicted from modelling sand temperatures may infact be not so female biased in real life.

LONG-TERM PATTERNS OF SEA TURTLE NEST SUCCESS IN RELATION TO BEACH NOURISHMENT

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Beach nourishment is a direct anthropogenic influence on sea turtle nesting success. It involves replenishing sand on beaches to counter erosion and sediment loss from natural or human-driven processes. Nourishment projects deposit mined or dredged sediment onto shorelines to expand beaches and mimic natural conditions but can alter beach morphology and sediment composition, leading to variable effects on nesting microhabitats. Because sea turtles depend on stable, undisturbed nesting environments for successful incubation and hatchling emergence, conservation efforts often focus on maintaining or restoring suitable beach habitats. This study examined how beach nourishment and the time elapsed since nourishment influence sea turtle hatching and emergence success along the St. Joseph Peninsula, Florida, from 2008 to 2024, using a zero-inflated beta-binomial generalized linear mixed model to compare outcomes between nourished and non-nourished zones. Nest success did not differ among nourishment categories, and time since nourishment was not a significant predictor of hatching or emergence success along the St. Joseph Peninsula, Florida. Subset models incorporating dune and mean high water distances found dune distance to be the only significant spatial driver of success. These results suggest that

nourishment and time since nourishment have limited long-term influence on nest outcomes, supporting previous findings that nourishment effects are short-lived and site-dependent. By clarifying how nourishment influences nest success over time, this study contributes to a broader understanding of how coastal restoration practices can balance shoreline protection with sea turtle conservation.

THE IMPACT OF HABANERO PEPPER CAPSAICIN POWDER ON MAMMALIAN NEST PREDATION

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Sea turtle hatchlings experience extremely high mortality between oviposition and sea finding stages. Along Florida's southeastern coasts, one of the world's most important loggerheads (*Caretta caretta*) nesting grounds, predation by mammals such as racoons, coyotes, and foxes pose a major threat to hatching success. Current management approaches, including nest caging and predator removal have shown previous success but are limited. Habanero pepper powder, which contains the chemical irritant capsaicin, is a potential deterrent that may reduce nest depredation. However, capsaicin's effects on predator impact and hatchling orientation have not been fully analyzed or evaluated. This study investigates the effectiveness of habanero pepper powder as a deterrent to mammalian predation on sea turtle nests. As historical data set (2010-2024) from the Gumbo Limbo Nature Center in Boca Raton, Florida is being analyzed using generalize linear mixed models to assess predator interaction rates. Additionally, this data set is being compared with data collected from the MOTE Marine Laboratory in Sarasota, Florida to create a comparison analysis. Preliminary analyses are currently ongoing. Results are expected to help further understand whether habanero pepper powder effectively reduces mammal predation on sea turtle nests. The expected outcome will provide standardized information and framework for pepper use as a future deterrent, further inform management protocols, and improve conservation strategies for hatchling survival success.

AN UPDATE ON NESTING ECOLOGY OF LEATHERBACK (*DERMOCHELYS CORIACEA*), GREEN (*CHELONIA MYDAS*), AND OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) SEA TURTLES IN PLAYAS GRANDE AND VENTANAS, COSTA RICA

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Playas Grande and Ventanas, located within Parque Nacional Marino Las Baulas (PNMB), are critical nesting beaches for the eastern Pacific populations of leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and olive ridley (*Lepiodochelys olivacea*) sea turtles. From the 2012-2013 to the 2024-2025 nesting seasons, we evaluated activity data—including confirmed nests, false crawls, body pits, aborted nests, and unknown events—across each species, to assess temporal trends and potential environmental causes. The decline of pacific leatherback populations is well documented, but our data showed recent stability in nesting numbers with confirmed nest numbers increasing in the last three years from 4 to 9 nests. Olive ridley nesting was relatively stable yet variable, characterized by multiple moderate peaks

consistent with diffuse or semi-continuous nesting patterns typical of this species, with about 50 confirmed nests each season. We observed an increase in green turtle activity, with confirmed nest numbers reaching a record during the 2023-2024 season with 61 nests. Variability across seasons occurred with known fluctuations in the El Niño Southern Oscillation (ENSO), which influences sea surface temperature and precipitation patterns. Periods of elevated green turtle activity coincided with post-El Niño years, when cooler temperatures and decreased rainfall prevailed. Leatherback declines are likely reflective of larger scale fishing impacts and climate patterns. Overall, results indicate species vary not only in timing and intensity of nesting but also in responsiveness to large-scale ocean and climate dynamics, highlighting the need for long-term, species specific monitoring to better understand climate driven variability in marine turtle reproduction. The results from this study provide an updated understanding of the status of these populations and offer critical insights into future conservation strategies within PNMB and across the broader eastern Pacific region.

MATERNAL BEHAVIOR SHAPES CLIMATE CHANGE RESILIENCE IN MEDITERRANEAN GREEN TURTLES*

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Climate warming threatens marine turtle reproduction by raising nest temperatures and reducing hatching success, but their capacity to respond to thermal stress is less understood. To identify mechanisms of thermal resilience, we used a long-term, individual-based dataset from Alagadi Beach, North Cyprus (2014-2024; n = 360 females, 1036 clutches) to test how maternal nesting traits influence incubation temperatures and hatching outcomes in Mediterranean green turtles (*Chelonia mydas*). Maternal traits can influence hatching success both directly, through maternal investment or nest placement (e.g. inundation risk), and indirectly, by changing incubation temperatures (e.g. lay dates). We used structural equation modelling (SEM) to disentangle these relationships, incorporating key maternal and nest-site traits as predictors of incubation temperature and hatching success. To assess the potential for thermal tolerance to respond to natural selection, we also estimated repeatability in hatching success. Repeatability quantifies how consistently individuals differ and provides a biologically meaningful upper bound on heritability. We show that lay date and beach selection have a strong influence on incubation temperature, and incubation temperature was subsequently a strong predictor of hatching success. We found 76% of clutches incubated within a thermally optimum range (30.0°C-32.5°C). However, a warming of 1.5°C, commonly predicted in near-term IPCC climate scenarios, could greatly reduce hatching success, emphasizing the importance of thermal tolerance. Repeatability of hatching success was strong (R = 0.83, 95% CrI [0.79, 0.86]), showing consistent differences among females that indicate scope for selection on thermally resilient phenotypes and suggesting potential capacity for long-term adaptation. Under "middle of the road" IPCC scenarios projecting warming of ~1.5°C by 2040 and ~2.7°C by 2100, these findings suggest maternal behavior may buffer incubation temperatures in the near-term, while consistent between-individual differences in hatching success show potential for longer-term adaptive responses through the end of the century.

COMPARISON OF INCUBATION DURATION PREDICTIVE MODELS USING INTERNAL AND EXTERNAL *CARETTA CARETTA* NEST TEMPERATURE DATA

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Communities and non-profit organizations along the East Coast of the United States rely on volunteers to monitor and manage marine turtle nests in compliance with State and Federal laws. In addition to patrolling beaches to document and protect nests, volunteers are often stationed at soon-to-hatch nests to assure hatchlings can make their way to the surf without disturbance. Hatchlings face many natural and anthropogenic challenges, such as predation (Erb & Wyneken, 2019), misorientation/disorientation due to artificial lighting (Salmon, 2003), and beach erosion (Lamont et al., 2002), when they emerge from the nest. Sea turtle monitoring programs, like the Network for Endangered Sea Turtles in North Carolina, aim to reduce hatchling mortality during this vulnerable portion of the sea turtle life cycle. Nest attendance is a time-consuming endeavour, and refining estimates of nest hatch date would help volunteers allocate their time more efficiently (Watson & Lamont, 2022). Previous studies have successfully predicted incubation duration within 1.9 days using external nest temperatures (Watson & Lamont, 2022), but there can be differences between internal and external nest temperatures due to metabolic heating within the nest as sea turtle embryos develop, which can influence incubation duration (DeGregorio & Williard, 2011). Previous research documented a significant increase in nest temperature due to metabolic heat production (DeGregorio & Williard, 2011 and Merwe et al., 2006) that results in a temperature differential between the nest and sand temperatures recorded immediately adjacent to the nest (Merwe et al., 2006). In a 2011 study, DeGregorio and Williard measured temperatures within loggerhead sea turtle (*Caretta caretta*) nests and at control sites within 1 meter of the nests and found no statistically significant difference between nests and control sites. However, control sites had greater temperature fluctuations compared to nest sites, and while not statistically significant, this could influence incubation duration estimates (DeGregorio & Williard, 2011). This study aims to compare incubation duration predictions using mean daily temperature up to 45 days of incubation (xT45) obtained from data loggers placed in the center of loggerhead sea turtle nest chambers at a depth of ~ 10-15 cm (internal) and at an equivalent depth in sand 40 cm adjacent to the nest (external). Paired temperature data (internal and external) were collected, and hatch date was recorded for 63 *C. caretta* nests from 2019-2022. Linear regression analysis was used to assess the relationship between temperature and hatch date for both internal and external temperature data sets, and ANCOVA was used to test for a significant difference in slope and intercept of the regressions for internal and external temperature (location) (RStudio 2025.09.1). Results showed no statistically significant difference between internal and external intercepts ($P = 0.667$) or slopes ($P = 0.603$). The results of this study indicate that the use of external nest temperature data to predict incubation duration functions similarly to predictions based on internal nest temperature data. Using external nest temperature data for incubation period predictions offers monitoring programs a less invasive method to retrieve temperature data.

POV: YOU'RE A SEA TURTLE THAT JUST HATCHED*

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The period between hatching and emergence represents a cryptic yet consequential stage in a sea turtle's life. Concealed beneath up to a metre of sand, hatchlings must dig cooperatively to the surface while conserving limited energy reserves. Conservation interventions such as nest relocation and artificial shading are widely used to mitigate risks of inundation, predation, and extreme temperatures. However, by modifying the nest microenvironment, these practices may also alter the cues that guide emergence behaviour. To investigate how such interventions shape within-nest activity, we used miniature tri-axial accelerometers equipped with temperature loggers on newly hatched green turtles (*Chelonia mydas*) at Heron Island, Australia. Nests were either retained in situ or experimentally relocated into shaded and unshaded treatments, allowing continuous measurement of movement and thermal conditions throughout the egg-to-emergence phase. This approach provides rare insight into an otherwise unobservable life stage and offers a framework for evaluating the behavioural consequences of conservation management. By linking nest thermal environments with hatchling activity patterns, accelerometry opens new opportunities to assess whether common interventions achieve their intended benefits or inadvertently reshape the processes underlying successful emergence.

SPATIAL VARIATION IN SAND TEMPERATURES ON THE SEA TURTLE NESTING BEACH AT PALMARITO, OAXACA

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Rising temperatures from climate change pose a significant threat to sea turtles, whose embryonic development and sex determination are temperature-dependent. Elevated sand temperatures can skew hatchling sex ratios toward females and increase mortality, raising concern for population viability. Campamento Tortuguero Palmarito near Puerto Escondido, Oaxaca, Mexico supports nesting by four of the world's seven sea turtle species, making it a site of high conservation importance. This study assessed how air and sand temperatures influence thermal conditions across the in situ and hatchery environments on this key nesting beach, offering management strategies for conservation groups. Two beach transects were established spanning three zones: near tide, mid-beach, and near vegetation. Sand temperatures were recorded every two meters at depths of 35 and 45 cm, along with concurrent air temperatures. In the hatchery, hourly temperatures were recorded using HOBO data loggers placed inside (n = 9) and outside (n = 1 control) the shaded enclosure. Across both environments, sand temperatures decreased with proximity to the waterline and with depth. Mean temperatures were significantly lower at 45 cm than at 35 cm ($p < 0.001$), and hatchery temperatures averaged 1 °C cooler than those in situ ($p < 0.001$). Although most temperatures remained within the thermal tolerance range for successful incubation, overall means exceeded the pivotal sex temperature (29–30 °C), indicating a risk of feminization. Lethal temperatures (35–37 °C) occurred only at shallow depths near vegetation. Air and sand temperatures were weakly

correlated, limiting predictive capacity for future warming scenarios. Our findings support continued nest shading and deeper burial in the hatchery as effective management strategies to reduce feminization risk. This study provides a baseline dataset and monitoring framework for ongoing conservation efforts at this key nesting beach.

MATERNAL AND ENVIRONMENTAL FACTORS INFLUENCING LEATHERBACK AND LOGGERHEAD SEA TURTLE REPRODUCTIVE SUCCESS IN SOUTHEAST FLORIDA*

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Maternal nest timing and site selection are key behaviors that influence offspring survival in oviparous species lacking parental care, such as sea turtles. The incubation environment is shaped by when and where nests are laid, which affects emergence success. On a nesting beach in southeast Florida from 2018–2024, we used minimally invasive methods (e.g., data loggers, nest location measurements, and post-hatch out excavations) to assess how leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) nesting behaviors (e.g., timing, site selection, clutch size) influence nest environments (e.g., incubation temperature, precipitation, wave over wash) and reproductive success. Using structural equation modeling, we found that nesting date exerted the strongest influence on mean incubation temperature, which most affected emergence success. For leatherbacks, when nest mean incubation temperatures met and exceeded 30.8°C, emergence success declined by 20% per 1°C past this thermal threshold. These elevated temperatures were more likely to occur after 15 April – 45 days into their official nesting season. For loggerheads, when mean incubation temperatures reached 30.6°C, success began declining by 9% per 1°C until 32.8°C, when success sharply declined by 33% per 1°C. Loggerhead mean nest temperatures reached 30.6°C beginning on 21 April (21 days after the mean date of the first loggerhead nest of the season on this nesting beach) and reached 32.8°C beginning day 23 May (52 days after the mean date of first nesting). Our findings reveal species-specific, multilevel pathways linking maternal nesting behavior, nest environment, and reproductive success, providing a framework for predicting and comparing interspecific responses to warming beach conditions and other climate-driven environmental changes.

18-YEAR OF GREEN SEA TURTLE NESTING MONITORING ON TETIAROA ATOLL IN FRENCH POLYNESIA: KEY RESULTS

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TE MANA O TE MOANA, Tahiti, French Polynesia

Since 2006, the Te mana o te moana foundation has been monitoring a unique green sea turtle (*Chelonia mydas*) nesting site on Tetiaroa Atoll in French Polynesia. This presentation will highlight key findings from this long-term research and outline upcoming research initiatives. Key results include: Nesting Monitoring: Over 7,500 turtle tracks have been recorded, with approximately 3,800 nests identified, and more than 350,000 eggshells counted; Female Identification and Tracking: Detailed profiles of over 360 females have been created, documenting their nesting frequency and migratory return routes through satellite tracking; Mature male argos monitoring during nesting period; Hatching success and parameters; Hatchling Predation : Crucial insights into local hatchling predation have been gained, especially in the context of rat eradication efforts; Beach Profile Changes and Erosion Threats: Changes in beach profiles

due to erosion have impacted nesting sites, prompting the development of a re-vegetation project using indigenous plant species. This program is part of a larger, over 20-year study conducted by the French Polynesian government. The findings now contribute to seminars, training, and capacity-building efforts across other Polynesian islands, with a focus on sea turtle nesting inventories supported by a dedicated application developed by our teams of veterinarians and biologists.

LOSING LALO: HABITAT DEGRADATION AT THE HONU'S (*CHELONIA MYDAS*) MOST IMPORTANT NESTING GROUNDS IN HAWAI'I*

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Since the early 1970's, researchers have monitored the Hawaiian green sea turtle (honu) at their primary nesting site. This critically important area hosted 96 percent of the population's nesting and was located on East Island, at Lalo (French Frigate Shoals) within the remote Papahānaumokuākea Marine National Monument. This islet, part of a low-lying atoll, is approximately 700 km from the main Hawaiian Islands. Unexpectedly, in 2018 East Island was destroyed by hurricane Walaka. Nesting subsequently shifted to Tern Island, a mostly manmade islet 12 km north of East Island that is home to a defunct runway, dilapidated structures, crumbling seawalls and entrapment hazards for adult turtles and hatchlings alike. These hazards require field biologists to perform life-saving interventions by helping to redirect or free as many as 325 adult honu in a single field season. Additionally, Tern Island is rapidly eroding with approximately 30 percent of its nesting habitat lost since 2018. Erosion is a major concern for Lalo's longevity. In the last five decades five islets that were known to be used by honu have been lost. Fortunately, East Island has slowly begun to reestablish itself and has built up to approximately 70 percent of its original size, allowing for nesting activity to be monitored from 2023 to 2025. Currently, only 25 percent of East Island is deemed to have favorable substrate for nesting, some of which also erodes throughout the season. It is estimated that up to 20 percent of nests on East Island are lost each year. The rapid degradation of Lalo raises critical questions regarding the honu population's vulnerability and their capacity to persist into the future.

NESTING IN THE DUST: ASSESSING THE LARGEST GREEN TURTLE ROOKERY IN THE RED SEA UNDER SEVERE INDUSTRIAL DEVELOPMENT

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Ras Baridi, on the Saudi Arabian Red Sea coast, hosts one of the largest and most persistent green turtle (*Chelonia mydas*) nesting aggregations in the region. Despite its importance, this rookery is heavily impacted by industrial activity from a nearby cement factory, whose operations have caused chronic

deposition of cement dust, altering the ecological functionality of adjacent nesting beaches for almost five decades. As part of the SHAMS Conservation and Management Plan, a monitoring program was initiated in 2024 to assess population trends and evaluate cumulative impacts in Ras Baridi. Initial rapid assessments were conducted to identify active nesting on 38 beach units, and scattered night patrols (n=20) to evaluate basic parameters of green turtle nesting ecology. In 2025, a baseline index monitoring program was implemented on two beach units with the highest nesting activity, S1 and S5, which accounted for 76% of total activity recorded in 2024. This baseline consisted of night patrols with equal effort across the season (n=60) and morning track surveys during the peak nesting period (n=40). Of the females handled in 2024 (n=46) and 2025 (n=175), recapture rates were 6.5% and 25.7%, respectively, indicating notable site fidelity. Additionally, 21 females underwent health assessments in 2025, with 41% exhibiting pathologies related to pulmonary complications and/or kidney dysfunction. During the two weeks of highest nesting activity in 2025, track surveys recorded 635 nests, suggesting that the nesting population has likely been underestimated in previous studies. Temperature and humidity loggers (n=3), placed at nest depth, recorded an average sand temperature of 32.6 ± 1.7°C, rising from 29.9°C to 33.2°C between early and peak season, suggesting potential female-biased hatchling production in 2025. Among the most notable observations during this nesting seasons is the sensitivity of incubation conditions to stochastic environmental events. In sector S5, of the nests monitored in 2024 (n=29), less than 7% hatched, with an average hatching success of 33.1%. In contrast, in 2025, over 75% of the monitored nests (n=39) completed incubation, with an average hatching success of 61.6%. Poor embryonic development and low hatching success in 2024 were presumably caused by heavy rainfall in August 2024, which solidified the cement dust and clay-rich sand, reducing gas exchange and emergence. Further, seasonal tides in response to monsoon winds raise both the tidal high tide mark and groundwater table toward the end of the nesting season in October and November, flooding nests laid near to the tide line. Other threats include accidental mortality (n=3) of misoriented females falling of 1–1.5 m cliffs bordering beach edges, or disoriented hatchlings from artificial lights from the cement company, preventing a considerable number of them from reaching the sea. These preliminary findings reveal that green turtles continue to use Ras Baridi as a major nesting ground despite long-term industrial impacts, showing strong site fidelity. However, the variable reproductive success underscores this population's vulnerability to ongoing habitat alteration and stochastic events under an increasingly changing climate, highlighting the urgent need to maintain long-term monitoring to inform effective conservation and mitigation strategies.

MULTIPLE INTERACTING FACTORS INFLUENCE HATCHLING PRODUCTION AT THE WORLD'S DENSEST LEATHERBACK NESTING BEACH*

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Leatherback turtles, the largest and most unique sea turtle species, require urgent conservation attention, particularly in the Wider Caribbean region where abundance has declined significantly in recent years. Grande Riviere in Trinidad and Tobago (T&T) hosts the world's densest leatherback nesting beach. However, tradeoffs between high nesting female abundance and density-dependent effects on hatchling production could have implications for population stability and recovery. Over three environmentally

diverse nesting seasons (2023-2025), we implemented a randomized block design using experimentally controlled nest densities (low (2 nests), medium (6 nests), and high (12 nests)) to measure how variation in nest temperatures and respiratory gas concentrations among different nest densities affects hatching rates. Across 180 nests, preliminary analyses indicate that hatchling production is highly variable and density-independent factors, such as ambient temperatures, primarily drive hatching success. Further, nest destruction may be more important for overall hatchling production than other density-dependent factors, such as density-related changes in nest temperature and oxygen availability. Together, our findings provide critical data to inform targeted conservation action at the community level and within T&T's national Sea Turtle Task Force to increase hatchling production at one of the world's most important leatherback rookeries.

HATCHING AND EMERGENCE SUCCESS OF LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*) NESTS ON THE WEST COAST OF PUERTO RICO (2015-2024)*

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The archipelago of Puerto Rico is considered important nesting habitat for leatherback turtles (*Dermochelys coriacea*) in the Caribbean with a reported 500-1,000 crawls per year. (Eckert & Eckert, 2019). Despite long-term nest monitoring and protection on Puerto Rican beaches, there are few recent accounts of hatching and emergence success of leatherback nests in Puerto Rico. This study focuses on the hatching and emergence success of in-situ leatherback nests laid on the west coast of Puerto Rico between 2015–2024, based on data from 1,416 nest excavations conducted by Tortugueros del Oeste, a volunteer-run organization in western Puerto Rico. Volunteers consistently monitor 20 beaches across 9 towns (~80km) during nesting and hatching seasons (February- September) and monitor all nests found throughout the incubation period. After the hatchlings have emerged, the volunteers excavate and record the egg chamber contents for all nests that produce hatchlings; they also excavate nest chambers with no signs of emergence 5 days after the expected hatch date. The data from all 10 years of monitoring indicate an overall average hatching success of 69.3% ±SEM and an average emergence success of 61.0% ±SEM. These results are higher than the commonly reported average success of ≤50% from nesting sites elsewhere in the world, indicating that the west coast of Puerto Rico is highly productive nesting habitat for leatherback sea turtles. The data also showed no significant seasonal or yearly variation in success metrics during the peak hatching months (March–June). These findings provide updated, location-specific data for Puerto Rico, and establish a more accurate baseline for future conservation assessments and regional management strategies.

TIME SERIES INVESTIGATION OF THE FUNGI, FUSARIUM SPP., IN THE SOUTHEASTERN FLORIDA, USA

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Threats to most sea turtle species populations are likely multifaceted; however, low hatching success is a significant factor contributing to limited or poor population recovery. Sustained hatchling production is necessary for population recovery and maintenance. Unfortunately, the leatherback sea turtle (*Dermochelys coriacea*) is particularly vulnerable, as they have the lowest average hatching success globally, roughly 50%. One of the higher density sea turtle nesting locations in the continental United States for leatherbacks is in southeastern Florida's Palm Beach County, which receives about ~30% of nests. Consequently, investigating causes of reduced hatching success in this region is not just important but is necessary. Current research suggests that Fusarium spp. may be negatively impacting leatherback nest success and long-term health in this region. Unfortunately, the fungal burden on these essential nesting beaches has not yet been assessed. To measure the burden of Fusarium spp. across the beaches in Palm Beach County, Florida, we obtained sediment samples from 11 different locations from Boca Raton, Juno Beach, and Jupiter, Florida, at 3 different time points during the 2025 sea turtle nesting and hatching season (April, July, and October). We used quantitative polymerase chain reaction (qPCR), a technology for measuring DNA to quantify the amount of Fusarium spp. present in the beach sand. These measures were used to assess its relationship to the sample collection time point, geographic location, sample depth, local weather patterns, tidal events, and other anthropogenic variables. These data provide a baseline survey of the highly pathogenic Fusarium spp. on these important nesting beaches. The knowledge gained from this work establishes previously unknown baselines and can be used to further understand the environmental and anthropogenic variables that may be driving the abundance and pathogenicity of these fungal organisms in sea turtle nests. These foundations may ultimately lead to the development of mitigation strategies to improve nest success in Palm Beach County, Florida.

IMPACTS OF IN SITU VERSUS EX SITU INCUBATION ON THE SKIN MICROBIOTA OF LEATHERBACK SEA TURTLES*

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Research exploring the skin microbiota of humans and nonhuman animals is an area of growing interest due to the skin's contact with the outside world. Sea turtles are no exception to this area of concern and are of specific interest to marine scientists as they are often used as sentinels of ocean health due to their long life spans. Unfortunately, little is currently known about the skin microbiota of different sea turtle species. Data gaps on this topic are vast and range from the need to understand sources of their microbiota to the microbial roles in health maintenance and disease. Additionally, current research suggests that environmental variables can significantly alter the microbiome. Addressing these knowledge gaps is critical for imperiled species. The leatherback sea turtle is one such imperiled species, and recent work has highlighted the need for further research into their skin microbiota, factors that alter it, and its role in health and survival. In this work, we characterized the microbial composition on the skin of leatherback hatchlings and post-hatchlings that emerged from in situ as well as ex situ nests. We also compared the microbial communities between turtles that incubated in these two different environments and identified significant differences in measures of alpha and beta diversity at both time points. As the skin is a primary defense mechanism against the outside world, these data suggest that the incubation environment (in situ vs. ex situ) may have a significant and potentially long-term impact on the composition of the skin's microbial community and therefore health. Currently, some nesting sites utilize ex situ incubation strategies to achieve key conservation goals. However, moving forward, mitigating negative changes to the skin microbiota due to ex situ incubation methods may need serious consideration due to the relative ease of these widely used conservation techniques.

EFFECTS OF TEMPERATURE ON FLATBACK HATCHING SUCCESS AND HATCHLING PERFORMANCE

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Monash University

Nest temperature strongly influences hatching success and hatchling fitness in sea turtles, both of which are maximised within a narrow thermal range. Outside these limits, embryos experience higher mortality, and hatchlings show reduced locomotor performance, increasing their vulnerability to predation in both terrestrial and nearshore environments. Climate change threatens to push nest temperatures beyond these optimal ranges, potentially limiting population growth. Although tropical flatback (*Natator depressus*)

populations appear relatively tolerant of high incubation temperatures, winter-nesting populations may be especially vulnerable. Seasonal shifts in nesting to cooler periods could provide an adaptive buffer against warming, but opportunities for such shifts are limited in winter populations that already nest at the coolest time of year. This is of particular concern given that flatbacks are endemic to Australia, which is projected to experience warming above the global average. In this preliminary study, we quantified the relationship between nest temperature and hatching success, late-stage embryonic mortality, and hatchling performance metrics (self-righting, crawling, and swimming speeds) in a winter-nesting flatback population at Bare Sand Island, Northern Territory. Our findings define the thermal conditions that support optimal embryonic and hatchling survival, providing critical data to assess how this Data Deficient species may respond to continued global warming.

LONG-TERM MONITORING OF HONU‘EA (*ERETMOCHELYS IMBRICATA*) NESTING ACTIVITY ON HAWAI‘I ISLAND

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For over 35 years, the Hawai‘i Island Hawksbill Project (HIHP) has been monitoring honu‘ea (Hawaiian hawksbill turtles; *Eretmochelys imbricata*) nesting sites along the southern coast of Hawai‘i Island, where approximately 85% of all honu‘ea nesting within the Hawaiian archipelago has been recorded. There are four primary nesting beaches where the majority of nesting occurs, each requiring about 2 hours to access via hiking or rough 4WD roads. The HIHP consists of a small collaborative team of personnel from the National Park Service and Research Corporation of the University of Hawai‘i. Monitoring includes overnight camps at nesting beaches to identify active nesters and visits to nesting sites during the day to document any signs of nesting activity that may have occurred since the team was last present. All nests are inventoried after hatching to record hatch and emergence success. Currently, the largest threats to the nesting population are predation (by mongoose, rats, and cats) and habitat degradation from erosion, which is expected to increase with climate change and sea level rise. Over the past 15 years, the HIHP has documented an average of 49 honu’ea nests year-1 on Hawai‘i Island, a number that varies with personnel and monitoring effort. Anywhere from 4-25 females were observed each season. Average clutch size was 162 eggs nest-1, and average hatch success was 72.94% (n=544). A record of 82 nests was documented in the 2023 nesting season. In the 2025 nesting season, the project reached 200 turtles tagged. While primarily only honu‘ea are observed nesting on Hawai‘i, olive ridley (2010, 2021) and green (2011, 2024, 2025) turtle nests have occasionally been documented on the island. Notably, there were multiple nesting attempts by green turtles in the 2025 season that resulted in the partial excavation and damaging of honu‘ea nests. These occasional nesting events represent a potential challenge that increased green nesting could pose for a population that already experiences intraspecific competition on small nesting beaches. They also highlight the value of continued monitoring of Hawai‘i Island’s beaches to track changes in species presence and nesting activity. In addition to continued regular monitoring, the HIHP is focusing efforts on answering important research questions. Dramatic variation has been observed in the false crawl rates and hatching success in honu‘ea across top nesting beaches, which has seemingly corresponded with storm events and changes in vegetation cover, indicating that changes in beach characteristics could drive nesting success and clutch survival. Additionally, the beaches on Hawai‘i Island are unique in composition, as some are primarily made of granular lava rock (black sand) and others coral (white sand). Because specific

populations have different preferred nesting habitat characteristics (slope, vegetation cover, beach width, sand type, etc.), the HIHP is working to identify the most important habitat characteristics for this distinct population so that predictions can be made about habitat suitability in response to climate change and sea level rise, and therefore management efforts can be allocated accordingly in the future.

NEW SAND IN SOUTHWEST FLORIDA: CHARACTERIZATION AND IMPACTS ON *CARETTA CARETTA* NESTING

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Southwest Florida has been impacted by multiple hurricanes in the last few years. These storms and their resulting beach renourishment projects, intended to restore the region's shorelines, have significantly modified the nesting environment available to loggerhead (*Caretta caretta*) and other sea turtles in this region. Beach sand lost to storm erosion has been replaced by material sourced from both offshore and inland sources with differing characteristics, including grain size distribution, organic and carbonate content, and shape. These variables influence the stability, thermal profile, moisture retention, and gas exchange rates which drive nest construction, embryonic development, and hatchling emergence. Previous studies have often focused on sand characteristics in isolation; however, understanding them in combination is critical for ecologically sound coastal zone management. Thus, the purpose of this study is to evaluate how multiple sediment characteristics influence sea turtle hatchling production in southwest Florida. Morning surveys were conducted on two southwest Florida beaches – Bonita Beach and Estero Island – and a subset of identified loggerhead sea turtle nests were selected for sediment sampling. Two 1 L samples were collected 0.5 m adjacent to each nest – one from the surface (0 cm) and the other from an approximate nest chamber depth (40 cm). Samples were transported to Florida Gulf Coast University for processing and analysis. In the laboratory, samples were dried to calculate moisture content, sieved to determine relative contribution of multiple sediment size classes, burned at 550 °C to quantify organic matter content, and subsampled for a detailed particle size analysis of the sand and smaller fractions (i.e., <2 mm) using a Malvern Panalytical Masterizer. Grain morphology was visually categorized under a compound microscope. Following sediment sampling, nests were monitored throughout their incubation period and inventoried post-hatch to determine clutch size and hatching success rates. This inventory data was then compared to sediment characteristics in a generalized linear model framework to determine which variables had the greatest influence on nest productivity. Preliminary results from 15 nests suggest that Bonita Beach nests had a greater mean hatching success (78.3%) than Estero Island (59.7%) while having a lower median grain size (234.4 µm vs. 260.4 µm, respectively) and lower average organic content (0.7% vs 4.1%, respectively). Further analyses of size distribution, carbonate content, and grain shape are ongoing. Supplemental data from temperature loggers deployed adjacent to incubating clutches, as well as sediment collection and instrumentation deployments at nest-independent locations are also underway to place the nest-specific data in context with the wider available beach habitat.

EFFECTS OF METAL ANTI-PREDATOR SCREENS ON SEA TURTLE EMBRYO ORIENTATION

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Sea turtles rely on Earth's magnetic field for navigation and migration. Previous research has suggested that incubating embryos align relative to magnetic north, which may affect subsequent magnetic navigation after hatching. Metal screens are a common method for protecting loggerhead sea turtle (*Caretta caretta*) eggs from predators in the Southeast USA. However, it is not yet known if using metal screens to protect eggs has a negative effect on the orientation of developing embryos. At our study site on Wassaw National Wildlife Refuge, GA, USA, we compared orientation angles (relative to magnetic north) of in situ embryos developing under metal anti-predator screens (n=10 clutches) and plastic control screens (n=10 clutches). For each experimental clutch, a small fine-mesh screen (30 x 30 cm screen with 1 x 1 cm mesh) made of either plastic or metal was placed on the surface of the sand above the clutch. All other conditions were kept the same; a large wide-mesh plastic screen (100 x 100 cm screen with 7 x 7 cm mesh) was placed directly over the small fine-mesh screen and secured into the sand with four 20-cm plastic tent stakes. At approximately 75% development, each clutch (n=20) was uncovered and the first 50 eggs from the top of the chamber were selected for embryo orientation measurements. Each egg was numbered, randomly assigned a cardinal direction (north, south, east, or west), and labeled with an arrow pointing in that direction. Each egg was then extracted and candlelit with a bright white light by a researcher blind to the assigned cardinal direction to indicate (with a second arrow) the direction of the embryo. Once all eggs were extracted and photographed, they were returned to the nest and the angle of each embryo's orientation relative to magnetic north was determined. After non-viable eggs were excluded from the dataset, a total of 761 eggs were analyzed (plastic=391, metal=370). Our results indicated that at 75% development there was no significant directional embryo orientation across eggs from plastic control clutches (Bimodal Rayleigh Test; r=0.0508, p=0.3647). Further, we found no significant directional orientation within any of the 10 individual plastic control clutches. There was marginal bimodal orientation across eggs from metal experimental clutches (Bimodal Rayleigh Test; r=0.0883, p=0.056). However, our analysis of individual clutch effects found that out of 10 metal experimental clutches, only one clutch was strongly oriented in a bimodal direction, which may contribute to the marginal orientation. Our findings are inconsistent with previous research suggesting that sea turtle embryos align predictably relative to the Earth's magnetic field. These results suggest that metal anti-predator screens do not have a negative effect on embryo orientation, which will inform predation management practices and contribute to our understanding of magnetoreception in developing sea turtles.

THERMAL PROFILING OF SEA TURTLE NESTS: COMPARING CLUTCH TO SAND TEMPERATURES

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The Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSTRRC) is a nonprofit sea turtle conservation organization in North Carolina, USA. KBSTRRC's Topsail Turtle Project (TTP) is permitted by the State of North Carolina to monitor and protect eggs laid on the beaches of Topsail Island from May through November each year. Sand temperature is a critical determinant of sea turtle egg development. Accurate assessment of thermal environments in nests is essential for understanding hatchling sex ratios, developmental rates, and survival. This study investigated whether metabolic heat generated by developing embryos significantly alters nest temperatures compared to sand at egg depth. Understanding thermal dynamics within nests can contribute to conservation management. HOBO MX TidbiT 400 temperature data loggers were placed in both loggerhead (*Caretta caretta*) nests and adjacent sand locations that were matched for depth, orientation, and substrate composition. Continuous temperature monitoring was conducted throughout incubation to quantify thermal differences over time. Temperature data were collected every 60 minutes. At the end of incubation, we compared paired datasets of each nest and adjacent sand location. Nest temperatures began to diverge from sand temperatures approximately during the last third of incubation, with mean nest temperatures exceeding sand locations by 0.5–2.0°C during this period. The magnitude and timing of this thermal increase varied among nests, suggesting a relationship with clutch size and developmental synchrony. These initial findings suggest that metabolic heat production contributes measurably to the thermal environment of sea turtle nests and should be considered when using control sites or artificial temperature models to infer incubation conditions. This study contributes to our understanding of how nest temperatures increase during incubation and can be used to estimate nest temperatures using sand temperature only.

EVALUATING THE ECOLOGICAL SIGNIFICANCE OF THE OSA PENINSULA FOR THE SOLITARY NESTING POPULATION OF OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) IN COSTA RICA

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In Costa Rica, olive ridley turtles (*Lepidochelys olivacea*) nest both solitarily, and in mass nesting events known as arribadas. Although arribada events have been the focus of extensive research for decades, solitary nesting populations remain poorly studied and understood, which is surprising considering that the olive ridley is the most widespread sea turtle species. Located along Costa Rica's southern Pacific coast, the Osa Peninsula hosts four out of the seven extant sea turtles species, with olive ridleys being the most common Based near the community of Carate, COPROT has conducted continuous nesting beach monitoring since 2019. However, to this date, no data analysis has been conducted nor published, leaving

the status of this nesting population unknown. Thus, this study aims to assess the spatiotemporal distribution and abundance of solitary olive ridleys nesting in Osa Peninsula, and assess clutch survival, to evaluate the status of this population and the ecological significance of the region's nesting beaches. Using environmental and spatio-temporal nesting data from Rio Oro and Pejeperro beaches, collected over six nesting seasons (June-December, 2020-2025), we applied several key factors (i.e. reproductive density, temporal variation in area uses and reproductive success indicators) to assess the status of the nesting olive ridley population. Our results reveal an average of 5,959 ±1,339 nests recorded per season, with a nesting success rate of 77.1 ± 1.8%. With over 1,000 nests on average per beach kilometer each season, the area hosts a high population density in a restricted area. A stable monthly trend in nest abundance was observed until 2024, whereas the 2025 season showed notable increases from August to October. Hatching and emergence average success, excluding failed nests, were 77.3 ± 6.5% and 71.9 ± 5.4%, respectively, suggesting that the environment supports favorable hatchling development and survival. Complementarily, the area reflects low levels of urbanization and is home to an engaged community actively involved in conservation activities, such as beach patrols and hatchery monitoring, providing a supportive framework for conservation and research efforts. In this ecological and social context, the studied region stands out as a key nesting site for the solitary nesting population of olive ridleys in the Pacific coast and provides a prime example of a favorable location for further investigations into the demography, behavior, and nesting trends of solitary populations, much of which remains to be understood.

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

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Sea turtles nest nearly year-round on Florida's (USA) east coast. However, late-season nests (i.e., laid after 31 August and incubating past 31 October) of loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*) are understudied. These nests are more likely to be impacted by beach nourishment projects and exposed to lower temperatures, possibly slowing incubation and reducing nest viability and hatching success. The 47.5 km of beaches monitored by University of Central Florida's Marine Turtle Research Group host 17% of loggerhead and 33% of green turtle nests statewide, making this study area a proxy for nesting activity throughout Florida. This study aimed to describe late-season incubation duration and reproductive success by species, compared to main-season nests (April-August) and use in-situ nest and sand temperatures to better determine late-season incubation durations. In 2021-2023, we marked 31 loggerhead and 183 green turtle nests laid during September-November to increase sample size of late-season nests. Between June and October 2023, we also deployed temperature data loggers in 40 green turtle nests and the adjacent sand at equal depth. The temperature difference in nest versus sand was used as a proxy for metabolic heat in order to estimate hatchling emergence date. Hatching and emergence success were compared across seasons and years using a binomial generalized linear model. A gamma generalized additive model was performed to compare incubation duration across months and years. Late-season nests of both species had significantly lower hatching and emergence success and longer incubation durations (up to 95 days) compared to main-season nests for all years. Late-season nests were more susceptible to being washed out compared to those laid earlier in the season. Despite determining most nests' fates, only 33% of hatched late-season green turtle nests in 2021 had observed emergence dates and therefore known incubation durations. Late-season nests in 2022 had significantly lower hatching success than the other two years due to impacts by Hurricanes Ian and Nicole, causing nests to completely washout. Late-season nests in 2023 experienced high levels of sand accretion, lowering hatching and emergence success. Using collected temperature data, we found a decrease in nest temperature from loss of metabolic heat during

hatchling emergence, allowing us to estimate emergence date and calculate incubation duration for nests without observed emergence. Late-season nests may become more frequent due to increasing green turtle nesting within our study area over recent decades. Results from this research will help determine the contributions of late-season nests to reproductive output, inform nest inventory protocols during cooler, slower-incubation months, and aid managers overseeing beach construction and seasonal beach restrictions.

COMMUNITY-BASED MONITORING AND CONSERVATION OF SEA TURTLES IN WESTERN PUERTO RICO: DECADAL NESTING TRENDS AND CONSERVATION OUTCOMES (2015–2025)

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Sea turtle nesting activity in western Puerto Rico has evolved into a coordinated, community-based monitoring program encompassing more than 20 beaches across 10 municipalities from Camuy to Cabo Rojo. Since its initiation in 1991, the program has expanded from a handful of focal beaches to a comprehensive coastal network. Here, we present decadal nesting trends (2015–2025) and hatching success, with an emphasis on conservation outcomes achieved through local stewardship. Standardized beach patrols and post-emergence nest inventories quantified nesting activity and estimated hatching success across both sandy (Añasco, Isabela) and rocky (Rincón, Cabo Rojo) beaches. Since 2015, systematic patrols by Tortugueros del Oeste have documented nesting by three species: leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and green sea turtle (*Chelonia mydas*). Nesting data from 2015–2025 indicated relatively stable levels with notable interannual variability. Leatherbacks averaged approximately 224 nests annually, with Añasco supporting 50–60% of the total. Hawksbills averaged about 119 nests per year, with 60% in Cabo Rojo, while green turtle nesting was sporadic. Mean hatching success across the decade was 67% for leatherbacks and 75% for hawksbills. Hatching success, calculated from post-emergence inventories (hatched eggshells/total eggs), includes failed nests and reflects results from both in situ and relocated nests implemented to reduce erosion and flooding risk. In 2025, 248 leatherback nests, 144 hawksbill nests, and three green turtle nests were recorded, making it one of the highest nesting seasons of the decade. Incubation averaged 62 days, and hatching success reached 73% for leatherbacks and 74% for hawksbills. An estimated 15,456 hatchlings were successfully protected in 2025 through nest monitoring, inventories, and beach rescues. These findings underscore the critical role of nest relocation and protection in mitigating erosion and flooding impacts. To complement the nesting data, 15 satellite transmitters were deployed in 2024–2025 in collaboration with the New England Aquarium, providing the first inter-nesting and migratory data for leatherbacks from western Puerto Rico. Preliminary tracks indicate inter-nesting use of nearshore waters and post-nesting movements into the wider Caribbean. Conservation actions included dune restoration, reforestation of more than 10 beaches, regular cleanups, protective signage, and reduction of light pollution through turtle-friendly lighting. Educational outreach engaged more than 100 schools across Puerto Rico via workshops, field visits, and collaboration with the International Sea Turtle Ambassadors Program of Inwater Research Group. This integrated approach—combining long-term monitoring, seasonal analyses, telemetry, and sustained community engagement—demonstrates how grassroots conservation can advance sea turtle management in the Caribbean.

BEACH CHARACTERISTICS AND NEST SITE SELECTION OF LEATHERBACK TURTLES AT FENA LEISELA BEACH, BURU ISLAND, INDONESIA*

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Western Pacific leatherback turtles (*Dermochelys coriacea*) are on the brink of extinction due to a drastic population decline. Fena Leisela beach in Indonesia is one of only a handful of remaining nesting sites for this critically endangered subpopulation, making it essential for its continued survival. Because nesting behavior and site selection strongly influence reproductive success, understanding the environmental characteristics that shape where females nest is vital for developing effective conservation strategies. This study aimed to identify the key environmental factors influencing nesting site selection at Fena Leisela. In July 2024, we surveyed beach characteristics, including slope, width, light pollution, and the presence of barriers, in 100-meter plots along the coastline. These data were combined with the total number of nests and false crawls recorded in each plot. Akaike's Information Criterion (AICc) model comparison was then used to assess which parameters best explained the number of nests and the proportion of false crawls. Coastal light pollution emerged as the primary factor affecting nest site selection, followed by beach slope and width. Light intensity had a significant negative effect on the number of nests found (Negative binomial GAM, $\chi 2(1, 139) = 19.31$, $P < 0.001$), likely reflecting leatherbacks' sensitivity to short-wavelength artificial light commonly emitted by coastal communities. Artificial light can both deter females from nesting near illuminated areas and disorient adults and hatchlings, reducing nesting success and hatchling survival, respectively. Nests were most frequently found on beach sections ranging from 14.2 to 26.1 meters wide and slopes between 11.32% and 15.48%. Slope also strongly influenced the proportion of false crawls, which were highest on slopes below 9% and above 23%. This pattern may reflect the energetic constraints of nesting on steep beaches, but could also indicate a biological preference for broader berms that allow females to achieve adequate nest depth and protection, consistent with evolutionary nesting requirements for this species. These findings highlight how local beach characteristics shape nesting distribution and can inform targeted management actions, such as minimizing coastal light pollution and maintaining suitable beach profiles, to enhance nesting success and support the recovery of this critically endangered population.

EVALUATING THERMAL PROFILES ON MARINE TURTLES' NESTING BEACHES IN QUEENSLAND, AUSTRALIA*

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For millennia, marine turtles have endured extreme climates and adapted their life histories around ambient temperatures. Yet evolution has not prepared them for the unprecedented pace and magnitude of modern climate warming. The thermal conditions experienced by the turtles on nesting beaches have been rapidly

shifting and influencing their reproductive success. Investigating these conditions over time can provide crucial information on the adaptation of these animals. This study investigates the past and current nesting beach temperatures in the central and southern coast of Queensland, Australia, focusing on three priority genetic stocks: green turtles from the southern Great Barrier Reef, loggerheads from the southwest Pacific, and flatbacks from eastern Queensland. Two key questions guide the study: (1) Using data from 1980-2025, examine to what extent air temperature (AT) can serve as a quantitative proxy for sea-surface temperature (SST) and (2) How have AT and SST thermal regimes at each site changed over time. To address these questions, I will use remote-sensing datasets extracted from the Copernicus Climate Change Service (C3S) aggregated at monthly scales to capture variability across nesting seasons, locations and time. Statistical analyses will identify long-term temporal and spatial trends and provide insights into thermal signatures on nesting sites. The analyses are expected to demonstrate a strong correlation between AT and SST, supporting previous literature on the use of AT as a reliable quantitative proxy for SST. Demonstrating a strong AT–SST correlation is crucial, as both variables jointly influence sand temperature—the main driver of embryo development and sex determination—allowing atmospheric data to serve as a practical proxy for assessing nesting beach thermal profiles. Preliminary diagnostics suggest that temporal variability remains consistent across nesting seasons, although site-specific slopes and intercepts may reflect local microclimatic influences and coastal exposure. Thermal profiles are anticipated to follow the latitudinal gradient, with progressively warmer and more stable regimes toward northern sites. Initial findings on long-term trends indicate a persistent rise in both AT and SST since the early 2000s. Beyond quantifying warming rates, this study represents the first comprehensive effort to characterise the thermal profiles of nesting beaches across central and southern Queensland, establishing a regional baseline for understanding site-specific climate sensitivity and population vulnerability. Collectively, the outcomes will provide an early-warning baseline for adaptive management of marine turtle rookeries and offer valuable insight into how climatic shifts may reshape the reproductive ecology of these species over decades.

INTERNESTING PERIOD OF LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) AT A PRIMARY NESTING ZONE IN NORTHERN PUERTO RICO

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Chelonia, Investigación y Conservación de Tortugas Marinas

The internesting period, the interval between consecutive nesting events by the same female, is a key parameter for understanding the reproductive ecology and habitat use of the endangered leatherback sea turtle (*Dermochelys coriacea*). In Puerto Rico, the Playa Grande El Paraíso Nature Reserve (PGEP) in Dorado is a primary nesting beach in the northern region, yet internesting patterns at this site had not been previously documented. This study is based on 14 consecutive nights of monitoring conducted during the peak nesting season (May) in 2024 and 2025. Nocturnal patrols were carried out to document nesting activity and identify returning females. Individuals were measured, tagged with metal and passive integrated transponder (PIT) tags, and morphological traits were recorded. After two field seasons, a dataset of marked and recaptured individuals is being analysed to estimate internesting intervals and assess spatial and temporal nesting patterns. Preliminary results indicate an average internesting interval of 9 days for the leatherback population visiting PEGP. These findings contribute to a better understanding of reproductive behaviour in northern Puerto Rico and support improvements to monitoring efforts and long-term management strategies at PGEP.

THE NESTING LANDSCAPE OF SEA TURTLES AS A FOUNDATION FOR ADAPTIVE COASTAL MANAGEMENT IN SAUDI ARABIA*

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The Red Sea is a globally significant yet understudied marine ecosystem among the youngest oceanic zones globally, forming a semi-enclosed basin that is bordered by nine nations. Two species, the green (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricata*), nest along these shores. Genetic and satellite telemetry evidence indicates that Red Sea turtles are largely isolated from populations in adjacent ocean basins, suggesting limited connectivity and emphasising the need for localised management. Saudi Arabia encompasses the majority of the eastern Red Sea coastline, spanning a wide latitudinal range that influences nesting seasonality, habitat conditions and management challenges. Despite this significance, knowledge of sea turtle nesting presence, abundance and distribution in Saudi Arabia has remained fragmented. Previous studies were typically short-term or site-specific and lacked standardised methodologies, hindering comparisons among rookeries and obscuring national and regional population assessments. The recent revision of the IUCN Regional Management Units identified only one green turtle rookery in the Red Sea and none for hawksbill turtles. Comprehensive data is urgently required to inform conservation and spatial planning efforts. To address these gaps, the General Organisation for Conservation of Coral Reefs and Turtles in the Red Sea (SHAMS) implemented the first standardised national survey of sea turtle nesting along the Saudi Arabian Red Sea coast. This initiative consolidated historical nesting records, engaged local stakeholders, and used remote sensing imagery to map over 2,200 sandy beaches across approximately 6,000 km of coastline. Over two nesting seasons (2024-2025), track and nest counts supported by drone surveys identified 638 sites with sea turtle nesting activity, including 448 from existing records and 190 newly discovered through SHAMS surveys. From these data, a spatial layer delineating confirmed nesting beaches was produced to facilitate marine and coastal spatial planning. Enhanced protection was proposed for 11 nesting sites representing approximately 0.5% of the Saudi Red Sea coastline but accounting for more than 70% of nesting activity recorded. Further long-term monitoring is needed to establish the importance of these index sites, which currently include nine rookeries supporting both species, as well as one used exclusively by green turtles and one by hawksbills. Alongside the development of additional spatial layers, these nesting data will support SHAMS in developing a multi-objective coastal zonation plan that balances biodiversity protection and national development priorities. As Saudi Arabia advances towards Vision 2030 through rapid large-scale coastal developments such as gigaprojects, integrating this standardised, evidence-based approach ensures that sea turtles serve as flagship indicators for integrated coastal zone management and marine spatial planning. This work represents a critical step in contextualising Saudi Arabia's contribution to Red Sea-wide sea turtle conservation and establishing a model for science-based adaptive coastal management.

REPRODUCTIVE DYNAMICS AND CARAPACE MORPHOMETRICS AS PREDICTORS OF REPRODUCTIVE SUCCESS IN *CHELONIA MYDAS* AND *LEPIDOCHELYS OLIVACEA* IN THE OSA PENINSULA, COSTA RICA

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Reproductive success in sea turtles represents a crucial component for the conservation of these species. This success may be influenced by multiple factors, including age, physiological condition and various environmental conditions. In the present study, nesting, morphometric, and reproductive data were analysed for 1,409 nesting females over two consecutive nesting seasons (2023-2024 and 2024-2025): 1,108 olive ridley turtles (*Lepidochelys olivacea*) and 301 Pacific green turtles (*Chelonia mydas*) on three highly significant nesting beaches in the Osa Peninsula, south Pacific of Costa Rica. The objective was to evaluate a possible correlation between morphometric measurements and reproductive success, in order to guide conservation strategies towards individuals with greater reproductive potential. Both species showed remarkably high reproductive values: in *Lepidochelys olivacea*, the average fertility was 97.96% and the hatching success was 82.65%, while in *Chelonia mydas*, fertility was 97.6% and hatching success reached 91.53%. These figures reflect high reproductive viability in the populations studied. The morphometric averages obtained by measuring the shell curve were 66.10 cm for CCL and 70.00 cm for CCW for the olive ridley sea turtle, and 81.60 cm for CCL and 77.45 cm for CCW for the Pacific green sea turtle The results showed a slight but statistically significant trend among turtles with larger measurements and a higher percentage of egg laying, which was more evident in olive ridley turtles. However, no significant correlation was observed between reproductive indices (hatching success and fertility percentage) and morphometric parameters. An exception was observed in *Lepidochelys olivacea* where an inverse trend emerged between body size and reproductive indices, smaller females exhibited slightly higher reproductive indices. These findings highlight the influence of morphological and environmental factors on reproductive performance, providing valuable information for optimising management and conservation strategies for these threatened species.

FIRST NESTING RECORDS OF THE EAST PACIFIC GREEN TURTLE (*CHELONIA MYDAS* AGASSIZII) ON CERRALVO ISLAND, BAJA CALIFORNIA SUR, MEXICO

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First Nesting Records of the East Pacific Green Turtle (*Chelonia mydas agassizii*) on Cerralvo Island, Baja California Sur, Mexico. Cerralvo Island, located within the Gulf of California near La Paz, Baja California Sur, represents a key marine habitat that supports diverse populations of sea turtles. Despite its ecological relevance, limited information exists on the foraging and nesting behavior of sea turtles in this area. Since 2024, a community-based monitoring program has been implemented to identify critical habitats and promote conservation awareness among local stakeholders and visiting volunteers. During the 2024–2025 field seasons, monitoring efforts included direct observations, morphometric data collection, and habitat assessments across multiple coastal sites on the island. Notably, two nesting events of the East Pacific green turtle (*Chelonia mydas* agassizii)—locally known as the "tortuga prieta"—were recorded. Based on

historical data and regional monitoring reports, these represent the first documented nesting occurrences of this species on Cerralvo Island. This finding highlights the potential expansion or reestablishment of nesting activity in this region, emphasizing the ecological importance of continued surveillance. The East Pacific green turtle is a priority species for conservation under both national and international frameworks. These results underscore the value of long-term community participation and the need for further scientific studies to better understand the species' habitat use, reproductive behavior, and potential response to environmental changes. Strengthening conservation efforts on Cerralvo Island could play a significant role in regional sea turtle recovery strategies across the Gulf of California.

THE SIGNIFICANCE AND CHALLENGES FACED BY THE INCREASING NUMBER OF NESTING HONU (HAWAIIAN GREEN SEA TURTLES) ON OAHU*

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The honu (Hawaiian green turtle, *Chelonia mydas*) once nested in large numbers across the main Hawaiian Islands. From the 1800s through the 1970s, widespread unsustainable harvest of adults and eggs eliminated virtually all significant nesting sites except Lalo, also known as French Frigate Shoals, which is a low lying atoll whose existence is threatened by a combination of sea level rise and increased storm frequency. Intrinsic life-history traits—late maturation and strong natal-site fidelity—impede recovery and mean population rebound will require recolonization of formerly used nesting areas. Although adult population abundance has increased at approximately 5% per year, there is little evidence of substantial nesting outside the low-lying atoll of Lalo, making colonization of higher-elevation islands that will persist under sea-level rise essential for long-term survival. A community-based citizen-science program on Oahu, initiated in 2016 to locate, monitor, and protect nests, documented increased nesting beginning around 2020 and continuing to the present. Nest counts were low (range 0 – 9) from 2016–2019, rose to 58 in 2020 and 67 in 2021, and reached 83 in 2024. Hatching and emergence success were generally high (86% and 79%, respectively). However, many nests and hatchlings required intervention due to misorientation to electric light, vehicle disturbance, invasive predators, and entanglement in discarded fishing line. In the last two years we have had an increase in observations of honu attempting unsuccessfully to nest in areas where homeowners have hardened the shoreline with erosion fabric, sandbags, etc. Public education—particularly on responsible use of night-time lighting—and targeted management actions are needed to mitigate threats and support the continued re-establishment of honu nesting on Oahu, an important step towards recovery.

SHELLED ALBUMIN GOBS DECREASE PCO2 DURING THE SECOND TRIMESTER OF LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*) INCUBATION*

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The deposition of shelled albumin gobs (SAGs), or "yolkless eggs," in every nest is a unique characteristic of leatherback turtles. Researchers have offered several hypotheses for SAG's function, including gas regulation in nests. Previous research suggests that increased CO2 does not decrease hatching success; however, turtles incubated under hypercapnic conditions displayed physiological changes that can impact fitness. The influence of SAGs on the internal environment of leatherback nests is poorly understood, and minimal experimental data exist on the subject. To address this, we examined the effect of SAGs on PCO2 inside developing leatherback nests. Between November 26 and December 7, 2010, we collected clutches from 12 unique nesting leatherback turtles on the southern coastline of Bioko Island, Equatorial Guinea. We relocated the nests to a standardized distance from the vegetation line, randomly assigned them to SAG or SAG-removed treatments (n = 6 each), and created three empty "nests" at ~75 cm for controls. Mean total egg mass was similar between treatments ($\bar{x}$no = 5108 ± 570 g (SD), $\bar{x}$SAG = 5522 ± 354 g). For nests with SAGs, average total SAG mass was 604 ± 117 g. We measured nest PCO_2 at high and low tides every 3–4 days throughout incubation, resulting in 429 data points. We fit a generalized additive mixed model to log-transformed data to evaluate treatment effects, which included a random intercept for nest ID, fixed effects for tide, and a smooth, non-linear effect of incubation day. We fit a separate smooth curve for each group and conducted pairwise comparisons of estimated mean PCO_2 at the midpoint of each trimester (days 12, 35, and 58). We detected a clear difference at the midpoint of the second trimester, where PCO_2 in nests with SAGs was 44.9% lower [-64.2, -15.3%] (p = 0.007) than in nests without SAGs, translating to a difference of ~4400 ppm. We could not reliably infer a difference between nests with and without SAGs at the midpoints of the first and third trimesters (PCO_2 was 15.6% lower [-5.7, 47.5% (95% CI)] in the first and 22.9% higher [-20.3, 89.6%] in the third, respectively). There was no detectable tidal effect on PCO_2 (p = 0.436). While PCO_2 in control nests remained stable throughout incubation (1300–6700 ppm), both treatment groups displayed a dramatic increase. By the end of incubation, mean PCO_2 in nests with and without SAGs was 40,200 [23,300, 57,100] and 25,900 [15,800, 36,000] ppm higher than controls, respectively. Of 12 experimental nests, four were lost to tidal overwash and four to crab predation (at the end of incubation), leaving three nests with SAGs and two without, with 20.8% and 25.5% hatching success, respectively. These findings suggest that SAGs impact nest CO_2, with an effect observed during the second trimester of incubation. Although few studies explore CO2's influence on leatherback hatchling ontogeny, changes of less than 10,000 ppm in CO2 can alter development in some vertebrates. Future research is needed to understand SAGs' function and the physiological responses of leatherback embryos in hypercapnic conditions.

POSTPANDEMIC CONSERVATION OF THE NESTING POPULATION IN PLAYA CEUTA, SINALOA, MEXICO

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Despite the world-wide lockout due to pandemic , the University of Sinaloa Bióloga School and the institutions partners implemented strategies for the monitoring of the sea turtle *Lepidochelys olivacea* nesting beaches, following sanitary and safety procedures. After the pandemic, these monitoring actions increased in number of hours. The goal was to reveal the aspects of the olive ridley turtle (*Lepidochelys olivacea*) nesting population along Playa Ceuta, Sinaloa, México, during the post pandemic period. Nesting data was compiled between the years 2020 and 2024. During the pandemic, 1062 nests were registered between 2020 and 2021, while in post pandemic, 855 nest were registered between 2022 and 2024, observing a decrease in the number of nesting turtles. This could be due to social factors, since the recreation activities started at the beach and in some cases the turtle turned around or It happened to be a poached nest, added to the fact that those years the pluviométric Index decrease. On the other hand the season 2024 started with good hopes but issues related with the organized crime started to show in Sinaloa State. Facing this situation that we'll name "narcopandemic", from September on beach monitoring had to be cancelled due to safety reasons.

SAND MICROBIOTA IN LEATHERBACK SEA TURTLE NESTS FROM SOUTHEASTERN FLORIDA USA*

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As amniotes with porous eggshells, sea turtle eggs are exposed to various sand-associated microorganisms (e.g., bacteria, fungi, protozoa, viruses) during incubation. These diverse microbial communities are a normal part of sea turtle nest environments; however, alterations in the microorganisms present can negatively affect embryonic development and ultimately nest success. Threats to leatherback sea turtle embryos are of particular interest because they have the lowest average hatching and emergence success globally. Due to advancements in high-throughput genetic sequencing, research investigating the microorganisms present in the environment and in different types of substrates is increasing. However, microbial communities in the environment are highly specialized depending on variables impacting a given

location (e.g., local geology, local weather and climate, sediment composition). These variables, while natural, complicate our understanding of host-microbial interactions across different locations. As such, characterizing beach-specific microbial communities is essential for understanding potential pathogens or shifts in the microbial communities that may negatively impact developing embryos and therefore nest success. Here we characterized the bacterial and fungal communities found in sand from leatherback sea turtle nests at two beaches (Boca Raton and Juno Beach) in southeastern Florida USA. We assessed differences in these communities as they relate to location and time of sampling (i.e., oviposition or post-emergence excavation). Significant differences in the bacterial community and alpha diversity (defined as diversity both in the species richness and their relative abundance) were identified between locations in sand collected at oviposition. Additionally, we found significant differences in both the bacterial and fungal communities in sand collected at oviposition versus sand collected at excavation. These spatial and temporal shifts in nest sand microbiota suggest that both the nesting site and active nest incubation influence microbial communities, warranting further investigation into the direct effects that sand microorganisms may have on leatherback sea turtle nest success.

INVESTIGATING THE BURDEN OF FUSARIUM SPECIES IN LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) NESTS LOCATED IN SOUTHEASTERN FLORIDA USA

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In recent years, there has been a significant rise in the prevalence of infectious diseases caused by fungi in marine ecosystems. Increasing temperatures and regional shifts in precipitation can foster fungal overgrowth within sea turtle nests, and reports of fungal infections of sea turtle eggs have increased worldwide. Fungal overgrowth by Fusarium spp. in sea turtle clutches causes sea turtle egg fusariosis (STEF). STEF may lead to embryo mortality and is linked to decreased hatching success in all seven species of sea turtles. The leatherback turtle (*Dermochelys coriacea*), which has the lowest average hatching success, globally, at ~50%, is at high risk of suffering negative impacts from STEF. While existing studies highlight the urgent need for research on the prevalence of Fusarium spp. in the sand where leatherbacks nest, we are not aware of any published research on this topic in southeastern Florida USA, a leatherback nesting hotspot. To address this knowledge gap, we obtained sand samples from leatherback sea turtle nests at oviposition and excavation in Boca Raton, Juno Beach, and Jupiter, Florida. Using quantitative polymerase chain reaction (qPCR), we measured the amount of Fusarium spp. present in nest sand at both time points. These quantitative data were used to determine the relative quantity of Fusarium spp. in each nest at the two time points and whether those measures covary with emergence success, hatching success, and environmental factors (e.g., pH, clutch temperature, washover events, sediment size). This quantitative molecular approach in combination with environmental metrics can highlight key factors correlated with the occurrence and abundance of Fusarium spp. and whether they are associated with the low hatching success observed in crucial southeastern Florida nesting hotspots. Additionally, the knowledge gained from this study enhances our understanding of STEF and may help regulators plan mitigation strategies to improve hatching and emergence success.

EVALUATING THE IMPACTS OF BEACH RENOURISHMENT ON INCUBATION ENVIRONMENT AND HATCH SUCCESS IN LOGGERHEAD (*CARETTA CARETTA*) SEA TURTLE NESTS*

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Many natural sandy beaches are disappearing due to storm action, rising seas, and coastal development that disrupts natural sediment movement. Beach renourishment is considered a "soft" measure that can help replace lost sand and is a common response to erosion. Although less harmful to sea turtle nests than coastal armoring, sand placement can still negatively affect reproductive success. The specific mechanisms driving these impacts remain poorly understood. Beach renourishment has been occurring on Captiva Island (FL, USA) since 1961, with a recent project completed in August, 2021. Widespread sand placement had never occurred on the neighboring island of Sanibel (FL, USA) until 2023, when an island-wide renourishment project was ordered following Hurricane Ian. Although Sanibel and Captiva experience similar environmental pressures (i.e. storms, predation), historically the hatch success (HS) on Captiva has been approximately 20% lower than Sanibel. In order to understand the mechanisms driving this disparity, we characterized the changes and effects of sand quality resulting from beach renourishment on the incubation environment. Our objectives were to 1) Evaluate how renourishment affects sand characteristics, elevation, groundwater flow, nest temperature, and nest moisture and 2) Characterize how these covariates impact HS. In 2021, 2022, and 2024 we collected physical and microclimatic data (e.g., temperature, water content, water level, elevation, sand grain size) from 154 loggerhead (*Caretta caretta*) nests across Sanibel and Captiva. Ninety-five were monitored pre-renourishment and 59 were monitored post-renourishment. We used zero-inflated beta regressions (ZIBRs), generalized additive models (GAMs), and linear models (LMs) to determine if HS differed by renourishment status (pre- or post-), and to investigate relationships among incubation environmental parameters and HS. Models were checked internally and tested against null models using BIC and likelihood ratio tests to assess significance. Average HS decreased significantly following renourishment (from 66.5% to 43.7%; ZIBR, $p < 0.001$), and the estimated chance of a nest exhibiting 0% HS (excluding washouts) increased from 8.7% to 25.7% after renourishment (ZIBR, $p < 0.001$). Renourishment increased mean nest elevation on Sanibel and Captiva by ~0.4 m (ANOVA, $p < 0.001$), and nests had lower mean water content (GAM, $p < 0.001$) and higher mean temperature (LM, $p < 0.001$) with increasing elevation. Mean grain size and uniformity of grain size (sorting) decreased after renourishment, and proportionately more nests were coarse, coarse skewed, and moderately sorted following sand placement (ANOVAs, p's < 0.05). Multiple components of sand grain size distributions showed significant correlations with mean water content and temperature among nests (LM and ANOVA, p's < 0.05), with different sand characteristics affecting each parameter. On Sanibel and Captiva Islands, the observed ranges of nest mean water content and temperature after renourishment were consistent with lower HS relative to incubation conditions prior to renourishment, likely due to elevation constraints affected by renourishment. This research provides new insights on how sand placement impacts nest incubation environment and the results from this study can be used by managers in planning for beach renourishment projects to minimize impacts to reproductive success.

EFFECTS OF BEACH RENOURISHMENT ON EMBRYONIC DEVELOPMENT OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) IN SOUTHWEST FLORIDA

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Beach renourishment is a common solution for eroding beaches caused by rising tides and storms in Florida. While adding sand through renourishment may benefit sea turtles by creating more nesting habitat, potential negative effects on nest success and embryonic development should also be evaluated when considering overall impacts to sea turtle populations. Sand placement projects have occurred on Captiva, Florida, USA about every 5-10 years since 1961, with a recent project concluding in August 2021. Sanibel, FL, USA, immediately south of Captiva, was renourished for the first time in 2024 after Hurricane Ian. Despite their proximity and similar environments (such as predators, storms, and weather), the average hatch success on Sanibel over the past 10 years has been about 20% higher than on Captiva. The difference in hatch success could be due to Captiva's past history of renourishment. Previous studies have demonstrated that temperature, moisture, and water level can impact hatch success following renourishment, but research characterizing the relationships between embryonic mortality and these factors is limited. Quantifying the timing of embryonic mortality provides insight into the effects of incubation conditions on embryonic growth and reveals stage specific vulnerability to environmental variation. This preliminary study provides insight into the impacts of renourishment on embryonic development by evaluating the relationship between percent of development time (%DT) and renourishment status. 4,163 unhatched eggs were collected at inventory from loggerhead (*Caretta caretta*) nests outfitted with temperature (Onset Model S-TMB-M006), moisture (Onset Model S-SMC-M005), and groundwater level loggers (Onset Model U20L-04) on Sanibel and Captiva in 2021 (n=1,331), 2022 (n=1,628), and 2024 (n=1,329). Unhatched eggs were categorized into stages 6-31 of embryonic development post-oviposition and then calculated into %DT as defined by Miller et al. (2017). An ordinal mixed model was used to evaluate whether year and nourishment status (pre- or post-) can predict early (<15%DT), mid (15-60%DT), or late (>60%DT) stage embryonic death, with nests within the same beach as a random effect. Temperature, moisture, inundation, elevation, and sand characteristics will be used as covariates during modeling for the next phase of this project to determine how these variables contribute to embryonic mortality. Preliminary analysis shows eggs from pre-nourishment beaches exhibited substantially lower odds of late-stage mortality relative to post-nourishment beaches ($\beta = -3.75$, $p < 0.001$), indicating that nourishment was associated with delayed embryonic death. Significant variation among nest–beach units (SD = 2.61) highlighted the importance of local nest conditions. The increased likelihood of late-stage embryonic mortality on post-nourishment beaches suggests that embryos are able to initiate and sustain early development but encounter increasingly restrictive nest conditions as metabolic demand rises. Given the increasing use of sand placement to mitigate the effects of eroding beaches, our results provide guidance for optimizing design of these projects. The incubation environment plays a critical role in nest success and population recruitment, and the impacts of beach projects on sea turtle embryo development should be considered when implementing conservation strategies.

STANDARDIZING SEA TURTLE NESTING BEACH ENVIRONMENTAL MONITORING THROUGH TEMPERATURE DATA LOGGERS

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The environmental conditions of nesting beaches are critical determinants of sea turtle reproductive success. As Earth's climate continues to change at an accelerated pace, shifts in environmental conditions (e.g., ambient temperature and precipitation) can influence maternal nesting behaviors, hatchling development, reproductive success, and offspring sex ratios. However, comparing parameters across nesting beaches to evaluate long-term, global trends is difficult due to the lack of standardized monitoring methods. Equipment type, precision, placement (within or adjacent to nests, in sand along beach gradients), monitoring duration, and site stratification differ widely across projects. Additional variables to consider for inclusion in temperature-based studies include sand color (e.g., Munsell color scale), grain size, rainfall or moisture levels, beach location (e.g., proximity to the dune), and sources of ambient environmental data (e.g., nearest weather stations). Here, we synthesize the outcomes from the 2025 Southeast Regional Sea Turtle Meeting "Standardizing Nesting Beach Environmental Monitoring Workshop" and propose establishing a coordinated global network to unify nest and beach temperature (and moisture) monitoring. Key discussion points included (1) the advantages and limitations of deploying loggers inside versus outside of nests; (2) recommended monitoring intervals and resolutions; (3) using moisture loggers to detect rainfall or washover events; and (4) the need for multiple logger depths or replicates to reflect site-specific nest characteristics. Participants also highlighted the importance of collaborative data sharing and using open-source analytical tools (e.g., embryogrowth R package) for estimating incubation duration, sex ratios, and reproductive success. To complement these discussions, we developed a "must have-good-better-best" framework outlining the minimum and optimal standards for nest and environmental monitoring programs. Recommended practices included consistent logger calibration (e.g., annual ice-bath verification to determine drift), high-resolution sampling intervals (15 minute), multiple logger depths (e.g., 30–70 cm) for sand-based studies, and representation across the beach (dune to high-tide line). Long-term success will also depend on data storage, public accessibility, and the use of comparable logger types with a high precision (±0.2°C). By implementing these standardized approaches, researchers can enhance data consistency across nesting sites, improve model accuracy for predicting hatchling sex ratios and reproductive success, and strengthen global assessments of climate impacts on sea turtle populations. We invite more organizations to join us in this initiative to create a unified foundation for evaluating nesting beach environments worldwide.

ANALYSIS OF THE POPULATION MANAGEMENT OF NESTING *LEPIDOCHELYS OLIVACEA* IN PLAYA CEUTA, ELOTA SINALOA MEXICO. 2013 TO 2017 SEASONS

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In Playa Ceuta Sinaloa the protection of sea turtles began in 1976 through the Universidad Autonoma de Sinaloa. The protection program requires great handling in the transfer of nests and incubation. The objective of this study is to compare the management phases that range from the nesting of the females, to end with the release offspring to the sea, the 2013 to 2017 nesting seasons for olive ridley turtle (*Lepidochelys olivacea*). For the data analysis, a model based on the losses that occur during management actions was used (P1: registred nesting, P2: collection nest, P3: moved, P4: incubation, and P5: hatchling release), for statistical analysis, a two-way ANOVA was applied. The 2013 season recorded 524 nests with 36,919 eggs collected, compared to the 2017 season, which reported 924 nests and 63,679 eggs. The significant statistical differences recorded between the management phases in Playa Ceuta, Sinaloa ($F = 23,866$, $DF = 4$, $p = 0.001$), indicate that in phase 4, which been the incubation phase, there is a greater loss (0.693 ± 0.237 arcoseno). The self-evaluation of our work through the years analyzed (2013-2017) in Playa Ceuta showed no significant statistical difference ($F = 1.739$, $DF = 4$, $p = 0.146$). The losses are exclusive to the management phases and these do not change over time, hence the importance of nesting management depending on the region and type of monitoring.

INTERSPECIFIC DIFFERENCES IN SEA TURTLE EGG CONSUMPTION AMONG GHOST CRABS

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Ghost crabs (Ocypode spp.) are small omnivorous crustaceans widely distributed on sandy beaches worldwide, and are known predators of sea turtle eggs at nesting sites. In areas where multiple Ocypode species coexist, the interspecific differences in diet compositions have been reported. However, the studies on sea turtle egg predation have rarely considered the species identity of ghost crabs, and little is known about whether different Ocypode species vary in their use of sea turtle eggs as food resources. In this study, we aimed to estimate the dietary contributions of different food sources for Ocypode species using stable isotope analysis and to clarify whether the contribution of sea turtle eggs differs between the coexisting species. This study was conducted on the beaches in Chichijima Island, Ogasawara Islands, which hosts the largest green turtle (*Chelonia mydas*) nesting population in Japan. On this island, the ghost crabs are

the major predators of green turtle eggs. Samples were collected during the turtle nesting seasons of July–August 2023 and August 2024. Two ghost crab species, *Ocypode ceratophthalma* and *O. cordimanus*, were collected; both species were found on all surveyed beaches. Potential food sources included ants, seaweeds (genus Sargassum), mussels (family Mytilidae), nerite snails (family Neritidae), and terrestrial plant leaves (*Scaevola taccada*). Carbon and nitrogen stable isotope ratios were measured for all samples. The isotope data for green turtle eggs, a protected species, were obtained from the previous collections on Chichijima Island. Bayesian mixing models were applied to estimate the proportional contributions of each food source for the two Ocypode species. Both carbon and nitrogen stable isotope ratios differed between the two species, with *O. cordimanus* exhibiting higher nitrogen isotope values than *O. ceratophthalma*. The mixing model indicated that O. ceratophthalma derived most of its diet from seaweeds, while the contribution of sea turtle eggs was relatively low. In contrast, *O. cordimanus* showed higher contributions from ants and sea turtle eggs than from other food sources. These results suggest that, among the two Ocypode species inhabiting Chichijima Island, *O. cordimanus* is the major predator of green turtle eggs. The interspecific difference in egg consumption may be related to their microhabitat preferences within the beach. *O. cordimanus* tends to inhabit the areas in and around coastal dune vegetation such as Ipomoea pes-caprae, *Vitex rotundifolia*, and *S. taccada*. In contrast, O. ceratophthalma occurs closer to the shoreline. Because green turtles typically nest near the vegetation zone, *O. cordimanus* is likely to have greater access to eggs. This study indicates that differences in sea turtle egg utilization among Ocypode species may also occur in other regions worldwide.

SCALE-DEPENDENT SHIFTS IN HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA*) NESTING PHENOLOGY ON BUCK ISLAND REEF NATIONAL MONUMENT*

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Buck Island Reef National Monument lies 1.5 miles off the northeast coast of St. Croix (USVI). The island is uninhabited, managed by the National Park Service, and is one of two named hawksbill index nesting beaches under U.S. jurisdiction. The Buck Island Sea Turtle Research Program was established in 1988 with the goal of collecting biological data and tagging hawksbill sea turtles as part of a long-term population study. This study investigated the spatiotemporal shifts of hawksbill nesting patterns on Buck Island. By using the data collected from the program's inception to present, nesting season was compared to previously established peaks to ensure the program continues to accurately monitor population dynamics and capture nesting patterns. To determine whether the timing of peak hawksbill nesting has shifted over time and whether patterns differ between population and individual scales, we analyzed all recorded hawksbill nesting events from 1988-2025. At the population scale, which includes tagged and untagged hawksbills, we computed the annual median Julian day of nesting then fit a generalized additive model (GAM); to detect temporal trends. At the individual scale, we summarized each tagged female's within-season median nesting date for each year she nested and fit a GAM with turtle identity as a random effect. The preliminary findings from this study indicate that shifts in hawksbill nesting timing on Buck Island are evident at the population scale but not the individual scale. This research identifies shifts in peak hawksbill nesting season, providing valuable insights for program managers to adapt operations to continue studying population dynamics of this critically endangered species.

VALENCIA REGION (EASTERN SPAIN) LEADS THE COLONIZATION OF THE LOGGERHEAD SEA TURTLE ALONG THE SPANISH MEDITERRANEAN COASTS: RECORD IN 2025

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The nesting activity of the loggerhead turtle (*Caretta caretta*) in the Spanish Mediterranean is now a well-established phenomenon. Since 2014, nests have been recorded annually, with a marked increase observed over the past three years. In 2025, we documented 33 nests across the Spanish Mediterranean, the highest annual record to date. Of these, 14 (42.4%) were located in the Valencian Community (VC), a region that accounts for more than one-third of all nests and unsuccessful nesting attempts recorded in Spain since 2001, despite representing only 25% of the Spanish Mediterranean coastline. Of the 14 nests recorded in VC in 2025, 7 were detected through direct observation of nesting females and subsequently relocated to protected sites. The remaining 7 were identified from hatchlings crawling on beaches, reported by citizens, beach cleaning personnel, and law enforcement agencies; clutches were found in 6 of these 7 nests. Nests were distributed along the entire regional coastline (5 in Castellón province, 2 in Valencia, and 7 in Alicante). Based on direct observations and citizen-provided videos, we estimated that at least 6 different females laid these nests; however, considering additional reported sightings, we infer that 7 to 8 individuals likely visited VC beaches in 2025. As in previous years, we identified both "resident" females, which nested within the same area or beach, and "explorer" females, which laid clutches at widely separated sites within the same nesting season. One resident female that laid three clutches on a beach in Denia (Alicante) in 2023, laid four additional clutches on the same beach in 2025, demonstrating strong site fidelity. Among the explorers, one female laid three clutches in 2025: two on beaches in Valencia province, approximately 430 and 530 km from the first clutch, laid in Girona province (Catalonia). Videos of unsuccessful nesting attempts recorded by passers-by, together with hatching dates from nearby nests, suggest that another female may have produced three of the five nests recorded in Castellón province. Overall, these observations indicate an average clutch frequency of three to four nests per female per season. Excluding the nest in which only crawling hatchling were detected, we assessed the hatching success of 13 nests, all them successful, with hatching success ranging from 40.8% to 93.9% (averaging 70%). Additionally, one turtle constructed a fully covered nest with a chamber but without laying eggs, the second case of this type observed in the region. Although some beaches show repeated nesting activity across years and beach surveys have recently begun in some areas, nesting remains scattered, and detection of females and nests still largely depends on citizen science and beach users. Nest monitoring in the VC benefits from a long-standing citizen science–based stranding network active for over three decades, as well as interinstitutional collaboration through the oldest protocol for sea turtle nesting events in Spain. Nevertheless, high nesting activity may not solely reflect increased detectability, as data from the 2025 nesting season suggest that the Valencian Community may represent a primary nesting area for *C. caretta* in the Spanish Mediterranean.

OPTIMAL, SUBOPTIMAL, AND LETHAL CONDITIONS FOR DEVELOPING LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) EMBRYOS

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Embryonic development and mortality in sea turtles are strongly influenced by temperature and moisture during incubation. To examine how temperature and moisture affect hatching success in leatherback turtle (*Dermochelys coriacea*) eggs under ex situ incubation, we collected 540 freshly oviposited eggs (30 eggs from each of 18 nests) and incubated them under six controlled temperature (27°C, 28°C, 29°C, 30°C, 31°C, or 32°C) and two moisture treatments (5% and 9% sand moisture content). Eggs collected from each nest were divided among treatment conditions to account for maternal influence on development and success, and female identity was included as a random effect in statistical analysis. Hatching success was calculated as the proportion of hatched eggs out of the total number of eggs in a treatment. Eggs that did not hatch were necropsied, and embryos were staged using developmental keys. To compare hatching success across the different temperature and moisture treatments, a binomial GLMM and Type III Wald chi-square tests were used. Hatching success was significantly affected by incubation temperature (χ^2=16.62, df=6, p=0.011), moisture (χ^2=4.04, df=1 p=0.044), and their interaction (χ^2=16.12, df=6, p=0.013). The interaction indicated that moisture effects depend on temperature, therefore post-hoc pairwise comparisons between moisture levels within each temperature were conducted using estimated marginal means. Eggs in the 5% moisture treatment had increased hatching success at 27°C (z=2.01, p=0.044), 30°C (z=3.55, p=0.0004), and at 31°C (z=3.83, p=0.0001). There was no difference in hatching success between moisture treatments at temperatures of 28°C (p=1.000), 29°C (p=0.999), or at the highest temperature of 32°C (p>0.100). A notable finding was that exposure to 32°C from day 1 of incubation was completely lethal, as all 47 embryos exposed to 32°C early in development died before embryonic stage 23. After this discovery, and in order to investigate the effects of 32°C on embryos at later stages of development, a different group of eggs were incubated at 30°C and then increased to 32°C on day 22 of incubation. Embryos (n = 37) in this treatment had an overall hatching success of 57% and there was no difference in hatching success between moisture treatments (p=0.1002). Thus, our results support previous descriptions of late-stage embryos of all sea turtle species tolerating higher incubation temperatures than embryos at earlier developmental stages. Leatherback sea turtle embryos have lower tolerance to high temperatures during incubation, but their lethal temperature limit is not well understood at various stages of development. Our findings are the first to describe 32°C as a lethal thermal threshold during early development. While ex situ incubation provides controlled conditions, these findings highlight potential risks for in situ nests exposed to sustained high temperatures or excessive moisture, especially early in development. Understanding optimal, suboptimal, and lethal temperature and moisture conditions is critical for improving ex situ leatherback conservation or research practices and predicting embryo survival in warming in situ nesting beach environments.

EFFECT OF UPWELLING-INDUCED MARINE COOLING EVENTS ON LOGGERHEAD NESTING BEHAVIOR

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Linking oceanographic processes with sea turtle nesting phenology provides key insights into sea turtle behavior in response to the environments they experience. While many studies focus on long-term environmental trends, sea turtle responses to short, dynamic oceanographic events remain understudied. Marine cooling events are periods of anomalously low sea surface temperature (SST) that primarily result from upwelling events caused by fluctuations in the Gulf Stream and wind-driven Ekman transport. These events tend to occur seasonally during summer months along the east-central Atlantic coast of Florida, USA. This region includes the Archie Carr National Wildlife Refuge (ACNWR), a globally important nesting beach for loggerheads (*Caretta caretta*). Historically, marine cooling events were hypothesized to temporarily reduce or slow loggerhead daily nesting locally. To evaluate the influence of these events on nesting activity, we applied generalized additive models (GAMs) to model the effect of cooling events on nest counts while accounting for seasonal nesting trends, interannual variation, and temporal autocorrelation. Nesting data were collected by the University of Central Florida's Marine Turtle Research Group along the 21-km Brevard County portion of the ACNWR from 2002 to 2024. In total, 250,571 loggerhead nests were recorded, with annual counts ranging from 6,405 to 17,191 nests (mean = 11,390 ± 2,687 SD). Daily sea surface temperature (SST) data were obtained from the GHRSST Level 4 MUR Global Foundation SST dataset and averaged over an offshore area extending 15 km offshore of the ACNWR. We defined marine cooling events as periods when SST fell at or below the 10th-percentile climatological threshold for three or more consecutive days and were identified using the R package heatwaveR. From 2002 to 2024, 45 marine cooling events were identified, encompassing 345 nesting days (~8% of total nesting days). Marine cooling events were associated with a significant ~7% reduction in daily nesting counts after accounting for seasonal trends, annual variation, and temporal autocorrelation. Loggerheads were slightly less likely to nest during periods of anomalously cold nearshore water temperatures, suggesting mild, but consistent, short-term behavioral sensitivity to these thermal conditions. However, this effect was temporary, as overall seasonal nesting patterns remained consistent. These results indicate that loggerhead nesting behavior exhibits limited plasticity, with some turtles adjusting short-term nesting activity during marine cooling events. By understanding behavioral responses to cold anomalies, we can better predict how nesting populations may respond to increasing oceanic variability. This can help shape conservation efforts by allowing managers to anticipate and interpret short-term changes in observed nesting behavior.

NEST DENSITY AND INCUBATION CONDITIONS INFLUENCE SEA TURTLE HATCHLING QUALITY AT THE WORLD'S DENSEST LEATHERBACK NESTING BEACH

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The Northwest Atlantic leatherback population was reclassified as Endangered due to long-term declines in nest abundance. Trinidad supports one of the largest leatherback colonies globally, with Grande Riviere recognized as the world's densest nesting beach. At such high-density nesting sites, close proximity among egg clutches may influence incubation conditions, including temperature and gas concentration, with potential consequences for hatchling development and post-emergence performance. To investigate these effects, we manipulated nest density at Grande Riviere across 60 relocated nests and assessed the resulting variation in body morphology and locomotor performance, specifically self-righting time and crawling speed. Overall, our results suggest that nest density and incubation conditions affect body morphology and locomotor performance, and that certain morphological characteristics may confer advantages for self-righting and crawling behaviors. These findings highlight nest density and body morphology as important factors influencing locomotor performance, with potential implications for the management of high-density nesting beaches, such as Grande Riviere.

BUILDING CLIMATE-READY HATCHERIES: EARLY INCUBATION HEAT SENSITIVITY IN LEATHERBACKS*

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Rising nest temperatures pose a growing challenge for sea turtle conservation, as incubation temperatures strongly influence embryonic development and survival. During incubation, embryos experience changing thermal conditions driven by ambient sand temperatures and metabolic heat production, such that temperature effects vary by developmental stage. Leatherback turtles (*Dermochelys coriacea*) appear less tolerant of elevated incubation temperatures and often exhibit lower hatching success than other sea turtle species, yet the timing and thermal conditions underlying this vulnerability remain poorly defined. To address this gap, we monitored nest temperatures and hatching success of relocated leatherback clutches at Pacuare Nature Reserve (Caribbean Costa Rica) across two nesting seasons (2022: n = 39; 2023: n = 28). Clutches were assigned to shaded and unshaded hatchery plots, and temperature was recorded at the centre of the nest every 30 minutes throughout incubation using HOBO data loggers. Thermal conditions were summarized as mean temperature and cumulative exposure to elevated temperatures (>30°C) during early incubation and across the full incubation period, and then related to hatching success using mixed-effects models. Hatching success was most strongly associated with thermal conditions during early incubation, particularly cumulative exposure to sustained warmth, whereas temperature metrics averaged across the full incubation period were less informative. These results indicate that leatherback embryos are

most sensitive to heat shortly after oviposition and highlight the importance of considering both the timing and intensity of heat during development. Hatchery interventions for relocated nests that reduce thermal exposure early in incubation, such as earlier or more targeted shading, are likely to be most effective for improving hatching success under future warming conditions.

DNA METHYLATION REVEALS BUFFERING RESPONSES TO CLIMATE-INDUCED SEX RATIO SKEW IN VULNERABLE SEA TURTLES*

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Species with temperature-dependent sex determination (TSD) face increasingly skewed sex ratios as climate change progresses, threatening long-term population viability. All sea turtle species are impacted, with many rookeries predicted to produce exclusively female hatchlings by 2100. Yet most forecasts have relied on nest temperature as a proxy for sex ratio, extrapolated from limited constant-temperature lab experiments. As a result, these models likely limit our ability to account for natural thermal variability and population-specific responses across the globe, leading to uncertain demographic projections. This research gap has persisted as sexing hatchlings necessitates lethal or invasive methods to date, which are both impractical at scale for assessing hatchling sex ratios in situ. To overcome this limitation, we developed a DNA methylation-based sexing method for loggerhead turtles (*Caretta caretta*). As a stable epigenetic mark involved in gene expression regulation, DNA methylation offers a scalable and minimally invasive solution for sexing hatchlings. We performed whole genome bisulfite sequencing on blood samples collected from 29 hatchlings incubated at male- (27oC), mixed- (30oC), and female-producing (32oC) temperatures, whose sex was verified independently via gonadal laparoscopy. This identified 777 differentially methylated sites that strongly discriminated hatchling sex without a confounding influence of temperature. These sites were associated with 392 genes, including 40 genes linked to sex development and gametogenesis. For the first time, we applied our novel methylation-based markers to assign hatchling sexes in a split-clutch field experiment, where nests were incubated at varying temperatures in biologically relevant conditions by burying them at different depths across three timepoints as temperatures rose over the nesting season (n=58 experimental nests). For this rookery in Cabo Verde (Northeast Atlantic), we revealed that traditional temperature-based predictions overestimated female hatchling production by an average of 46.9% and up to 79.1%, suggesting the presence of evolved buffering mechanisms that mitigate temperature effects on sex determination. Overall, we provide the first scalable, empirical assessment of hatchling sex ratios, directly measured from the field without invasive procedures. Our study highlights the need to rethink current projections of climate-driven sex ratio skew and advocates for the deployment

of methylation-based assays to improve monitoring and management of demographic resilience under climate change.

Population Biology and Monitoring

PROJECTED PRIMARY SEX RATIOS, THE LOSS OF DEMOGRAPHIC REFUGES, AND FEMINIZATION IN THE RED SEA DURING THE PAST 124 YEARS*

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Sea turtles are vulnerable to increasing nest temperatures which may result in decreased hatchling fitness and survival, and increased feminization. However, other studies have suggested that female majority hatchlings are not a result of recent warming but has likely persisted at some sites for many decades. The objective of this study was to examine the adult sex ratios and projected primary sex ratios of hawksbill and green turtles in the Red Sea. The hyper arid landscape surrounding the Red Sea make it an ideal site to study sex ratios and potential feminization given that beach temperatures are among the hottest in the world and turtles reside and nest in the Red Sea. We used a citizen science approach to study the adult hawksbill and green turtle sex ratios. A Generalized Additive Model (GAM) incorporating a random effect was employed to assess the relationship between in situ sand temperature (Tanabe et al. 2020), climatic conditions (HadiSST index), and measurement depth (hawksbill: 30 cm and green: 50 cm). Given the extremely high model fit, we then projected the model to examine historic (124 years) temperatures across all known 254 nesting beaches in the entire Red Sea. Adult hawksbill and green turtles are mostly females. This was expected given that projected primary sex ratios favored females during the past 124 years. We believe it is advantageous for sea turtles in the Red Sea to have female majority populations given that nesting temperatures are among the hottest in the world, females do not breed every year and there is female specific mortality. Higher than typical male production occurs because of geographic variation and years with lower temperatures of the Atlantic Multidecadal Oscillation temperature cycle. Historically, the southern Red Sea likely produced almost all females. The northern beaches were likely a demographic refuge, with males comprising between 10 – 40 % of potential hatchlings from those nesting sites. Interannual thermal variability may contribute to the production of males over time (e.g. decades), but not consistently every year. Slightly more males (1 % - 18%) will be produced during the few cooler years of each 35 year Atlantic Multidecadal Oscillation temperature cycle, especially at northern beaches. However within the past 25 years, the northern beaches have experienced widespread coastal development and feminization from both global warming and the positive phase of the Atlantic Multidecadal Oscillation temperature cycle. The upcoming negative phase of the Atlantic Multidecadal Oscillation will shift from a warmer to a cooler phase, masking increasing the SST, which is expected to result in slightly more males being produced in the short term. However, the warmer part of the next cycle will likely include new high temperature extremes which could result in an increase in nest mortality, reduced fitness of hatchlings, and fewer males being produced.

OBSERVED AND MODELED SEX RATIOS OF A NEW POPULATION OF LOGGERHEAD TURTLES IN THE WEST MEDITERRANEAN BASIN COULD EXPLAIN THE META-POPULATION FUNCTIONING OF THIS SPECIES*

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Basin (Spain, France, and Italy) have been colonized by new populations of loggerhead sea turtles (*Caretta caretta*) originating from mixed Mediterranean and Atlantic rookeries (Hochscheid et al. 2022, Luna-Ortiz et al., 2024). These nesting sites occur at latitudes higher than those historically used by this species within the Mediterranean Sea. The sex ratios produced under these new cooler thermal regimes remain largely unknown, despite their potential importance for population persistence under climate change. To address this question, we analyzed the incubation temperatures recorded in 22 loggerhead nests laid along the Mediterranean coast of Spain (Andalucia, Murcia, Balearic Islands and Catalonia) from 2018 to 2023. The sex of 298 hatchlings (126 females and 172 males) from a headstarting program was determined through direct observation after laparoscopy. The sex ratio was also estimated using an extended version of a recently developed mechanistic model of sex determination specifically designed for loggerhead turtles (Monsinjon, Guillon, Wyneken & Girondot, 2022). This model was originally validated using data from Floridian nesting beaches. For the Spanish nests, the observed sex ratios were consistent with the predictions generated by the Floridian model, suggesting that the temperature–sex determination (TSD) pattern does not significantly differ among Regional Management Units (RMUs) for loggerhead turtles. Our findings indicate that this newly established population produces a more male-biased sex ratio than the long-established Mediterranean nesting populations, which typically produce mostly females. This masculinization was expected given the cooler thermal conditions at these higher latitudes. Such colonization of northern habitats could play a crucial compensatory role by maintaining balanced sex ratios at the metapopulation level. Overall, these results support the hypothesis that the recurrent colonization of new nesting areas, driven by climate variability, may enhance the long-term resilience of marine turtles exhibiting temperature-dependent sex determination. Further research is needed to estimate the overall primary sex ratio from incubation temperature on the Spanish coast and in the western Mediterranean basin using this mechanistic model of sex determination for loggerhead turtle. This will also enable us to evaluate the overall impact and to gain a better understanding of these new male-producing nesting areas on the dynamics of the metapopulation.

GENOMIC DETERMINANTS OF TRANS-OCEANIC MIGRATION IN PACIFIC LEATHERBACK SEA TURTLES*

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Sea turtles undertake some of the most iconic long-distance migrations in the world. These marine reptiles navigate vast distances using geomagnetism and olfaction, yet it remains unclear whether migratory traits are controlled by genes, environment, or a combination of both. Here we present the first evidence of genomic determinants of migratory phenotypes in sea turtles, using whole genome resequencing to demonstrate that complex genomic architecture underlies divergent migratory destinations and reproductive timing in the critically endangered western Pacific leatherback turtle (*Dermochelys coriacea*). Specifically, in an otherwise completely admixed population, individuals from the same nesting beach that navigate to foraging grounds on the opposite sides of the Pacific Ocean exhibit pronounced genomic differences. Much of the genomic differentiation is concentrated inside a putative inversion on Chromosome 2 and falls within one gene. This gene, molybdenum cofactor sulfurase, is a key regulator of enzymes that impact physiological traits required for long-distance migration, including fat deposition, muscle performance, and blood pressure maintenance. Leatherback turtles with divergent reproductive timing – individuals consistently nesting in either summer or winter – exhibited a more dispersed genomic architecture with differentiation occurring in genes known to affect sperm production and reproduction, which may warrant further study to understand possible consequences for reproductive output in a species with already low rates of hatching success and globally endangered status. Finally, both migratory timing and destination involve genes underlying the development of neural circuitry, highlighting the importance of neurodevelopment in shaping these complex behavioral traits here and in other migratory taxa. Our study adds to the growing evidence of at least partial genomic control of migratory traits in wild populations, and aligns with a growing body of work indicating that structural variation and complex genomic architecture underlie diversity in key eco-behavioral traits. Complex traits like migration likely include environmental cues and behavioral plasticity, thus further research is needed to quantify the roles of each of these components. The relative degree of genomic control of these and other migratory traits is important for assessing conservation measures that would augment endangered populations, like translocation, genetic rescue, and mitigating fisheries interactions. Thus, our findings of a genomic basis of migration in leatherback sea turtles constitute an important step forward in understanding the evolution of long-distance migration in sea turtles and support conservation of these endangered species.

CAN MATING BEHAVIORS BUFFER CLIMATE IMPACTS? EVIDENCE FROM FERNANDO DE NORONHA GREEN SEA TURTLE REPRODUCTIVE DYNAMICS*

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Climate change presents multifaceted challenges to marine biodiversity, with ectothermic species facing particularly acute vulnerability to rising temperatures. All sea turtle species exhibit temperature-dependent sex determination where higher incubation temperatures produce greater proportions of female hatchlings. There is widespread concern that increasing sand temperatures due to climate change will result in extreme feminization of offspring and negative impacts on long-term population viability. However, sea turtles have evolved complex life histories and mating strategies that may provide some resilience to unbalanced sex ratios. Understanding operational sex ratios (OSR - the ratio of sexually active males to receptive females) and reproductive behaviors is crucial for accurate population viability assessments and effective conservation strategies, yet remain poorly documented in most sea turtle populations due to logistical challenges in robustly estimating these parameters. The green turtle (*Chelonia mydas*) population in Fernando de Noronha, Brazil represents an ideal study system to conduct a comprehensive investigation of breeding dynamics because its manageable population size (~43 nesting females annually) allows comprehensive sampling of breeding individuals across multiple seasons, enabling robust estimates of population-level breeding parameters, isolated geographical location and access to nesting females, hatchlings and breeding males. Here, we combined a high-throughput genotyping platform (a genetic analysis system that allows us to rapidly process DNA from hundreds of samples simultaneously) we recently developed with extensive field sampling over a complete breeding cycle to robustly estimate breeding sex ratios (BSR), prevalence of mating systems (e.g., multiple paternity and polandry), and sex specific breeding intervals. We analyzed >2,000 samples from nesting females (n=104), males (n=26), and hatchlings over 4 seasons (2020-2024), reconstructing familial relationships through genotyping. Our results revealed a male-biased BSR(1F:1.51M), with 77.8% of clutches exhibiting multiple paternity. The median number of fathers within a nest was two, however there were some nests that included up to seven fathers within a clutch. Combining direct sampling of 26 males (15 sired offspring) with reconstructed fathers, kinship analyses identified 139 males contributing reproductively within the population. Each male contributed to a median of 1 nest (mean = 1.45 nests). Notably, 17.3% of identified males successfully contributed to reproduction across multiple breeding seasons, supporting that shorter male breeding periodicity relative to females may offset primary female bias in this population. We also documented significant polygynous mating (26.62% of males), suggesting behavioral adaptations that may partially buffer against primary sex ratio skew. These findings indicate potential resilience mechanisms within the Fernando de Noronha green turtle population and provide critical baseline data for monitoring reproductive parameters in the face of ongoing climate change. Beyond the immediate conservation implications for Fernando de Noronha's green turtles, this study demonstrates the power of genomic approaches for monitoring cryptic reproductive parameters in marine turtles. Our high-throughput genotyping platform can be adapted for other green turtle populations and species facing similar climate-driven threats, to provide actionable data on breeding dynamics that are otherwise difficult to obtain.

DEMOGRAPHICS AND INJURY PATTERNS OF SEA TURTLES IN AQABA, JORDAN

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Sea turtles in the Red Sea have been under studied in comparison to other oceans and seas. Very little is known about the sea turtles in Jordan. The objective of this research was to assess population demographics and injury patterns of sea turtles in Aqaba, Jordan. We assessed subadult and adult sex ratios and injury patterns of hawksbill (*Eretmochelys imbricata*), green turtles (*Chelonia mydas*), leatherback turtles (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*) (Data was collected as part of a citizen science project using images and social media records between 2003 – 2025, with most records overring after 2021. Hawksbill was the most common species comprising 83% (N = 205) of the encounters, green turtles 15% (N = 36), leatherback 0.8% (N = 2), and loggerhead 0.04% (N = 1) of the encounters. The subadult and adult sex ratio of green turtles was 0.29 males/female and 0.29 males/female for hawksbill turtles. None of the turtles had shark predation injuries. Fishing is the main threat to sea turtles in Aqaba, as there were 10 turtles stranded because of fishing gear entanglement, with 5 able to be rescued and released. The higher proportion of hawksbill observations was expected giving that the majority of Jordan's coat consists of a coral fringing reef. We believe that the green and hawksbill population in Aqaba Jordan are healthy given the female dominated sex ratio and lack of observed injuries from boats and fishing. The lack of boat strike injuries is likely related to scarcity of boats and recreational watercraft, compared to other sea turtle populations. The high proportion of females in the population suggest a healthy population as healthy sea turtle populations are often female dominated.

INDIVIDUAL IDENTIFICATION OF SEA TURTLES: WHICH METHOD FOR YOUR PROJECT?

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Individual identification of sea turtles is essential for understanding their population structure, reproductive parameters, migratory patterns, and behavioral ecology. Numerous identification methods exist, and selecting the most appropriate one for a specific project can be challenging. The process requires careful justification, rigorous evaluation, and thorough preparation to ensure scientific validity while upholding

animal welfare standards. The preferred method should minimize the risk of injury or infection and best meet the study's objectives. This project aims to develop a decision-making tool to help researchers and conservation practitioners select the most suitable individual identification method(s) based on their study objectives, available financial and human resources, target species, regulatory context, and other key parameters. A comprehensive literature review was conducted to compile current knowledge on sea turtle individual identification techniques. Based on this synthesis, a decision framework was designed, detailing for each method its advantages, limitations, recommended applications, and authorization requirements examples. The framework includes i) a decision tree linking study objectives and species, ii) a decision matrix integrating additional parameters, and iii) a technical reference table summarizing practical details such as cost, size, and suppliers. Concise summary sheets were also created to provide quick, accessible guidance for field use. This tool is intended to streamline and strengthen decision-making in sea turtle monitoring programs involving individual identification, both in France and internationally. It will be made available as an open-access resource to promote consistent and ethical practices in research and conservation programmes.

SEX RATIO OF HAWKSBILL TURTLES IN A FLORIDA FORAGING AGGREGATION: IMPLICATIONS FOR LONG-TERM POPULATION MONITORING UNDER WARMING CONDITIONS*

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Understanding sex ratio dynamics in sea turtles is critical for predicting population responses to changing environmental conditions, given their temperature-dependent sex determination (TSD). This study provides an updated assessment of the sex ratio in a foraging aggregation of juvenile and subadult hawksbill turtles (*Eretmochelys imbricata*) off southern Florida – a region linked to nesting stocks in the wider Caribbean. Plasma testosterone concentrations were measured in 54 turtles using a biochemically validated enzyme immunoassay following solid-phase extraction. Sex was inferred using Gaussian mixture modeling of log-transformed hormone data; although independent confirmation of sex was not performed, this approach successfully replicated sex assignments in a previously published dataset with confirmed testosterone reference ranges. Two hormonal groups were identified, corresponding to putative males and females, with a model-derived statistical separation at 57.5 pg/mL (95% CI: 44.7–72.4 pg/mL, reflecting classification uncertainty). In the sampled population, the overall sex ratio was female-biased at 2.1:1, excluding five individuals of ambiguous sex assignments (i.e., falling within the 95% CI range). The female bias was most pronounced in the smallest size class (<35 cm SCL, n = 9), where all turtles were assigned as female; however, it remains unclear whether this reflects true feminization in the most recent cohort or a delay in hormone expression due to their developmental stage. Among larger turtles (>35 cm SCL), the sex ratio remained slightly female-biased at 1.6:1, down from 2.4:1 per a 2008 report from the same region, suggesting a potential gradual shift toward a more balanced ratio over time. Our findings highlight the utility of hormone-based approaches paired with statistical modeling for sex inference, and demonstrate that solid-phase extraction improved reproducibility, offering a practical tool for long-term monitoring. Continued assessment of foraging grounds, integrated with independent validation and/or investigation of complementary biomarkers, will be critical for understanding population-level responses to warming incubation conditions and informing conservation strategies for this critically endangered species.

GENETIC STRUCTURE AND CONSERVATION IMPLICATIONS FOR THE GREEN TURTLE (*CHELONIA MYDAS*) AT RANCHO NUEVO SANCTUARY, GULF OF MEXICO

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This study aimed to analyze the population structure of nesting females at Rancho Nuevo Sanctuary, Mexico, using mitochondrial DNA (control region) sequences to assess genetic connectivity with other colonies in the Caribbean and Atlantic. The investigation provides critical insights for regional conservation strategies of this endangered species. A total of 103 sequences were obtained from nesting females across the 2018-2025 seasons, aligned to a length of 750 bp, and compared with haplotypes previously reported in international databases, including Archie Carr. Comprehensive analyses were performed using BioEdit, DNAsp, Haploweb Maker, PopArt, and IQTree, applying genetic diversity estimators, haplotype networks, and phylogenetic reconstructions to evaluate population structure and evolutionary relationships. The results revealed remarkable genetic patterns with significant conservation implications. Global analysis identified 76 haplotypes from 103 sequences, demonstrating high regional diversity. Specifically for Rancho Nuevo, examination of 16 sequences uncovered 9 haplotypes, with 8 representing novel variants - indicating substantial local genetic singularity and micro-endemism. This pattern aligns with findings from other significant rookeries, including Atol das Rocas (Brazil) and Isla de Aves (Venezuela), confirming that specific nesting beaches serve as crucial reservoirs of unique genetic diversity. Concurrently, the identification of one shared haplotype (A1.1-A1.5), previously documented in Florida and Texas populations, confirms historical genetic connectivity within the North Atlantic Regional Management Unit (RMU). The population differentiation value (Fst = 0.49) indicates moderate to high genetic structuring, suggesting that while gene flow exists, it is sufficiently limited to permit the development of distinctive local variants. The coexistence of endemic and shared haplotypes reveals a complex population dynamic that necessitates dual-scale conservation strategies. The high number of novel haplotypes (8 out of 9) underscores the imperative for stringent local protection of Rancho Nuevo, as this unique genetic capital represents vital adaptive potential for the species. When contrasted with studies from the Mexican Caribbean showing different haplotype predominance (CM-A8, CM-A13), these results reveal distinct population substructure within the Gulf of Mexico, possibly influenced by separate migratory corridors or oceanographic currents. Simultaneously, the demonstrated genetic connectivity, evidenced by the shared A1 haplotype complex, demands coordinated transboundary management with the United States and other regional nations. The moderate to high genetic differentiation (Fst = 0.49) confirms that Rancho Nuevo functions as both a distinctive demographic unit and an interconnected node within the broader metapopulation. This genetic evidence solidifies Rancho Nuevo's dual conservation value: as a reservoir of unique genetic diversity and as a vital component within the North Atlantic green turtle network. The study provides the scientific foundation for implementing marine biological corridors and designing integrated conservation policies that address both local endemic diversity and regional connectivity, ensuring the long-term persistence of *Chelonia mydas* against escalating environmental challenges.

FROM NESTING TO RECRUITMENT: ASSESSING THE DEMOGRAPHIC RELEVANCE OF NEW LOGGERHEAD TURTLE NESTING IN THE WESTERN MEDITERRANEAN THROUGH STABLE ISOTOPE ANALYSIS*

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The loggerhead turtle (*Caretta caretta*) is the most common sea turtle species in the Mediterranean Sea. Historically, the only known Mediterranean rookeries were found in the eastern Mediterranean and early juveniles of less than 30cm in curved carapace length (CCL) rarely occurred in the foraging grounds of the western Mediterranean. This was because turtles born at the eastern Mediterranean would have to disperse against the strong eastward current at the Strait of Sicily, and those from the northwestern Atlantic population need to cross the Atlantic Ocean along the Gulf Stream, thus reaching the western Mediterranean after several years. However, the recent colonization of this region as a viable nesting ground and the exponential increase in the number of nests found during the last decade, especially along the coasts of Italy and Spain, might be causing an increase in the number of early juveniles from local nesting beaches. To test this, the present study reconstructed the dispersal routes of 29 small juveniles (17-32cm CCL) dead stranded or bycaught in the Spanish Mediterranean coast between 2017 and 2023. The stable isotope ratios of carbon (δ13C) and nitrogen (δ15N) were analyzed in contiguous, 30 μm thick layers of carapace keratin, each layer reflecting a few months of foraging. A regional isospace was built as 1x1 grids using the δ13C and δ15N values of 251 juvenile loggerhead turtles, including the innermost (most recent) carapace layer of dead stranded or bycaught juveniles from the northeastern Atlantic, western Mediterranean (Northern Current) and Algerian Basin, and previously published values from the Adriatic Sea and eastern Mediterranean. On this basis, the bivariate isotopic values of the outermost (oldest) carapace layer of the small juveniles were used to characterize their initial foraging grounds, whereas those from the more recent layers allowed to reconstruct the potential movements between isotopically distinct regions. Uncertainty in zone assignment for both the gridded isospace and individual carapace layers was evaluated using a non-parametric bootstrap approach. Results showed that the isotopic values of the outermost layer of 44.8% (n=13) of the analyzed turtles were consistent with initial foraging in the western Mediterranean, 24.1% (n=7) in the Algerian Basin, 17.2% (n=5) in the Adriatic Sea, 10.3% (n=3) in the northeastern Atlantic and one individual was unknown. Furthermore, the sequential analysis of carapace layers revealed that 69% of these turtles spent most of their life within the western Mediterranean and Algerian Basin, regardless of the initial foraging ground. However, some individuals appear to have entered this region shortly before stranding, since the δ13C and δ15N values of their innermost carapace layer were consistent with those from the eastern Mediterranean (n=4), the Adriatic Sea (n=3) or the northeastern Atlantic (n=1). These results suggest that nearly half of the early juveniles currently occurring in the foraging grounds off the coast of Mediterranean Spain have an origin within the western Mediterranean. Hence, the recent increase of nesting events in the region seems to be already contributing significantly to the recruitment of early juvenile loggerhead turtles in the western Mediterranean Sea.

SPATIAL AND ENVIRONMENTAL PATTERNS OF SEA TURTLE STRANDINGS IN CHILE (1973–2025)

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Sea turtle strandings provide valuable information on species occurrence, distribution, and potential threats in coastal ecosystems. In Chile, systematic recording of strandings began in 2009 through the National Fisheries and Aquaculture Service (SERNAPESCA), while earlier information (1973–2008) derives from grey literature, museum collections, and opportunistic records. Despite this long temporal span, a comprehensive spatial and environmental analysis of these records has not yet been conducted. This study compiles more than 590 sea turtle stranding records documented between 1973 and 2025 along the Chilean coast. All records are being georeferenced and analyzed in QGIS to identify spatial and temporal patterns and to assess their relationship with oceanographic and climatic variables derived from satellite imagery, such as sea surface temperature (SST), chlorophyll-a concentration, sea-level, and surface wind intensity. By integrating historical and contemporary data, this work aims to generate the first long-term spatial overview of sea turtle strandings in Chile. The analysis seeks to identify potential environmental and geographic drivers influencing stranding patterns and to provide baseline information for regional conservation planning. The results are expected to contribute to a better understanding of the environmental context in which strandings occur and to inform management actions within a broader Pacific-scale conservation framework.

ASSESSING THE ORIGIN OF LEATHERBACK TURTLES IN SPANISH WATERS THROUGH THE ANALYSIS OF THEIR GENOME DIVERSITY*

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The leatherback turtle (*Dermochelys coriacea*) is the largest extant sea turtle species, listed as Vulnerable by the IUCN, with some populations undergoing rapid declines. Traditionally, mitochondrial DNA (mtDNA) has been used to investigate population structure and connectivity between nesting and foraging areas in marine turtles. However, leatherbacks exhibit exceptionally low mtDNA variation globally, undermining reliable analysis. Advances in High-Throughput Sequencing (HTS) and the availability of a reference genome now enable genome-wide analyses using millions of markers. This, in turn, facilitates the study of genetic diversity and population structure, as well as the assignment of individuals to their populations of origin. Here, we aim to determine the genomic structure of leatherback turtles across its geographical range. We are using Whole Genome Sequencing (30 Gb output) on individuals from nesting populations that belonged to four different Regional Management Units (RMUs): Northwest Atlantic (Colombia, Dominican Republic), Southwest Atlantic (Brazil), Southeast Atlantic (Gabon) and East Pacific (Costa Rica) and added samples from Papua-Indonesia (West Pacific RMU) from the SRA archive (PRJNA1254794). We genotyped all samples by mapping their reads against a reference genome, producing a set of more than 5 million nuclear single-nucleotide polymorphisms (SNPs) across individuals. We found a deep genetic structuring across RMUs, as indicated by both multidimensional scaling analysis (MDS) and fixation index (Fst) analyses, useful to measure genetic differentiation between populations. To test the potential of genomics to assign individuals in the marine environment, we sequenced and genotyped 23 turtles detected in Spanish waters, including stranded individuals: Andalusia (both Atlantic and Mediterranean waters), Catalonia, Galicia, Valencian Community and Canary Islands. The high level of genetic structuring detected among RMUs enabled the assignment of most individuals found around Spain, with almost all of them assigned to the Northwest Atlantic RMU. The high genetic structuring among RMUs allowed assigning most individuals around Spain to the Northwest Atlantic RMU, showing that conservation should target both nesting and foraging areas to protect genetically distinct populations.

Focusing only on the nesting individuals, using Fst analyses, we found that some regions of the genomes were more differentiated than others across RMUs suggesting adaptive processes. We also analysed Runs of Homozygosity (ROHs), continuous regions where both chromosome copies are identical, providing a measure of inbreeding. Total ROH ranged from ~200 Mb to 900 Mb, mainly short, indicating historical rather than recent inbreeding. Individuals from the Dominican Republic showed the lowest ROH accumulation, whereas those from Gabon the highest. Higher ROH accumulation reflects reduced genetic diversity and a potentially lower adaptive capacity, increasing vulnerability to environmental changes and disease. Therefore, ROH patterns represent an important genomic indicator of population health. We also reconstructed their demographic history, showing different evolutionary dynamics among populations. Our study demonstrates that whole-genome data can provide valuable insights that guide conservation strategies aimed at preserving the genetic integrity and adaptive potential of sea turtles in response to multiple pressures.

CALIBRATING SPECTRAL MODELS FOR KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*) SEA TURTLE AGE ESTIMATION VIA NEAR-INFRARED REFLECTANCE SPECTROSCOPY (NIRS)*

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Age data are essential for estimating longevity, tracking cohorts, and studying the population dynamics of vulnerable species. Traditional sea turtle aging methods have a variety of drawbacks because they require large investments of time and staff resources (skeletochronology, mark-recapture of hatchlings) or are imprecise (size-at-age keys). However, emerging technologies could dramatically increase age estimation efficiency, provided they can maintain comparable aging accuracy and precision to traditional methods. Here, we evaluate the feasibility of using Near-Infrared Reflectance Spectroscopy (NIRS) to accurately predict sea turtle age from scanning locations along front flippers and cleaned humeri bones. Near-Infrared Reflectance Spectroscopy (NIRS) is a non-destructive method that shines light on a sample, exciting chemical bonds and forming a "spectral signature" of reflectance measurements at specific wavelengths (300–2500 nm), which reveal a sample's biochemical properties. Studies have shown that spectral signatures correlate well with age in other vertebrate species using otoliths from red snapper (Passerotti et al., 2022) and barramundi (Wright et al., 2021), as well as the vertebrae from hammerhead sharks and spiny

dogfish (Rigby et al., 2016). When signatures are paired with known age estimates (e.g., humerus bone-derived), age can be predicted from a simple NIR scan. We calibrated Partial Least Squares (PLS) models with consensus ages (years) from Kemp's ridley sea turtles (*Lepidochelys kempii*), using age estimates derived from skeletochronology. Raw spectral signatures displayed an increase in reflectance with increasing age between the wavelengths of 300 and 1250 nm. Cross-validated PLS model outputs illustrate a strong correlation between bone-derived ages and NIR-predicted ages for whole-flipper (n=127; R2 = 0.64; RMSE = 1.6 yrs; RPD = 1.4) and dried-humerus scanning locations (n=308; R2 = 0.74; RMSE = 2.4 yrs; RPD = 1.9). Our NIRS research yields an efficient method to accurately and rapidly age samples from deceased sea turtles, which will significantly advance our ability to monitor age structure and age-based demographic changes for a critically endangered species, thereby increasing the quality and quantity of age-specific demographic data available to natural resource managers.

SHIFTING PATTERNS IN SEA TURTLE SIGHTINGS ALONG AUSTRALIA'S SOUTHERN COAST (1971–2025)

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Australia is home to six of the world's seven sea turtle species: leatherback (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and flatback (*Natator depressus*). Of these, three are listed as endangered, while the remaining three are classified as vulnerable. Due to their highly migratory behaviour, sea turtles in Australian coastal waters face numerous threats throughout their life cycle. These threats are intensifying as rising sea temperatures shift their natural distribution patterns, exposing them to new risks. In recent years, government agencies and community groups have emphasised recording turtle sightings, which in some areas appear to have increased in frequency and occurred in atypical locations, particularly along the southern coast of Australia. To examine patterns of strandings and sightings in regions not typically associated with regular turtle presence, we collated data from online repositories, including the Atlas of Living Australia (ALA) and iNaturalist. Records from 1970 onwards within southern Australia were included to assess occurrences outside species' typical geographic ranges. ALA data was downloaded and analysed in R (ggplot2) to visualise trends, and spatial distribution was mapped using ArcGIS Pro. Records were excluded if they lacked a date, were collected outside southern states, did not include coordinates, or were identified via satellite tracking. Where possible, records were verified using photographs from independent sources. Five key findings emerged. (1) New South Wales reported the highest number of sightings, with 794 events overall. (2) The highest number of sightings across all species in a single year was 97 in 2020, reflecting a notable peak. (3) The most sightings for a single species in one year occurred in 2024, with 41 green turtles reported. (4) Loggerheads were most frequently stranded in March, the highest case month overall, with 46 cases recorded across all years. (5) The most frequent species-month-year combination was observed in March 2021, with 10 loggerhead strandings, representing the highest monthly total for any species. A comparison between two time periods (1970-2000 vs. 2000-2025) revealed a 20.83% increase in reported sightings. Apparent trends may reflect effort bias, which has changed over time and across regions with the rise of citizen science platforms and mobile technology. Overall, this study provides an important baseline for assessing long-term patterns in sea turtle distribution under a warming climate. By analysing historical records and sightings outside typical ranges, it aims to highlight how environmental changes, such as warming sea temperatures, may be influencing the frequency and spatial distribution of sea turtle sightings. While reported sightings have increased, it is unclear whether this reflects true changes in turtle abundance or shifts in reporting effort. These observational patterns could

nonetheless provide valuable information for predicting future climate impacts and guiding conservation strategies in newly emerging habitats.

SMALL FORAGING GROUNDS, LARGE POPULATION SIGNIFICANCE: ADULT- AND MALE-RICH AGGREGATIONS OF GREEN TURTLES IN SENEGAL*

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Green turtles (*Chelonia mydas*) are highly vagile, connecting breeding and foraging grounds through extensive migratory movements. Although breeding sites are more studied due to better accessibility, foraging habitats are essential for understanding demographic structure, abundance, and spatio-temporal distribution. West Africa is a region of major significance for green turtles globally, hosting large foraging aggregations, such as the estimated 150,000 individuals in Banc d'Arguin (Mauritania), and one of the top three nesting grounds in the Atlantic, at Poilão Island, Guinea-Bissau. After the reproductive season at Poilão, turtles migrate to foraging grounds along the West African coast (Mauritania, Senegal, and Guinea-Bissau). Although Senegal is a key foraging destination, limited data exist on its foraging aggregations. To address this, we combined nesting and satellite-tracking data from Poilão Island with in-water capture data from Senegal to estimate the abundance, demographic structure, and spatial distribution of foraging green turtles in Senegal. We found that adult green turtles along the Senegalese coast concentrate in two areas — Joal and Saloum Delta — highlighting these sites as key foraging hotspots in the region. Of the 46 nesting females tracked during their post-nesting migrations from Poilão, 20% foraged in Senegal. Based on the number of nesting females in Poilão, we estimated that 4,132–4,599 adult breeding females forage in Senegal. We captured a total of 131 green turtles in Joal and Saloum Delta, with approximately 33% being breeding females, thus estimating 12,589–14,010 turtles foraging in this region. Turtles foraging in Senegal (~300–400 km north of the main rookery in Poilão) had a mean curved carapace length (CCL) of 89.1 ± 14.3 cm (N = 131; CCL range 42.8–117.8 cm) and were significantly larger than those reported foraging in Mauritania, 1,000 km north of Poilão. Among adults, we identified males by their elongated tails and large recurved claws on the front flippers, allowing us to estimate an adult sex ratio of 1 male to 1.54 females. This male-rich sex ratio is more than twice the proportion of males reported for the foraging aggregation in Mauritania (1:3.75, males to females), supporting emerging evidence that males forage closer to breeding grounds. Satellite tracking of 19 turtles at Joal and Saloum Delta (52.8 ± 44.0 days) showed a mean individual home range and core area of 18.10 ± 15.53 and 2.84 ± 2.28 km², respectively. These values are comparable to those reported for most green turtle populations but smaller than those observed in Mauritania. All tracked individuals exhibited residency behavior, with no evidence of movements outside their foraging areas. This study provides the first in-water assessment of green turtles in Senegal and demonstrates that small foraging grounds can support large aggregations with distinct demographic structure and high turtle concentrations. Our findings highlight the ecological importance of West African foraging habitats and reinforce the value of in-water studies for understanding the spatial ecology and population structure of sea turtles.

TEMPORAL VARIATION IN THE OPERATIONAL SEX RATIO OF THE BLACK SEA TURTLE POPULATION (*CHELONIA MYDAS* AGASSIZII) IN MICHOACÁN, MEXICO

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The operational sex ratio (OSR) is defined as the ratio between sexually active males and sexually receptive females within a population. The OSR reflects the number of males available to mate with receptive females. OSR values have been reported for the black turtle breeding population since conservation activities began in 1978. During the 2023 and 2024 black turtle nesting seasons on Colola Beach, the operational sex ratio (OSR) of the black turtle population was evaluated through direct observations of groups of breeding adults in reproductive interactions using the "focal" and "ad libitum" sampling methods and the continuous recording method. A total of 145 hours of observation of reproductive interactions of adult black turtles were carried out on Colola Beach on the coast of Michoacán. A total of 283 mating groups were observed, 178 in 2023 and 75 in 2024, through direct and indirect observations using videos and photographs obtained by drone flights. Unfavorable weather conditions caused by the occurrence of the "El Niño" phenomenon in 2023 and "La Niña" in 2024 in the eastern Pacific region hampered observations and caused a significant delay in the reproductive activity of female black turtles in Colola. A sex ratio of 3.3:1 males to females was found in 2023 and 2.3:1 (male:female) in 2024 in a multi-year analysis of the Michoacán population. We also identified monthly variations in PSO values at the beginning and end of the nesting season, probably due to the differential arrival of males and females to the breeding area and the variable number of sexually receptive females. According to these results, it is likely that multiple paternity occurred in 58% of the nests laid in the 2023 breeding season, with a parental contribution of 3.3 fathers per clutch. On the other hand, in 2024 we estimate that multiple paternity occurred in 68% of nests with a parental contribution of 2.3 fathers per clutch, a lower frequency of multiple paternity than in 2023. The conditions generated by the "El Niño" and "La Niña" phenomena affected the variations in OSR values during 2023 and 2024, and these variations have consequences for the multiple paternity of offspring and their fitness. Research on this topic is scarce because reproductive interactions (mating and courtship) take place far from the nesting area, which complicates their study due to accessibility and operating costs.

ASSESSING THE SPATIAL DISTRIBUTION OF HAWKSBILL (*ERETMOCHELYS IMBRICATA*) AND GREEN (*CHELONIA MYDAS*) SEA TURTLES AROUND WATER ISLAND, USVI

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We investigated the spatial distribution and abundance of both hawksbill and green sea turtles around Water Island, U.S. Virgin Islands. Water Island lies off the island of St. Thomas, Virgin Islands and forms part of the harbor for Charlotte Amalie, a busy port for large freight boats, cruise ships, and smaller recreational vessels. The distance around Water Island is 11 km. One of the bays on the island is a popular beach destination and boat anchorage that is also known to be good habitat for foraging green sea turtles. The rest of the island's marine habitat is known anecdotally to be good habitat for sea turtles, both hawksbills and greens. Our study had three components: a) assessing the distribution of sea turtles around the perimeter of the island, b) assessing the density of turtles in four selected bays on the island, and c) benthic surveys of those bays to investigate benthic composition and density of various seagrass species. During our study from July to November 2025, 153 turtle observations were made; 45 observations around the perimeter of the island, and 108 in the selected bays. Green turtles accounted for 135 observations, and hawksbills accounted for 12 observations. Six turtles were unable to be identified due to their distance from the observer or low underwater visibility. All turtles encountered were juveniles, except one adult male hawksbill observed on the perimeter of the island, and one possible adult female hawksbill who was observed twice resting in one of the bays. Green turtles showed a preference for Druif Bay, one of the four bays, where 91 of the 108 bay survey turtles were observed. These data will highlight areas for conservation efforts to be focused; such as identifying areas for mooring buoys to be installed to prevent damage to turtle habitat, and areas to install signage to educate beachgoers on proper behavior around sea turtles.

ASSESSMENT OF THE GREEN TURTLE (*CHELONIA MYDAS*) POPULATION IN AKUMAL BAY, QUINTANA ROO, MEXICO (2024–2025)

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This study characterizes the green turtle (*Chelonia mydas*) population in Akumal Bay, Quintana Roo, Mexico, an important foraging ground due to its dense seagrass beds. Although Akumal Bay was designated a Marine Refuge in 2016, turtles continue to face threats from water pollution, boat strikes, seagrass degradation, and heavy tourism impacts. Fieldwork was conducted from April to November in 2024 by Centro Ecológico de Akumal (CEA) and volunteers, and from June through July 2025, by our team using standardized snorkel transects and GoPro videos of turtle encounters. In 2025, we analyzed 236

videos (18.5 hours total) of turtle behaviors and 51 videos (5.8 hours total) of tourist behaviors. Turtle and tourist behavior durations were normalized by total video length to yield the proportion of time spent in each behavior per video. These proportions were then averaged across all videos. For turtles, the mean proportion of time swimming per video was 0.38, resting was 0.26, and evading (people) was 0.13. Still images from the videos were entered into a CEA photo catalog and visually compared to 2024 photographs. We identified 71 unique individuals in the photos; 50% were observed in both years, 32% were seen only in 2024, and 18% were newly recorded in 2025. Across the 48 turtles filmed in 2025, 79% appeared healthy, 11% showed signs of fibropapillomatosis (FP), 4% had carapace damage, 4% exhibited malformations, and 2% were missing limbs. We suggest collaborating with veterinarians to better assess FP and health conditions, as well as using a computerized photo-identification tool to help match photos. For tourist behaviors, the mean proportion of video time showing acceptable behavior was 0.12, approaching the turtles was 0.07, and chasing the turtles was 0.06. Although recent measures such as roped no-swim zones may be helping, our results indicate that additional enforcement and education are needed. We recommend stricter verification of tour guide permits and limits on snorkel group size, which reached up to 33 people. These findings contribute to understanding the current status and health of Akumal Bay's green turtle population and support Marine Park management efforts to mitigate threats to this ecologically and economically significant species that draws thousands of tourists per year.

PRELIMINARY GENOMIC CHARACTERIZATION OF GENETIC DIVERSITY IN STRANDED GREEN SEA TURTLES FROM THE SINGAPORE STRAIT

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Climate change and anthropogenic pressures are rapidly altering marine ecosystems, posing significant threats to keystone species. Previous genomic investigations of hawksbill turtles in Singapore identified a distinct population bottleneck coinciding with post-glacial sea-level rises, suggesting that large-scale climatic events have historically dictated the demographic trajectories of regional sea turtles. This study extends this research to *C. mydas* strandings in Singapore, which occur at the intersection of the Southeast Asian and Northeast Indian Ocean RMUs. We aimed to characterize the genomic diversity of these individuals as a first step toward understanding the evolutionary health of this population. We performed high-depth whole-genome resequencing (WGS) on four individuals. Following initial data processing, one individual was excluded from downstream analysis due to a low mapping rate, which could have introduced biases in variant calling. Utilizing a DeepVariant-based pipeline on the remaining three individuals, we identified an average of 14,518,580 SNPs per individual. Technical validation confirmed high data fidelity, with transition/transversion (Ts/Tv) ratios ranging from 1.79 to 1.80 and a total cohort variant pool of 24.8 million markers. We observed a mean nucleotide diversity (π) of 0.00644 and an average heterozygosity-to-homozygosity ratio of approximately 1.45. While these metrics are consistent with maintained genetic diversity, it should be noted that population-level inferences are limited by the current sample size of three individuals. Principal Component Analysis (PCA) anchored against the *C. mydas* reference genome showed that these individuals form a cohesive genetic cluster distinct from the assembly. These preliminary findings establish an initial genomic baseline for green turtles in the Singapore Strait. The observed diversity metrics are encouraging but do not yet permit robust conclusions about adaptive capacity or inbreeding status at the population level. Future work will expand the sample size and incorporate selection analyses to determine whether these individuals are representative of broader regional genetic trends.

Ultimately, this effort aims to contribute to a genomic framework for the informed management of sea turtle populations in an increasingly volatile oceanic environment.

USING TECHNOLOGY IN REMOTE AREAS TO PRODUCE ROBUST POPULATION CENSUS DATA*

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Recent IUCN Red List assessments of sea turtle populations have reported encouraging upward trends for many populations around the world although there is considerable regional variation. Against a backdrop of increasing pressures for sea turtles from anthropogenic activities and climate change, it remains important to optimise monitoring of populations in understudied or remote regions to increase confidence in future sub-population estimates. The Chagos Archipelago is amongst the most important rookeries in the Southwest Indian Ocean sub-population, providing nesting beaches for 39-51% of hawksbills (*Eretmochelys imbricata*) and 14-20% of green turtles (*Chelonia mydas*) (Mortimer et al. 2020 https://doi.org/10.1017/S0030605319001108) across 67 remote islands. To improve understanding of nesting numbers across the archipelago, we first assessed nesting success, track seasonality and longevity, and clutch frequency along a 2.8 km index beach on the largest island of Diego Garcia. We blended data from two-weekly foot patrols (2018-2024) and remote assessments (daily images from 13 camera traps; 2021-2024) of track numbers and nesting success across the year with satellite tracking observations of clutch frequency to update and extend previous estimates of nesting numbers and to develop a synergistic methodology that may have broad utility. We refined seasonal distribution for hawksbills and green turtles on the index beach (Nov-Jan: 86%; Jun-Oct: 79% of tracks respectively). We then applied results for the index beach for seasonality, track longevity and track success to convert track counts from foot patrols on four other atolls (156 patrols; 2021-2024) to estimate nesting numbers across the archipelago. Population trends between 1996-2024 were positive with over two-fold increase in hawksbills (2408 clutches in 2024) whilst green turtle clutch numbers increased by over seven-fold (16,879 clutches in 2024). Extending trends from remote rookeries like Chagos across global datasets provides an updated global conservation status of hawksbill and green turtles. The improved status likely reflects the continuing high levels of protection on nesting beaches but continued monitoring remains critical to record changes in interannual variation and trends across time and to evaluate emerging threats to the populations. We recommend using data from satellite tracking and remote camera traps to address long-standing assumptions in population estimates.

RECRUITMENT OF BREEDING MALES FROM REGIONAL ROOKERIES MAY OFFSET FEMALE-BIASED SEX RATIOS IN BRAZIL GREEN TURTLES (*CHELONIA MYDAS*)*

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Determining connectivity between different breeding grounds is critical to understanding genetic diversity and gene flow between populations. Nesting habitats are warming due to climate change which may produce female-biased primary sex ratios. Recruitment of males originating from other locations into breeding populations may provide important buffers against reproductive failures. In Brazil, there are three main rookeries where the majority of green turtle nesting occurs: Trindade Island, Rocas Atoll, and Fernando de Noronha. Previous studies have established that nesting females in these locations share some mitochondrial haplotypes but differ in others, facilitating natal origin assignment. Many studies focus on female nesting mothers, leaving open questions about male migratory origins found at these breeding sites. This research seeks to answer 1) the origin of male green sea turtles found near Fernando de Noronha (FdN) and 2) the diversity of male haplotypes found on this island for evidence of genetic diversity within the population. We collected samples from 29 males in conjunction with in-water surveys and hand captures for satellite tag attachments from 2020-2023. Since sample size was limited in previous baseline studies, we also sampled 30 nesting females, randomly selected from a larger sample set to avoid erroneous inference of male origins. After DNA extractions, we prepared sequencing libraries using an Oxford Nanopore Promethion sequencer to generate 20X coverage of whole mitogenomes for each individual. Following bioinformatics data processing, we generated consensus sequences for extended Control Region (CR) and assigned them CR haplotypes based on ACCSTR nomenclature. From our analysis, we confirmed eight previously established CR haplotypes found across both female and male samples in our study. Two haplotypes are historically found in FdN, three found historically in surrounding Brazilian rookeries, and three found historically in the Greater Caribbean region. 71% of females had haplotypes previously identified in FdN (CM-A25.1 & A8.1) while 29% had those previously only identified in surrounding Brazilian rookeries (CM-A8.3 & A10.1). While the majority of males also exhibited haplotypes originating from FdN (76%; CM-A25.1 & A8.1) and surrounding Brazilian rookeries (4%; CM-A9.1), 20% had haplotypes assigned to the Greater Caribbean region (20%; CM-A3.1, A5.1, & A5.2); notably, these haplotypes were only found in our male samples. Collectively, these results support that (1) prior establishment of baselines at FdN missed some haplotypes present in the nesting population due to sample size limitations, and/or recent recruitment of females from other locations, indicating a need to update baselines for future assignments, and (2) at least some males present in the FdN breeding aggregation likely originated from other rookeries. Analyses of complementary hatchling samples are currently underway to establish if any of these males successfully sired offspring, which would confirm male-mediated gene flow into the FdN population from the Greater Caribbean region and surrounding Brazilian rookeries. If confirmed, this male recruitment and male-mediated gene flow may play an important role in maintaining genetic diversity in smaller, geographically isolated rookeries and act as a mechanism for population resilience under climate change.

BREEDING SEX RATIOS AT A HAWKSBILL TURTLE ROOKERY AFTER 10 YEARS

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Understanding the breeding dynamics of endangered species, including mating behavior, breeding population size, and breeding sex ratio, is important for assessing population resiliency. Yet for marine turtle demographic studies, the male component of populations is often missing from analyses due to the absence of males at easily accessible nesting beaches. Genetic techniques provide a solution: male breeders can be identified indirectly by reconstructing unique paternal genotypes from the genotypes of offspring cohorts along with their nesting mothers. Knowledge of breeding sex ratios is of particular importance for species with environmental sex determination, such as marine turtles, to track predicted shifts in sex ratios driven by climate change. Paternity, mating behavior, and the breeding sex ratio (BSR) were previously analyzed for the Jumby Bay hawksbill rookery in Antigua from samples collected in 2013, showing a low rate of multiple paternity and an even BSR (24 males to 23 females). Here, we analyze data from nests collected in 2023, ten years later. We genotype hatchlings with five microsatellite markers and use a maximum-likelihood, full-pedigree reconstruction program to reconstruct paternal identities from our nests. Preliminary data from six nests shows single paternity for all nests, aligning with 2013 results and indicating minimal polyandrous behavior for Jumby Bay females. Males reconstructed from our six nests also indicate an even BSR. We plan to present data from 10 additional nests for the conference. Our preliminary results suggest no major changes in patterns of paternity, mating behavior, and BSRs over a decade time scale in the Eastern Caribbean.

LEATHERBACK *DERMOCHELYS CORIACEA* STRANDINGS REVEAL POPULATIONAL PARAMETERS AND SPATIO-TEMPORAL VARIABILITY IN OCCURRENCE AND MORTALITY OFF BRAZILIAN WATERS*

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Conservation of the threatened *Dermochelys coriacea* at the Regional Management Unit level requires information on movement and behavioral ecology, demographics and anthropogenic interactions. Stranding monitoring can provide such data at large temporal and spatial scales, offering opportunistic access to individuals at both reproductive and foraging grounds. All stranded leatherbacks along ~1,400km of coastline in southern Brazil have been recovered during daily beach surveys conducted since 2015 by the Santos Basin Beach Monitoring Program (PMP-BS). We evaluated this comprehensive stranding dataset to characterize populational structure and spatio-temporal stranding patterns of leatherbacks, as well as the nature of interactions with anthropogenic activities in Brazilian waters. Over ~9 years, 311

leatherback turtles strandings were recorded; 98% of individuals were deceased and 87% in advanced or mummified decomposition stages. Most strandings were comprised of adults (~74%) or large juveniles (~25%), with mean curved carapace length at 135.98 cm ± 19.5 SD. Sex was determined for 43% of individuals and a male biased sex ratio was observed (1.44:1). Evidence of anthropogenic interaction was identified for ~24% of stranded leatherbacks, including fisheries bycatch (n = 39), marine debris ingestion/entanglement (n = 36), boat collision (n = 7), targeted aggression (n = 7) and injury from dredging activities (n = 2). Considering that carcass decomposition hinders detectability of anthropogenic interaction, we also determined bycatch proportion among only fresh carcasses: 47.5%. We detected a cycle of biannual increase in leatherback strandings, with higher rates in 2016, 2018, 2020, and 2022 (~40 to ~50 individuals), while counts in other years remained within ~15 to ~30 individuals. Negative binomial GLMMs identified seasonal and spatial variability in stranding incidence. An increase in leatherback strandings was observed in southern Brazil (Paraná state), considering standardized monitoring effort between states, although higher absolute number of individuals were recovered in other two areas (São Paulo and Santa Catarina). The highest stranding rates per 100km occurred during summer and autumn (Rio de Janeiro state), and a significant increase in absolute number of stranding events occurred during spring (especially in Paraná state). Binomial GLMMs revealed a significant higher frequency of females in some states (e.g., Paraná vs São Paulo), and that fresh carcasses are ~3 times more likely to exhibit evidence of anthropogenic interaction. The detected mortality of adult individuals from this mixed-stock aggregation in Brazilian foraging grounds, in addition to the high frequency of anthropogenic interaction in fresh carcasses, highlight the need for urgent enforcement of mitigation measures in the region. Further evaluation of mortality patterns in high-fishing-effort seasons and areas is required to improve the effectiveness of bycatch assessment and conservation actions.

NEW GENETIC INSIGHTS INTO THE NORTH PACIFIC LOGGERHEAD'S KEY FORAGING GROUND

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The North Pacific loggerhead sea turtle (*Caretta caretta*) RMU, which nests exclusively in Japan, depends critically on the foraging ground in Baja California Sur (BCS), Mexico. This area is a hotspot for juvenile turtles, but also for bycatch mortality. Genetic characterization of this key aggregation has been severely limited, relying on a single study from 1995 and short mtDNA fragments, obscuring effective conservation and monitoring. To address this, we present a contemporary genetic analysis of the BCS loggerhead hotspot using 77 blood samples collected from juveniles at the epicenter distribution in front of Adolfo López Mateos Port. Standard genetic differentiation and diversity statistics were estimated to update the North Pacific and BCS genetic landscape employing 533 novel and worldwide mtDNA control region sequences (837 bp and 370 bp). By applying a longer, 837 bp fragment, we uncovered significantly higher haplotype diversity than previously reported with standard ≈350 bp markers in BCS, highlighting a critical need for standardized molecular protocols in the Pacific. Our analysis confirms the presence of key haplotypes (including CcP2.1, CcP2.3, and CcP3.1) linking this foraging ground to the nesting rookeries in Japan. This work bridges a 30-year genetic data gap and provides a crucial baseline for monitoring this vulnerable population. We propose a new, standardized haplotype nomenclature for the Pacific. Our findings form the foundation for ongoing work and underscore the immediate need for Mexico-Japan policy partnerships for addressing research gaps and informing and directing effective conservation strategies.

UNCOVERING AGING PATTERNS ACROSS CAPTIVE AND WILD SEA TURTLES*

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A driving force behind centuries of biological inquiry has been the profound desire to understand the ecological and evolutionary mechanisms shaping aging patterns in nature. At the heart of this fascination lies the challenge of unravelling how trait assemblages define a species' position in life history space, and how this position presupposes a species' susceptibility to the negative effects of aging, i.e., senescence. Protective phenotypes (e.g., shells and venom) and specialized life modes (e.g., flight and fossoriality) have emerged as key drivers of macroevolutionary patterns that reduce aging rates, yet empirical tests have been strongly biased toward birds, mammals, and terrestrial ectotherms. Marine ectotherms, despite their ecological importance, remain critically understudied. Here, we synthesize a combined 130 years of census data from wild and captive sea turtle populations across three continents to provide an unprecedented view of aging in this group. Using long-term nesting records for more than 1,800 first-time breeding female green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles from Cyprus, Australia, and the Cayman Islands, we show that sea turtles exhibit negligible but positive actuarial senescence. Across populations, individuals maintain high reproductive viability late into their lives, a finding consistent with other studies on testudines. Captive green turtles had lower aging rates compared to their wild counterparts, with wild loggerheads having similar aging rates to wild green turtles. These findings establish a new empirical baseline for aging in highly fecund long-lived marine ectotherms and emphasize the exceptional capacity of sea turtles to sustain reproduction across extended lifespans, with broad implications for both evolutionary theory and conservation biology.

BASK ME A QUESTION: HONU (*CHELONIA MYDAS*) BASKING TRENDS AT LALO

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Throughout the global range of the green sea turtle, basking on land is an uncommon behavior. One of only a small number of locations where this behavior is documented is in Hawai'i, USA. In Hawai'i, green sea turtles, or honu, are known to frequently haul out on beaches and bask diurnally and also nocturnally. There are a number of theories on why honu utilize basking, ranging from thermoregulation to predator avoidance or even aiding in digestion. A particular area where honu bask in large numbers is at their nesting beaches at Lalo (French Frigate Shoals) in the remote Papahānaumokuākea Marine National Monument, approximately 700 km from the main Hawaiian Islands. At Lalo basking behavior is documented in adults of both sexes as well as occasionally juveniles.

Field biologists at Lalo conduct unique surveys during the nesting season that allow them to tag, measure, and collect tissue samples from basking individuals. This also allows for robust data collection on breeding adult males, which is extremely rare across all sea turtle species. Basking surveys also provide a unique form of re-sight data, helping aid in population monitoring and sex ratio estimations. Aggregations of basking honu allow for the rare opportunity to rapidly collect data on a large number of individuals. These aggregates can even exceed 300 honu on a 0.5 km area of beach. These surveys have revealed interesting trends including the relationship between the number of male and female basking honu, what percentage of turtles display basking behavior, and how this information pertains to the number of nesting individuals. Additionally basking surveys have helped reveal more details on when honu arrive, when they disperse, when their numbers peak at the nesting grounds and also how tidal events can influence the number of basking turtles.

TIMING MATTERS: SEASONAL MIGRATION AND ADAPTIVE GENOMIC PATTERNS IN GREEN TURTLES (*CHELONIA MYDAS*) FROM POILÃO ISLAND, WEST AFRICA*

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Sea turtles are highly migratory, with adults cyclically moving between breeding and foraging areas that are often hundreds to thousands of kilometers apart. Variations in migratory patterns have been described in some sea turtle populations. However, genomic and temporal differences within the same population, which play a significant role in explaining migratory patterns in other seasonal migrant species, remain largely unexplored. Additionally, differences in breeding timing can also lead to genetic divergence within seasonal migrant species, have not yet been reported for sea turtles. Advances in genomics allow comparative analyses that can potentially identify genes linked to adaptive behavioral/physiological changes driven by seasonal environmental conditions. This is highly relevant in the face of climate change, as the existence of environmental-associated loci may be key for local adaptations. Poilão Island, Guinea-Bissau, one of the world's largest green turtle (*Chelonia mydas*) rookeries, hosts year-round nesting, with most activity concentrated during the wet season (June to October) and with fewer turtles nesting at distinct periods during the dry season (November to January and January to April). We tracked post-nesting females from Poilão during the main nesting season (from 2018 to 2021; n = 44) and during the dry season (2023 to 2025; n=20), to understand if migration destination varied depending on breeding seasonality. We found that green turtles from the main (wet) nesting season either migrate north, to Mauritania (1000 km north), Senegal and The Gambia (300-400 km north), or stay within 40-90 km of the nesting site, in the Bijagós Archipelago. However, turtles nesting in the early dry season migrated about 2,000 km southeast to forage offshore near Accra, Ghana, while turtles from the late dry season crossed the Atlantic, travelling almost 3,000 km westward to forage in Brazil. These novel insights suggest that Poilão hosts at least three groups of green turtles with distinct breeding phenology and migratory behaviors. To understand the potential genetic and ecological differentiation of the three groups of green turtles breeding in Poilão, we performed a comparative genomic analysis using whole genome sequencing of individuals from each group

(n=24 in total), including phenotypic variables (i.e. nesting phenology, non-breeding area, body-size, clutch size, reproductive output) and environmental variables (i.e. sea surface temperature at foraging and breeding grounds, oceanic currents at the time of migration, and foraging ground productivity). Through genomic scans of over 25 million SNPs along the genome, and a functional enrichment analysis, we were able to determine whether specific biological functions or pathways are overrepresented among the candidate genes, providing new insights into potential adaptive differences between groups. By combining satellite tracking with ecological and genomic data, our integrative approach has allowed us to better understand the interplay of breeding phenology, migratory movements and genomic variation within one of the worlds' most important green sea turtle rookery.

DYNAMIC FORAGING LANDSCAPES SHAPED BY BODY SIZE AND GENETICALLY INFERRED NATAL ORIGIN OF GREEN TURTLES IN OKINAWA

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Seagrass meadows along the Okinawan coast are key foraging habitats for green turtles (*Chelonia mydas*), supporting individuals from multiple natal origins and contributing to coastal ecosystem productivity. These habitats are also crucial for understanding population connectivity and the ecological role of coastal ecosystems under changing oceanographic conditions. Previous studies have shown regional variation in the composition of natal origins and body-size distributions among foraging grounds in Japan. For example, around the Yaeyama Islands of the southern Ryukyus, turtles originating from lower-latitude regions outside Japan are disproportionately represented in smaller size classes relative to individuals of the local Ryukyu origin. Building on these findings, this study investigates whether size-based and natal-origin patterns are consistent across other foraging grounds in Okinawa. We analyzed green turtles from seagrass beds around Kume Island (n = 162) and the Miyako Islands (n = 150), integrating these data with previously published samples from the Yaeyama Islands (n = 102). Natal origin was inferred at the individual level using mtDNA control-region haplotypes and genome-wide nuclear variants, together with straight carapace length (SCL) as a proxy for growth stage. Individuals were assigned to three natal regions: the Ogasawara Islands, the Ryukyu Archipelago, and the lower-latitude Northwest Pacific outside Japan (including Southeast Asia, Micronesia, and the Marshall Islands). Our analyses revealed clear differences in natal-origin composition among the three foraging grounds. Turtles originating from the lower-latitude Northwest Pacific were most frequent in the Yaeyama Islands, located at the upstream end of the Kuroshio Current. However, their contribution did not decrease monotonically with downstream distance: the proportion of lower-latitude individuals in the Miyako Islands was comparable to that observed in Kume Island, despite Miyako being geographically adjacent to Yaeyama. Furthermore, size-specific histograms constructed for each natal origin revealed clear, origin-dependent constraints on body-size distributions: Ryukyu-origin individuals were concentrated in smaller size classes in Kume and Miyako, and lower-latitude individuals consistently peaked at 45–50 cm across all sites. These results demonstrate that the structure of foraging aggregations cannot be explained by geography or current flow alone, but instead reflects a complex coupling between natal origin, growth stage, and habitat selection. By enabling

individual-level natal assignment, we move beyond population-level averages and reveal fine-scale, size-dependent structuring within foraging aggregations in the Northwest Pacific.

STABLE ISOTOPE RATIOS THROUGHOUT THE DECOMPOSITION OF KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*) SEA TURTLES

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Stranded sea turtles can provide a vast amount of ecological data that are otherwise difficult to collect from these migrating threatened and endangered species. For example, stable isotope analysis (SIA) is a critical tool in population ecology and is often applied on collected tissues from stranded or deceased sea turtles to illuminate various aspects of an animal's life history, such as foraging and movement patterns. While collecting these samples, it is important to acknowledge the range of body conditions responders encounter while working with stranded sea turtles. For deceased sea turtles, the decomposition process may alter stable isotope values as tissues break down. Previous research in sea turtles and other marine megafauna suggest that stable isotope ratios in skin and muscle are largely invariant over long periods of the decomposition process, but no study has evaluated this process in sea turtle carcasses subject to field conditions that mimic the natural stranding process (e.g., tidally influenced). Stable carbon (δ13C) and nitrogen (δ15N) isotope ratios were analyzed from seven decomposing Kemp's ridley (*Lepidochelys kempii*) sea turtles who stranded in the state of North Carolina. For this study, carcasses were secured within fine mesh cages, positioned along three inundation levels in the intertidal zone of a marsh at the University of North Carolina Wilmington's Center for Marine Science. Skin samples were retrieved at low tide with a 5mm punch from the back of the neck, if available, on known decomposition intervals (Day 0, 1, 3, 5, 7, 9, 11, 13) over the span of 13 days. All turtles fully decomposed naturally within this time period. The epidermis layer was separated, freeze dried, and ground into a homologous powder. Samples were then run on a Thermo Delta V Plus continuous-flow mass spectrometer paired with a Costo 4010 elemental analyzer to quantify δ13C and δ15N values. We will use time series statistical analysis to identify significant breakpoints in each turtles' isotopic record over time, providing clarity on how stable isotope data change in relation to stranding conditions. By examining SIA values through the decomposition process, this study can help validate under what conditions researchers can obtain reliable and accurate SIA data from dead stranded turtles.

ENHANCING MARK-RECAPTURE METHODOLOGIES IN ORDER TO PRODUCE UPDATED POPULATION ABUNDANCE ESTIMATES FOR THE HAWAIIAN GREEN SEA TURTLE*

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The Hawaiian green sea turtle (honu) population is a geographically isolated and genetically distinct population of green sea turtles (*Chelonia mydas*) found across the Hawaiian Archipelago. An assessment of the honu population abundance trend spanning 1973-2012 estimated a total of 3,846 breeding females and concluded that the population was recovering at 5.4% annually, but a global species status review in 2015 listed this population as threatened under the Endangered Species Act due to continued threats facing the population (e.g., vulnerability to climate change and lack of nesting habitat diversity). From 2018 to 2023 (excluding the year 2020 due to the corona virus pandemic), a saturation tagging effort identified 1,752 unique breeding individuals, less than half of what was estimated in the previous assessment. This finding necessitates updated abundance and trend estimates for the honu population. Thus, we are developing a new model using adult female mark-recapture data from Lalo within the Papahānaumokuākea Marine National Monument. Specifically we are using a Bayesian multi-state open robust mark-recapture framework to ultimately provide updated abundance estimates of the honu population. Current data inputs for this model are five years of female nesting data collected from East Island and Tern Island from 2018 to 2023. Use of the multi-state open robust mark-recapture model framework is motivated by sea turtles' unique reproductive strategy which includes a remigration interval and internesting interval. This leads to periods of unobservability where researchers are unable to resight individuals. The multi-state aspect utilizes four states to describe a honu's general movement through a nesting season. States in our model include: Reproductive Migration (movement from Main Hawaiian Islands to Lalo), Nesting (female honu hauling up on the beach to lay a clutch of eggs), Internesting Interval (the period between each clutch), and Migration Back to Foraging Grounds (migration from Lalo to the Main Hawaiian Islands). Initial model explorations identified capture probability and survival of individuals between nesting seasons as the primary drivers of population size estimates. For capture probability, this finding illustrates the importance of understanding and accounting for imperfect detection in nesting studies. Similarly, survival of individuals between nesting seasons exemplifies the importance of multi-year datasets capable of observing individual turtles across multiple nesting seasons. Although challenging to collect for sea turtles, such datasets allow researchers to reliably estimate the remigration interval and refine other important demographic parameters like internesting interval and total nests per year. Next steps for the model are to incorporate more survey data from long-term monitoring efforts by NOAA Pacific Islands Fisheries Science Center. Leveraging this dataset will be highly insightful in assessing the current population trajectory for honu along with updating our understanding of internesting and remigration intervals. Incorporating data not collected under a saturation tagging effort will also allow for evaluation of the impacts of survey effort on abundance estimation and investigate the level of effort needed to produce reliable estimates.

"ALOHA A ME E KOMO MAI, MAI NĀ HONUʻEA O HAWAIʻI ISLAND" (HELLO AND WELCOME, FROM THE HAWAIʻI ISLAND HAWKSBILLS)

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The Hawaiian archipelago, one of the most isolated island chains in the world, consists of ~137 islands that span ~2,400 km. Two species of sea turtles inhabit nearshore habitats for foraging and nesting in Hawaiʻi: the more common green sea turtle known as "honu" (*Chelonia mydas*) and the rarer hawksbill turtle known as "honuʻea" or simply "ʻea" (*Eretmochelys imbricata*). Hawaiian sea turtles fulfill important ecological roles and are highly revered culturally. The overwhelming majority of honuʻea nests within the archipelago have been laid on Hawaiʻi Island, so the epic journey of this genetically distinct species begins here. The Hawaiʻi Island Hawksbill Project (https://hawaiiislandhawksbillproject.org/) has been monitoring nesting activities and protecting coastal habitats for over 35 years. These impressive efforts have reached 200 nesters tagged and have helped the success of 1,459 nests that have yielded ~151,500 hatchlings (on 16 beaches). Once the hatchlings enter the ocean, they likely spend their "lost years" traveling with the prevailing currents westward or remaining in local offshore habitats. After their pelagic phase, hawksbills can be found among the diverse nearshore habitats surrounding the Hawaiian Islands. If they choose Hawaiʻi Island as their foraging grounds, they could be spotted on the "View Into The Blue" streaming camera installed by The Mega Lab at the University of Hawaiʻi at Hilo (https://www.themegalab.org). Or, they could be tagged through mark-recapture studies (n=10 hawksbills, 4 of which were recaptured, compared to thousands of greens from 1976-2025) conducted by a cooperative project with the National Oceanic and Atmospheric Administration and the Hawaiʻi Preparatory Academy Sea Turtle Research Program (https://turtle.hpa.edu/). Through the Hawaiian Hawksbill Conservation Project (https://www.hihawksbills.org/), 115 individual hawksbills have been identified around Hawaiʻi Island utilizing photo-identification (PID) methodologies from opportunistic citizen scientist reports. This amount comprises 26.6% of the total 433 individuals in the statewide in-water catalog (1998-2025). Nearly one third of these Hawaiʻi Island individuals have been found in the Honokōhau Harbor (n=17) and the Kawaihae Harbor (n=17), possibly due to foraging species preferences. The higher density of anthropogenic threats within harbors include vessel collisions, fishing gear interactions, pollution, and marine debris. NOAA runs a statewide marine wildlife emergency hotline (1-888-256-9840), in which various organizations help respond to turtles in trouble. Five individuals in the PID catalog are known to be deceased and 40.4% of the 115 had a physical injury. The age-class groups in the Hawaiʻi Island photo-ID catalog consisted of 62.3% juveniles (n=72), 23.7% subadults (n=27) and 14.0% adults (n=16). Among these adult-sized hawksbills, 12 individuals were males and 4 were females. Upon reaching sexual maturity, nesters from all around Hawaiʻi return to Hawaiʻi Island, where the natural cycle of life continues. These respective long-term projects will continue to collaborate to gather information on knowledge gaps that will help further document, understand and protect this iconic species.

42 YEARS OF SEA TURTLE TAGGING IN A GROWING ROOKERY ON FLORIDA'S GULF COASTLINE

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Long-term data sets and analyses are essential to long term conservation plans of a species. In ideal populations, observations of behavior can be partnered with census counts of individuals – thus allowing researchers to quantify how populations change over time. Unfortunately, marine turtles tend to be elusive, limiting availability. Mark-recapture studies of nesters allow researchers to identify reproductive parameters for their populations, including: size at sexual maturity, age at sexual maturity, clutch frequency, remigration rates, nest site fidelity, and survivorship can all be estimated from analyzing long-term tagging data. Most studies focus on one nesting beach to make inferences about the population, but in this study, two long-term tagging groups in the Sarasota, Florida region have pooled resources to assess their nesting population from 1983-2025. These nesting beaches make up the largest loggerhead (*Caretta caretta*) rookery in the Gulf and the green sea turtle (*Chelonia mydas*) is rapidly growing. This project will quantify the number of nesting loggerhead and green sea turtles that comprise this established rookery on beaches in the Sarasota County, Florida region - identify their reproductive parameters and survivorship. These reproductive parameters can provide beach managers with necessary information to further monitor and protect future nesting populations.

REPRODUCTIVE LONGEVITY AND GROWTH IN LEATHERBACK TURTLES AT SANDY POINT NATIONAL WILDLIFE REFUGE, ST. CROIX, U.S. VIRGIN ISLANDS*

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Seven regional management units (RMUs) have been identified for the effective management of leatherback sea turtles (*Dermochelys coriacea*). The Northwestern Atlantic Regional Management Unit includes the Caribbean Sea, the Gulf of Mexico, and the Mediterranean Sea. This subpopulation is classified as Endangered. In the Caribbean, Sandy Point National Wildlife Refuge in St. Croix, U.S. Virgin Islands, has one of the longest research and recovery programs for nesting leatherbacks under United States jurisdiction. After the refuge was established in 1984, there was a steady increase in the number of nesting females until 2001. Between 2001 and 2010, the nesting population stalled, and since 2010, the number of nesting females has declined. Understanding the reproductive lifespan of individuals provides key insights into overall population stability and lifetime reproductive output. Reproductive longevity, size at sexual maturation, and post-maturation growth of leatherback sea turtles have been assessed using estimates from captive observation, mark-recapture studies, skeletochronology, and growth curve modeling, all of which have yielded varied results. Current best estimates for reproductive longevity (22 years) and size (129.2 cm) of sexual maturity for leatherback turtles come from studies using skeletochronology. These estimates

may be empirically tested using site-specific mark-recapture data. We analyzed 44 years (1981-2025) of leatherback nesting mark recapture data obtained from nightly monitoring at Sandy Point National Wildlife Refuge. Reproductive longevity, size at sexual maturity, and post-maturation annual growth rates were assessed for nesting leatherbacks (n = 575) at Sandy Point. The mean reproductive longevity was estimated to be 8.0 years, with a maximum observed of 31 years (n = 3). The average estimate obtained in this study is similar to those found using skeletochronology in the same RMU. The maximum observed reproductive longevity at Sandy Point is greater than estimates found in previous studies. The mean size at presumed sexual maturity was 150.6 cm (CCL), with a range of 127.6-176.0 cm (CCL). The size at sexual maturity found in this study was higher than estimates previously identified from growth curves based on skeletochronology. After the onset of sexual maturity, growth rates for leatherback sea turtles have been found to decrease. At Sandy Point, the post-maturity annual growth rate was estimated to be 0.2 cm/yr (CCL), which is consistent with findings from other mark-recapture studies. These site-specific estimates provide a more accurate understanding of reproductive duration and growth and validate estimates derived from skeletochronology studies. This information is also essential for improving population models, assessing conservation strategies, and evaluating the long-term success of recovery programs.

WITHIN AND BEYOND THE CONTROL REGION: EXPLORING THE MITOGENOME FOR NEW MITOCHONDRIA DNA HAPLOTYPES IN INDO-PACIFIC NESTING GREEN SEA TURTLES (*CHELONIA MYDAS*)

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The northern Great Barrier Reef (nGBR) hosts one of the world's largest green turtle populations, with an estimated 200,000 nesting females. Since the mid-1990s, hatchling production and survival have declined, particularly at Raine Island, where rising water levels, altered weather patterns, and warming habitats are expected to further threaten the population. Increasing sand incubation temperatures have caused extreme feminisation, raising concerns about a shortage of male hatchlings and future reproductive success. Previous studies indicate that juvenile and subadult males originating from the nGBR are largely absent from northern foraging grounds, while males from the southern GBR (sGBR) and other stocks persist, suggesting shifts in population structure. These patterns highlight the need to improve monitoring of turtles' recruitment within nGBR foraging areas, which requires accurate identification of the natal origins of foraging turtles. A comprehensive understanding of the genetic population structure of green turtles nesting across northern Queensland is a critical prerequisite to trace the population origin of turtles in those foraging areas using mixed stock analysis. Most of the current green turtle rookery dataset analyses a short (384 bp) mitochondrial DNA (mtDNA) control region, with some samples collected more than 30 years ago, while other gaps exist. Tissue samples recently collected from nesting turtles in the sGBR, nGBR, Coral Sea, together with old samples from the 1990s from the Gulf of Carpentaria and Papua New Guinea, were analysed for an 800 bp mtDNA control region fragment and a longer ~4000 bp proportion of the mitogenome beyond the control region. Novel sequencing technologies were applied to identify additional genetic variants that could increase mixed stock analysis resolution, with the final aim of improving the genetic characterization of potential contributing stocks to nGBR foraging grounds. Additionally, the study aimed to: (i) improve the shallow genetic resolution between southern GBR and Coral Sea stocks and (ii) obtain the first 800 bp-based haplotype profile for the Gulf of Carpentaria and use it to investigate the

genetic differentiation between the Gulf of Carpentaria and the GBR rookeries. Novel undescribed haplotypes were detected in the 800 bp control region fragment of the Coral Sea and Gulf of Carpentaria rookeries, improving the population structure resolution and confirming the identification of the Coral Sea and southern GBR as separate management units for conservation purposes. A subset of 145 samples showing the most common shared haplotypes CmP47.1 and CmP80.1 were further sequenced for a longer ~ 4000 bp mitogenome fragment to assess additional variation. Phylogenetic analyses and haplotype networks revealed a strong genetic differentiation of the Gulf of Carpentaria from GBR rookeries, while within the Great Barrier Reef an admixture of multiple lineages was detected. This study provided an updated 800 bp mtDNA haplotype dataset and explored a first extended mitogenomic characterisation of green turtle nesting populations in the Southwest Pacific. The mitochondrial variation of nesters identified in this study was subsequentially used to improve mixed stock analyses in foraging grounds in the northern GBR, ultimately aimed at monitoring turtle recruitment in the context of climate changes.

TRACKING THE RISE OF A NESTING COLONY: FROM SPORADIC NESTING TO POPULATION ESTABLISHMENT*

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Global warming is driving many species to alter their geographic distribution to avoid potential extinction. Among the species affected by climate change is the long-lived loggerhead sea turtle (*Caretta caretta*), showing a high vulnerability due to its singular biological and ecological traits. These include long-distance migrations between feeding and breeding areas, temperature-dependent sex determination, and strong natal philopatry, which limits its ability to lay nests in new areas. Despite these constraints, nesting activity started to expand into the western Mediterranean over the last decades, reaching the eastern Spanish coasts. We conducted systematic monitoring of nesting events over 23 years, collecting in situ data and samples since the first recorded nest in 2001. This recent colonisation offers a rare opportunity to study the early stages of population establishment—a process with limited empirical documentation. Between 2001 and 2023, we monitored 69 nests and sampled 330 hatchlings and 13 nesting females. To investigate the colonisation process, we analysed genetic origin, relatedness, and reproductive performance using 2bRAD genomic data, mtDNA D-loop sequencing, and biometric measurements. We identified 16 renesting events from 11 females (i.e., laying more than one nest within the same season) and seven remigrations from six females (i.e., nesting in different seasons), indicating emerging site fidelity and suggesting the formation of a new nesting colony. Parentage analysis and field observations estimated a minimum effective breeding population of 38 females and 47 males, with some males contributing across seasons. Most nests originated

from individuals from the populations in the eastern Mediterranean, particularly Greece; two were of Northwest Atlantic origin, six showed admixture across Regional Management Units (RMUs), and 24 among Mediterranean sub-RMUs. Regarding the drivers guiding the reproductive output, clutch size was influenced by genetic origin—especially the Greek component. Hatching success (i.e., defined as the percentage of live hatchlings per nest) was also influenced by nest origin, suggesting lower reproductive performance in RMU admixed hatchlings. By integrating genomic and field data, we propose three stages in the colonisation of new nesting areas: 'sporadic nesting', 'incipient colonisation', and 'population establishment'. Considering female curved carapace length and associated reproductive strategies, our results indicate that the new colonisation is driven by both early-maturing neophytes and experienced adults, potentially strengthening demographic resilience. Continued monitoring will be essential to detect the return of locally born individuals—a key indicator of long-term colony viability. Given the nature of the data, this study represents a unique opportunity to explore and characterise the early stages of a new colonisation process in a philopatric and long-lived species. Our findings underscore the value of genomic tools and long-term monitoring for understanding colonisation dynamics and guiding science-based conservation strategies.

AT-SEA ABUNDANCE ESTIMATES OF OLIVE RIDLEY TURTLES IN THE EASTERN TROPICAL PACIFIC

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In the eastern Pacific off Mexico, olive ridley turtles (*Lepidochelys olivacea*) nest on beaches from Sinaloa to Chiapas, either solitarily or in arribada. Three decades of data from La Escobilla, Oaxaca—the main arribada beach in Mexico—indicate that the population of olive ridley turtles in the Mexican Pacific is the largest in the world and exhibits a stable trend. However, these counts represent only a small portion of the species' total abundance. At-sea abundance estimates complement nest counts and provide more detailed information on the species' spatial and temporal variations. This study estimated the abundance of olive ridley turtles (large juveniles and adults) in the eastern tropical Pacific off Jalisco, Colima, and Michoacan, Mexico, using distance-sampling techniques. We covered an area of 70,134 km², extending up to 185 km from the coast, aboard two research vessels in nine cruises conducted between 2010-2012. The study area was divided into coastal and oceanic strata, separated by the 4000-m isobaths. The total survey effort amounted to 8,351 km, during which 2,830 sightings were recorded. The weighted mean abundance in the tropical Pacific off Mexico was estimated at 139,690 individuals (CV=14.56%, 95% CI: 119,745-159,635), corresponding to a density of 1.99 individuals km-2. Compared to the only previous study published using the same methodology, our results suggest that the species is more aggregated in our study area than across the entire eastern tropical Pacific (0.22 individuals km^{-2}). We identified a distinct oceanic-coastal migratory pattern, with aggregates concentrated in coastal areas during the nesting season (July-January) and expanding into pelagic areas the remainder of the year. Our results highlight the tropical Pacific off Mexico as a critical region for the species and suggest that olive ridley turtles may move across the area in response to favorable oceanographic conditions and food availability.

A NATIONAL SEA TURTLE STANDARD RESEARCH METHODS MANUAL*

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All sea turtle species occurring in U.S. waters are protected under the Endangered Species Act of 1973 (ESA) and as such are afforded special conservation status and rely on continued management actions for their recovery. NOAA Fisheries is the federal agency responsible for the management, conservation, and recovery of sea turtles in U.S. waters. Research, guided by sea turtle recovery plans, is an important part of this process as it provides sound scientific knowledge that increases our understanding of sea turtle biology and ecology, allowing for more targeted and successful management actions. Research protocols may vary according to project logistics, species, life history stage, and habitat, complicating scientific research efforts and data comparisons across research studies. We developed the NOAA Fisheries National Sea Turtle Research Standard Methods Manual sourced from regional methodologies employed in the U.S. to provide research protocols that can be implemented broadly for in-water activities where appropriate. We provide an initial compendium of standard research methods, defined as routine and regularly implemented with known impacts and are not likely to change substantially except for minor improvements based on the latest scientific advancements. We provide general information on the purpose and description of each method, relevant information on animal welfare, human training, safety, and example protocols as appendices. A primary goal of this Manual is to help streamline scientific research permit applications, reviews, and approvals required under Section 10 of the ESA and internal Institutional Animal Care and Use Committee (IACUC) research approvals as required under the Animal Welfare Act and other regulations. Additionally, the development of sampling and data collection protocols and methodologies is identified as a key action in recovery plans for U.S. sea turtle populations and management units. This Manual is an important contribution to identifying and describing such protocols. We hope that this document also serves as a reference guide for researchers in other regions of the world. As such, this Manual provides an initial framework for standardized research methods that encourages the collection of comparable data throughout the many regions sea turtles inhabit.

FIRST INSIGHT INTO THE GENOMIC CHARACTERIZATION OF THE EMERGING NESTING SITES IN ITALY*

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Many species are adapting to global warming constraints by changing their distributions to new suitable places. In this context, the loggerhead turtle has started a colonisation process in the western Mediterranean as a new nesting area, with increasing numbers in Italy, Spain and France during the last decade. Under these new circumstances, there is a growing need to provide scientific information to understand this process and to provide basic population parameters to aid management and conservation. However, gathering information is challenging in emerging nesting sites, due to the scattered nature of these events. The LIFE project Turtlenest is using of genomic tools to characterize the new breeding nesting population (males and females) and to determine the origin of the colonizers by analysing adult breeders and hatchlings. Although these techniques have been successfully tested in Spain, its application in Italy, has not yet been explored. In order to fill this gap of knowledge we sampled one hatchling per nest from 67 nests in the regions of Toscana, Lazio, Campania, Sardinia, Calabria and Puglia from 2023 nesting season, 49 additional nests laid in Campania were sampled for the period 2018-2022 and blood or tissue samples were obtained from 16 nesting females or foraging adult individuals, 15 from Campania region and one from Sardinia. All samples were genotyped using 2bRAD and a relatedness analysis was performed to detect familiar relationships among nests and adults. Additionally, individual assignments were performed using a genomic baseline including samples from regular nesting sites in the Atlantic and Mediterranean. Relatedness analyses revealed renesters (females laying more than clutch per year) in all regions except Puglia and Lazio. The analysis of Campania across six nesting seasons indicated the presence of one remigrant (females laying nests in different nesting seasons), suggesting that returning individuals are starting to be present at least in this region. Furthermore, the comparison of this data with an available dataset of 57 nests and 13 females from Spain sampled between 2001 and 2023 revealed no connection between the nesting activity in the two countries. The individual assignments revealed that the colonisers arriving to Italy came almost exclusively from the eastern Mediterranean nesting populations, which contrasts with the colonisation of the Spanish coasts, which is known to include also individuals from Atlantic origin. When analysed at a finer scale, the colonisation of almost all regions was a mixture of individuals coming from Greece and the Levantine regions, with the exception of Calabria that also had a significant contribution from Libya. As a summary, we can conclude that the nesting activity in Italy originated mainly from eastern Mediterranean regular nesting areas, that the connectivity among regions and between countries is very low and that renesters and remigrants are detected, indicating early signs of establishment. Future sampling and genotyping across different years and regions are needed to have a

more comprehensive picture of the emerging nesting activity in Italy. The application of genomic tools is very promising in providing key information on this rising nesting area.

PRECISE NATAL HOMING AND AGE AT MATURITY IN HAWKSBILL TURTLES: RE-VISITING KIN STRUCTURE AT THE JUMBY BAY HAWKSBILL ROOKERY

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The geographic specificity of natal homing influences breeding biology, genetic diversity and habitat range, and therefore has important implications for species resiliency and management. Also, the age at which individuals reach sexual maturity and enter the breeding population is a key parameter for demographic analyses. Research on natal homing and maturation, however, is challenging for long-lived animals that are difficult to observe, such as marine turtles that have complex oceanic life histories. While broad-scale natal homing is well established for marine turtles, the geographic specificity of philopatry is still difficult to ascertain. Plus, estimates of age at maturity vary widely. Previous research on the kin structure of hawksbill turtles sampled from 2010-2015 at Jumby Bay, Antigua, found considerable mother-daughter and full-sibling pairs, providing evidence of precise natal homing to a one-kilometer beach (Levasseur et al. 2021). Here, we revisit this analysis with 51 new nesting hawksbill samples from Jumby Bay, collected between 2016-2021. We genotype our new samples with 12 microsatellite markers and re-run the full-pedigree reconstruction analysis with new and old samples. We update our findings on relatedness, precise natal homing, and time to maturity, showing that time to maturity is shorter than previously estimated. We caution that rookeries like Jumby Bay, with strongly philopatric nesters, might have limited behavioral plasticity and colonization potential, and consequently be at a disadvantage with the growing threat of nesting habitat loss.

AN ANCIENT LINEAGE: GREEN SEA TURTLE ORIGINS AND EVOLUTION

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Over half of living turtle species, members of the distinctive, ~220-million-year-old reptile order Testudines, face extinction. Deviating remarkably from this trend, the green turtle (*Chelonia mydas*) has been moved from a Red List classification of Globally Endangered to Least Concern, because of protection efforts and current understanding of population size, range, habitat, ecology, threats, and conservation actions. To contextualize this qualified success and explore its broader implications for both theory and practice, this review examines the evolutionary history of marine turtles, including the lineage leading to *Chelonia mydas*, with a focus on origins, diversification, phylogenetic relationships, distribution, and abundance. Although debated, there is strong evidence supporting a sister group relationship between turtles and the group crocodiles plus birds within the Reptilia. Living marine turtles display markedly reduced diversity, with only two extant cryptodiran, or hidden-necked, families, and no surviving side-necked, or pleurodiran, lineages. The extinct, often giant, protostegid sea turtles appear to be an early-diverging lineage within a monophyletic (containing a single common ancestor and all descendants)

superfamily, Chelonioidea. The chelonioid lineage, among other turtles, survived the Cretaceous-Paleogene mass extinction ~65 million years ago, although many large reptile groups, including the non-avian dinosaurs, did not. Extant sea turtles, which have existed for millions of years, are all members of this ancient superfamily. Among them is just one mostly herbivorous species, *Chelonia mydas*. Despite major changes in environmental conditions, global ocean connectivity, and population size (e.g., during Pleistocene ice ages), green turtles have persisted in multiple refugia and then shown signs of population expansion following post-glacial warming. Traits such as a wide geographic range, a complex life cycle that often includes long-distance migration and the possibility for resource partitioning, high fecundity, long lifespan, and advantageous morphology have all supported population survival, growth, and expansion. In contrast, pronounced early mortality, delayed maturity, long generation time, and thermal sensitivity tend to increase risk. Temperature-dependent sex determination, homing behavior, and slow molecular evolution have played complex roles along with a largely herbivorous diet based on seagrass and algae. An extended temporal context provides essential insight into the biological, ecological, and environmental factors that have historically aided survival and reduced extinction risk for this conservation-dependent species, informing conservation theory and practice in a human-dominated world.

THE ORIGIN OF JUVENILE STRANDED AND NERITIC SEA TURTLES IN SOUTH AFRICAN WATERS: GENETIC ASSIGNMENT TO NATAL HOME POPULATIONS

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Determining the natal origins of sea turtles in in-water habitats is essential for understanding population connectivity, vulnerability, and the effectiveness of conservation efforts at nesting beaches, but difficult due to their wide dispersal potential after leaving nesting areas. However, natal philopatry and genetic isolation, particularly within maternal lineages, allow useful genetic approaches for identifying source populations. Sea turtles occurring along the South African coast may originate from either of two ocean basins (the Atlantic or Indian Ocean) and any of the regional management units (RMUs) within them. The aim of this study was to identify the population origins of loggerheads and leatherbacks (both nesting in South Africa), as well as non-nesting green turtles and hawksbills that frequent South African waters, using mitochondrial DNA (mtDNA) analysis. This represents the first such effort for these populations, as individuals of nesting species are typically assumed to be local, and information on in-water distributions remains limited. Skin biopsy samples were collected from loggerheads (*Caretta caretta*, n = 64), leatherbacks (*Dermochelys coriacea*, n = 19), green turtles (*Chelonia mydas*, n = 57), and hawksbills (*Eretmochelys imbricata*, n = 21) stranded along the coast, entangled in shark safety gear (bather protection nets), or captured live on foraging grounds between 2006 and 2020. The control region of the mtDNA (expected fragment length ≈880 bp) was sequenced and compared to published haplotypes from nesting females in potentially contributing rookeries (GenBank and literature sources). Measures of genetic diversity, including haplotype (h) and nucleotide (π) diversity, were calculated for each rookery. Phylogenetic relationships were inferred using haplotype networks, which were also used to identify potential source populations of individual turtles. Sample sizes for loggerheads and green turtles were

sufficient to estimate the relative contributions of contributing rookeries. Patterns of origin and diversity along the South African coast differed among species. Most stranded or bycaught loggerheads and leatherbacks originated from South African rookeries, which exhibited notably low haplotype diversity relative to other global populations. However, we also found evidence of long-distance migrants: one loggerhead stranded in Cape Town was assigned to the Oman population, another to Western Australia, and one leatherback likely originated from eastern India—representing the first evidence of connectivity with these regions. Non-nesting green turtles predominantly belonged to the Southern Mozambique Channel (Juan de Nova and Europa) clade, although one individual originated from East Atlantic rookeries. Non-nesting hawksbills appeared to originate mainly from the Seychelles and Chagos Archipelagos. While sample sizes for leatherbacks and hawksbills were small, and stranded or bycaught individuals may not fully represent populations, these findings provide important first insights into population connectivity in South African waters. Overall, the results demonstrate that South African waters support both resident and transient turtles from multiple RMUs, reveal long-distance migration between recognized RMUs, and function as developmental foraging grounds for regional green turtle and hawksbill populations.

TURNING THE TIDE… BACK? GLOBAL SEA TURTLE POPULATION TRENDS AFTER DECADES OF CONSERVATION*

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Sea turtles are widely recognised as conservation-dependent species because of their slow growth, late maturity, wide-ranging migrations, use of multiple habitats and extensive anthropogenic threats they face across all ocean basins, necessitating long-term protection to maintain population viability. After decades of substantial conservation investment, particularly at nesting beaches and foraging habitats, it is critical to ask the question whether these efforts have translated into enduring population recovery? Multiple global databases have been developed to evaluate population status and trends, most notably the Living Planet Index (LPI) and the IUCN Red List, as well as a few recent publications comparing global trends. The IUCN Marine Turtle Specialist Group (MTSG) also coordinated several "Burning Issues" processes, including the recent Conservation Priorities Portfolio re-evaluation, which combined empirical data and expert judgment to answer this key question. Building on the LPI framework, we combed through literature and reports and collated 4,606 nesting records (1956–2022) for all 7 sea turtle species, representing 304 rookeries across 43 Regional Management Units (RMUs) globally. To standardise diverse data types, all trends were expressed as nesting females per rookery, using consistent nest-to-female conversion factors. Instead of relying on smoothed curves, we applied a modelling approach using the Multivariate Autoregressive State–Space (MARSS) framework to estimate RMU-level and their aggregated species-level trajectories. Each RMU's abundance was modelled as a random walk in logarithmic space over time, incorporating both process and observation error. Resulting RMU trends were then clustered using the R package cluster to identify groups exhibiting similar temporal patterns, and the average rate of change was compared over all years and recent trajectories (since 2010) separately to detect emerging shifts. Three main insights emerged. First, sea turtles benefit from a portfolio effect, where the diversity of populations and rookeries within a species stabilises overall abundance for the RMU or species. Second, four species showed increasing global trends, two were stable, and one was in decline. Third, and perhaps most concerning, while long-term data reflect widespread recovery since the 1980s, recent patterns reveal signs of stabilisation or renewed decline, particularly within one of the four major ocean basins (Pacific, Atlantic,

Mediterranean, and Indian) despite conservation. Collectively, these results suggest that while global conservation measures have yielded tangible gains, the momentum of recovery may be slowing. The reason for this plateauing is uncertain, and it may signal that populations have reached carrying capacity somewhere in their life history per habitat, or that threats have shifted either in distribution or cause. The evidence points to a need for renewed vigilance and regionally tailored strategies to prevent a reversal of progress. In essence, the tide that once seemed to turn in favour of sea turtles may now be turning back, signalling a critical juncture for their continued recovery.

GENETIC DIVERSITY, DEMOGRAPHIC HISTORY, AND FORAGING ECOLOGY IN TWO CONTRASTING LEATHERBACK POPULATIONS*

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Leatherbacks (*Dermochelys coriacea*) are unique amongst other sea turtle species, they are genetically distinct as the only extant individual in Dermochelyidae, and use a wide range of marine environments, mostly foraging in pelagic waters. Globally, leatherback populations vary in both population size and migration. In the Northwest Atlantic (NWA), the Florida subpopulation has increased in recent decades and typically migrates northward after nesting. Comparatively, the Southwest Indian Ocean (SWIO) population has remained stable over the past 50 years, with individuals showing more variable movements going north and south after nesting. What is unclear is whether the difference in abundance is from human pressure or natural variation in the environment, and how foraging ecology might play a role. To address these differences in contrasting leatherback populations we investigated current genetic diversity, past population trends, and foraging behavior. Restriction-site associated DNA sequencing of over 10,000 single nucleotide polymorphisms was used to estimate levels of nucleotide diversity and effective population size across recent (~100 generations) and historical (>1,000 generations) timescales. Genetic diversity in the SWIO was lower than in Florida leatherbacks. The Florida population (~ 250 individuals) was larger than the SWIO (~ 140 individuals), with effective population size remaining stable over the last 60 years. Stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope analyses indicated distinct clustering, possibly representing specific foraging area use across oceanic regions for both Florida and SWIO populations. Decadal trends in isotope values showed cyclical changes, likely reflecting baseline isotopic variation, with a stronger temporal signal in Florida than the SWIO. The isotopic niche for leatherbacks in Florida was slightly smaller, possibly indicating a more limited geographic range in foraging areas. The lower population size in the SWIO is likely a result of historical factors like a small founder event, limited connectivity, and small population size over time rather than differences in foraging ecology. Genomic and stable isotope data are complementary tools that can be used for understanding conservation outcomes in sea turtles.

EXPLORING THE POPULATION GENETICS AND STRUCTURE OF CRITICALLY ENDANGERED HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) FORAGING OFF THE COAST OF FLORIDA

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Understanding the distribution of different populations of highly migratory species is crucial for identifying threats and delineating critical habitats. Foraging aggregations of a sea turtle species can consist of individuals from many nesting regions. The genetic makeup of these foraging grounds can provide information regarding the population connectivity and geographic range of contributing nesting populations. Also, combining information on disease can show possible origin. This study integrates high-resolution genomic and mitochondrial DNA to examine the origin of critically endangered hawksbills foraging off the coast of Florida, USA, an area that has individuals from multiple rookeries across the wider Caribbean and Atlantic. We used mitochondrial DNA (mtDNA) control region sequences from 88 individuals in comparison with published data to identify contributions from populations with known haplotype frequencies. Single nucleotide polymorphisms (SNPs) generated from restriction site-associated DNA sequencing was used to estimate genetic diversity and differentiation among the foraging aggregation. Preliminary findings indicate a new nesting haplotype from Brazil was found in foraging turtles in Florida, expanding the known habitat range for this population. The PCA data from mtDNA data revealed more differences among foraging groups compared to RADSeq, suggesting that grouping can reflect nesting ground origins. Additionally, 22% of individuals tested positive for tumor-associated herpesvirus (ChHV5) through qPCR. While this virus is not known to affect this species to the same degree as green turtles, hawksbills could act as a vector transporting it across their migration routes. The complementary approaches of RADSeq and mtDNA give a more comprehensive understanding of the population dynamics and connectivity of hawksbills, ultimately contributing to their effective conservation management.

GENOMIC FRONTIERS IN GREEN SEA TURTLE CONSERVATION: MONITORING THE ENDANGERED MEDITERRANEAN POPULATION AND ITS BREEDING DYNAMICS*

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The Mediterranean population of the green turtle (*Chelonia mydas*), confined to the eastern basin, is classified as Endangered by the IUCN. Within this region, the small Israeli nesting aggregation represents

a critical source of genetic diversity and underscores the ecological importance of Israel's Mediterranean coastline. Satellite tracking and genetic studies indicate that many migratory routes of Turkish and Cypriot turtles traverse Israeli waters, positioning this area as a central corridor within the connectivity network of Mediterranean green turtles. Our laboratory has developed a novel DNA analysis approach that enables precise determination of kinship, first applied to the local green turtle breeding stock. By combining large-scale genomic data with mitochondrial DNA haplotyping, this integrated molecular framework provides unprecedented resolution for individual and familial identification. Applied to 320 DNA samples collected over a decade from dead hatchlings, it allowed us to identify nesting females individually, revealing more than 50 distinct females—far exceeding previous estimates based on tagging or observation. This approach revealed unexpectedly high genetic diversity, frequent multiple paternity, and extensive dispersal among nesting females. Long-term genetic monitoring of 100 nests enabled us to examine breeding habits, confirming previously reported behaviors and uncovering new ones. We found molecular evidence for both sperm storage and multiple paternity. Analysis of paternal genotypes indicated the participation of approximately 80 different males in the studied mating events. Female philopatry was also detected; however, in some cases the same female nested up to 90 km away, highlighting an evident evolutionary advantage of spatial risk management. Remarkably, recurring nesting events of individual females occurred on nearly the same calendar date, even three or four years apart. The species' reproductive flexibility was further demonstrated by females nesting in successive years. Kinship analysis also indicated an absence of detectable inbreeding. Applying this approach to a less transient population of the Nile softshell turtle, *Trionyx triunguis*, yielded similar results, raising the intriguing possibility of kin-recognition mechanisms in turtles, a hypothesis now under investigation. These results establish the first genomic baseline for Mediterranean green turtles and demonstrate the strength of combining mtDNA and genome-wide SNP data for conservation monitoring. By identifying key breeders and quantifying genetic contributions across generations, our work provides a framework for evidence-based management and the maintenance of genetic diversity in a small, vulnerable population. Ultimately, this integrative genomic approach enhances our understanding of connectivity, reproductive strategies, and resilience in *C. mydas*, knowledge essential for guiding conservation policy and ensuring the long-term viability of one of the most threatened marine turtle populations in the world.

ESTIMATION OF AGE STRUCTURE IN FORAGING AGGREGATIONS OF GREEN TURTLES IN OKINAWA, JAPAN

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In recent years, intensified grazing pressure associated with the rapid growth of green turtle (*Chelonia mydas*) populations has resulted in a significant decline and desertification of seagrass meadows in Okinawa, Japan. To develop effective management strategies that promote coexistence between green turtles and seagrass ecosystems, it is essential to clarify the population structure, including age composition, of turtles utilizing these habitats. While previous studies have identified the natal origins of foraging turtles in Okinawa, age structure remains insufficiently understood, despite its importance for linking nesting population trends with foraging aggregation abundance. In this study, we estimated the ages of green turtles that stranded dead around the Yaeyama Islands and Kume Island, Okinawa Prefecture, using skeletochronology of humeral bone sections. A regression equation between straight carapace length (SCL) and age was established, and the age structure of foraging aggregations was inferred from the SCL

distribution of turtles observed in seagrass meadows. To verify the accuracy of the age estimates, we compared them with the known ages and growth records of captive green turtles reared at the Okinawa Churaumi Aquarium. Between 2016 and 2025, humeri from 116 turtles (SCL 36.5–95.5 cm) were collected. Each humerus was dried, sectioned into 3-mm slices using a high-speed saw (Isomet, Buehler), embedded in paraffin, and then cut into 25 μm thin sections using a rotary microtome (RM2145, Leica). The sections were stained with hematoxylin, and lines of arrested growth (LAGs) were observed and counted under a light microscope. For older individuals in which the innermost LAGs were resorbed, back-calculation methods were applied to estimate and compensate for the missing early growth marks. To date, analyses of 30 samples have been completed. Preliminary results indicate that the smallest foraging individuals (SCL 35–40 cm) inhabiting the Yaeyama region were estimated to be 3–4 years old. Furthermore, age estimates and growth trajectories up to approximately 10 years of age closely matched those of two captive individuals fed daily at 2% of their body weight. In this presentation, we will provide updated results based on additional analyses and discuss the age structure and growth characteristics of green turtles inhabiting the Okinawa Islands region.

A MULTIMODAL NETWORK MODEL FOR ANATOMICAL SEGMENTATION AND INDIVIDUAL IDENTIFICATION OF SEA TURTLES*

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Sea turtle species represent important bioindicators in marine ecosystems, contributing to the ecological balance and biodiversity of oceanic environments. Effective conservation of these species requires accurate methods for monitoring populations and understanding individual behavior, health, and migration patterns. Photo-identification (PhID) has emerged as a valuable approach for individual recognition through the analysis of unique morphological patterns present on the facial scales. However, traditional and semi-automated PhID methods depend on image quality, the manual selection of the anatomical region containing the morphological pattern, and manual comparison of facial scales and carapace scutes, which limit scalability and accuracy in large datasets. In this work, we propose a multimodal deep learning network model focused on the morphological identification of sea turtles, with two components: a preprocessing stage and a semantic segmentation framework for generalization and automatic promptable semantic segmentation. The preprocessing stage performs a visual isolation of the sea turtle from its natural environment by distinguishing between background elements—such as sand, objects—and the sea turtle's body. This process enhances the morphological inner and outer edges to emphasize the natural anatomical patterns, which improves the model's accuracy to detect and analyze geometric patterns of facial scales and scutes. Following preprocessing, we implement an automatic promptable semantic segmentation framework, based on the Segment Anything Model (SAM) and multimodal network architectures that integrate visual and textual representations. This workflow allows pixel-level segmentation and classification of distinct anatomical regions, including the head, carapace, and flippers. Each segmented region is treated as an independent region of interest (ROI), facilitating targeted feature extraction and comparison. The multimodal nature of the network enables the use of both visual descriptors and natural language-based prompts to refine semantic segmentation and improve generalization across different capture conditions, species, and perspectives. This integration of natural language-guided semantic segmentation represents an advancement over conventional convolutional models, as it introduces contextual understanding into the morphological analysis process. Once the ROIs are extracted, the model generates digital morphological signatures through geometric and textural feature analysis. These signatures are compared across individuals to identify consistent and distinctive morphological traits. Evaluations on field-collected image datasets from nesting sites in Colola and Rancho Nuevo demonstrate

high precision and sensitivity in the identification process. Results indicate that the multimodal architecture consistently classifies relevant anatomical regions and achieves strong generalization performance across individuals, maintaining high consistency in the recognition of distinctive morphological patterns. This work provides a scalable, non-invasive technique that supports long-term ecological monitoring and conservation efforts. By enabling automated identification of individuals across different nesting sites and seasons, the system contributes to understanding population dynamics, migration routes, and species health—ultimately advancing data-driven strategies for the preservation and sustainable management of sea turtle populations.

GENOMIC INDICATORS OF RISK AND RESILIENCE IN GLOBAL LEATHERBACK TURTLE POPULATIONS*

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Leatherback turtle abundance has declined in many places around the world from anthropogenic threats such as direct harvest and fisheries bycatch, with some populations losing over 90% abundance over the past 30-50 years. While conservation efforts have generated success stories for other sea turtle species, results in leatherback turtles have been mixed, with some populations showing evidence of stabilization while others continue to decline. The reasons for these differential responses are unclear, but could relate to legacies of historical demographies, life history traits, environmental and resource variability, and/or genetic factors such as inbreeding depression or accumulation of deleterious variants that negatively affect fitness (e.g., lower hatching success). Studies in other taxa of conservation concern have demonstrated that inbreeding depression and loss of genetic diversity can strongly impair population recoveries, but species

can vary widely in their sensitivity or resilience to these factors. Therefore, understanding the genetic health of leatherback turtles and how it connects with population sizes and trajectories, and demographic history is important to forecast future persistence under different conservation scenarios. Here, we combined long-term population monitoring assessments with whole-genome resequencing data (n=238) and genome-wide SNPs produced from reduced representation sequencing data (n=637) across globally representative leatherback management units (MUs) to quantify the effects of population status on genomic diversity, inbreeding, and genetic load. We also leveraged samples collected from select MUs over multiple time points (Eastern Pacific Mexico and the U.S. Virgin Islands) with well-documented recent demographic trends to examine for evidence of genomic erosion (i.e., changes in genetic diversity, inbreeding or genetic load over time) or resilience that may impact their long-term persistence. We evaluated global population structure, confirming likely demographic independence among most previously established MUs. We then used MUs and sample collection year to assign groupings for population size and trend in downstream analyses. First, using linkage disequilibrium-based estimation methods we observed that smaller, stable populations generally exhibit relatively stable effective population sizes (Ne) over the past 1,000 years, compared to larger declining populations that display more pronounced fluctuations in Ne over a similar period. Secondly, we find that small stable populations exhibit significantly lower genomic diversity (measured as genome-wide heterozygosity) and higher inbreeding coefficients (via runs of homozygosity), consistent with long-term small population sizes and limited gene flow. Additionally, although total genetic load tends to be higher in small populations than in larger ones, small populations also show clear evidence of purging the most harmful alleles. Finally, we find no evidence of genomic erosion over recent decades in populations that experienced strong declines, suggesting that genomic metrics likely reflect processes occurring over longer time scales relative to the demographic indicators currently used in population status assessments. Collectively these results offer insight into how genetic factors may influence leatherback recoveries now and into the future - offering both hope of potential natural mechanisms of resilience with continued conservation efforts and guidance for interventions such as genetic rescue and translocations.

FINER-SCALE MITOCHONDRIAL DNA MARKERS UNRAVEL THE ORIGIN AND GENETIC DIVERSITY OF GREEN TURTLES IN COASTAL BRAZILIAN FORAGING AREAS

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Many aspects of sea turtle biology are challenging to assess due to the species' migratory and cryptic nature, and this lack of information can obfuscate basic biological understanding and hinder conservation efforts. Characterizing migratory routes and identifying the populations contributing to foraging aggregations are essential for effective management. Therefore, this study aims to unravel the diversity and origin of green turtles (*Chelonia mydas*) along the Brazilian coast. We sequenced a fragment of the mitochondrial DNA (mtDNA) control region (CR) and a series of repetitive sequences present at the end of the mtDNA CR (mtSTR) from individuals sampled in nine foraging grounds along the Brazilian coast (n=423), and compared them with sequences from seven nesting areas (n=726). The most commonly found mtSTR haplotypes were CM-A8/7-12-4-4 (20.5%) and CM-A5/7-12-4-4 (14.4%). The former is widespread across Atlantic nesting populations, and the latter is exclusive to Caribbean rookeries. mtSTRs revealed higher genetic diversity than the CR alone, providing increased resolution in mixed-stock analyses. There was no significant genetic structuring among the Brazilian foraging areas, although haplotype frequencies differed between northern and southern sites. Genetic diversity was high for foraging areas, ranging from 0.822 to 0.954 (average=0.915) and moderate for nesting areas, ranging from 0.081 to 0.917 (average=0.653) when combining the mtDNA CR and mtSTRs. Mixed-stock analysis indicated that Ascension Island (UK) contributes most to the foraging areas along the Brazilian coast and that, despite ocean currents, there is migratory flow between Caribbean/North Atlantic rookeries and Brazilian foraging grounds. In contrast, the Brazilian nesting areas of Trindade and Atol das Rocas contribute little to regional foraging sites, possibly due to their small population sizes compared to Ascension Island and Caribbean rookeries, as well as marine current patterns. Both Fernando de Noronha and coastal African rookeries also give only small contributions to foraging grounds along the Brazilian coast. Overall, the data support the hypothesis that population size, ocean currents, and juvenile natal homing behavior shape connectivity between foraging and nesting areas in the Southern Atlantic. This genetic characterization highlights the need to conserve not only Brazilian foraging grounds but also the multiple nesting areas that contribute to these mixed stocks. By providing the first genetic characterization of nine foraging areas using mtSTRs, this work reveals the genetic diversity and connectivity of Brazilian foraging grounds, substantially expanding our knowledge of green turtles in the Southern Atlantic.

IS FORAGING SITE HERITABLE? INVESTIGATING LOGGERHEAD FORAGING SITE SELECTION THROUGH WHOLE GENOME ANALYSES*

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Site fidelity is observed across sea turtle species, commonly among female turtles returning to their natal beaches to nest. Beyond the beach, loggerheads (*Caretta caretta*) in the western North Atlantic show high fidelity to a foraging site between nesting migrations. These sites often contain a mix of individuals originating from different nesting beaches. Given the selective pressure to locate reliable foraging habitat, the lack of parental care or social cues, and high observed site fidelity, the information needed for individual turtles to locate a foraging site may be maintained through heritable components. The goal of this study was to integrate spatial and genomic data to investigate whether foraging site selection among mature female loggerheads may be guided by heritable genomic variation. To understand potential genomic drivers of foraging site selection and fidelity, we collected tissue samples from female loggerheads nesting at two rookeries in Florida, USA: Keewaydin Island (KEY) on the Gulf coast and Melbourne Beach (MEL) on the Atlantic coast. Satellite telemetry and stable isotope analyses revealed that after nesting, females from these rookeries migrate to distinct foraging regions including the Subtropical Northwest Atlantic, Mid-Atlantic Bight, and the Gulf of Mexico. We extracted DNA and conducted whole genome resequencing from 132 nesting turtles (n=50 KEY, n=82 MEL) with known foraging destinations. After assessing population structure, we identified genomic regions with outlier Fst values among foraging groups and the associated candidate genes. Our results indicate that several regions of the genome differ among individuals that migrate to different foraging sites, suggesting that migratory behavior is a polygenic trait. Functional analyses further revealed that these divergent regions contained genes related to DNA repair and brain function, cell growth, and heart function, among others. The genomic variants that differ among foraging sites may be important conservation targets for maintaining both genetic and behavioral diversity, as well as adaptive potential to environmental change in this highly migratory species.

DENSITY AND ABUNDANCE ESTIMATES OF GREEN TURTLES IN THE SAUDI ARABIAN RED SEA*

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Effective management and conservation of sea turtles is often constrained by a lack of knowledge of at-sea distribution and abundance. While nesting beaches are typically well-documented, and abundance of nesting females can be determined with relative ease, counting sea turtles at sea presents challenges due to their widespread distribution and cryptic habits. To estimate abundance and density of sea turtles in the Red Sea waters of Saudi Arabia in 2022, we conducted strip-transect aerial surveys using an Airbus H125 helicopter based off the research vessel OceanXplorer. Surveys covered ~66% of shallow water habitats (within the 200m bathymetry contour) and counted sea turtles and dugongs, other marine mammals, sharks, and rays. A data recorder and two observers participated in each sortie, with personnel limited due to endurance and space. The helicopter was fitted with a reference strut to delineate a 400m transect width, and the survey area was divided into four distinct zones based on vessel deployment and logistics. Flights were oriented in an E-W direction to minimise glare, and environmental data were collected to determine influences on detection. Flights usually lasted ~ 3 hours and were generally conducted between 0700 and 1300 as weather usually deteriorated in the afternoons. Waters were generally extremely clear given the lack of terrestrial runoff and the extensive fringing reef system along the Red Sea. Abundance estimates for green turtles were derived from visual records by two observers (one on each side of the helicopter) taking into account perception bias (whether a surveyor sees a turtle that is available) and detection bias (whether a turtle was available to be seen). Perception bias estimates were sourced from existing literature. Detection bias estimates were derived from time-depth data for 10 green sea turtles deployed in the northern Red Sea. There were insufficient hawksbill sightings to make any extrapolation meaningful. Extrapolating from the survey zones, our results suggest an abundance of ~200,000 (20.7 CV) green sea turtles potentially present between the 200m bathymetric contour and the shore. However, there was a statistically significant relationship between turtle location and proximity to coral reefs, with over 90% of turtles found within 3,500m of coral reef structures (whether coastal fringing reefs, barrier reefs or atolls). Adjusting for this substantially smaller buffer area we estimate ~95,000 turtles within the proximity of reef structures. Repeated over time, these surveys can help identify changes in population structure, distribution and abundance, and inform conservation and management agencies.

POPULATION MODEL PREDICTS LIMITED CAPACITY FOR MALE BREEDING ECOLOGY TO MITIGATE FEMINIZATION OF SEA TURTLE POPULATIONS DUE TO INCREASING INCUBATION TEMPERATURES*

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Climate change is steadily increasing the temperatures in sea turtle nests on beaches. This affects sea turtle hatchlings in two major ways. First, sea turtles have temperature-dependent sex determination, such that warmer nests produce female-biased hatchling cohorts. Second, hatchling survival is reduced as nest temperatures increase, up to an upper lethal threshold. How warming conditions will affect turtle population dynamics will depend on the shapes of those two temperature-dependent relationships, as well as the 'mating function' – the relationship between the sex ratio of adults available to mate and population reproductive success. In general, we expect populations to be more resilient to warming temperatures if they have a mating system in which each male is able to mate with multiple females, and if the thermal reaction norm for sex determination is such that some male hatchlings are still produced at warmer temperatures. However, the sensitivity of population dynamics to these interacting nonlinear relationships is not well understood. We used a two-sex, age-structured model to simulate the population dynamics of a green sea turtle (*Chelonia mydas*) population under a combination of scenarios. These included a full range of possible future temperature scenarios based on IPCC forecasts, a range of possible mating function shapes, and both a narrow and a broad sex-determination thermal reaction norm, both based on literature estimates from field studies of green turtle populations. The model included both demographic and environmental stochasticity, and we evaluated population persistence over a 100-year time horizon. In general we found that scenarios with wider thermal reaction norms (that produce more male hatchlings at higher temperatures) were more likely to support population persistence. Scenarios with mating functions in which males are highly promiscuous were also more likely to support persistence, but only if the thermal reaction norm was very narrow. However, in most cases, the temperature-mediated hatchling survival function had a greater effect on population persistence than did hatchling sex ratio. The model analysis also revealed that the hatchling sex ratio that maximizes the population growth rate (and minimizes the risk of extinction) is highly female-biased. Together these results suggest that 1) better quantifying temperature-mediated hatchling survival should be a higher research priority than quantifying the thermal reaction norm for sex determination, and 2) conservation efforts focused on nest cooling should aim for a slightly female-based sex ratio rather than an equal ratio of male and female hatchlings.

USE OF PHOTO-IDENTIFICATION FOR DETERMINING THE BASKING POPULATION SIZE OF HONU (*CHELONIA MYDAS*) AT HOʻOKIPA BEACH

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Basking behavior is globally rare and only known to regularly occur in four places globally, and solely by the green turtle, *Chelonia mydas*. Because of this rarity, very little is understood about basking behavior. The Maui County Beach Park of Hoʻokipa Beach, Maui, Hawaiʻi, USA represents a locally important basking site for Hawaiian green turtles (known as 'honu'). Due to the regularity with which high numbers of honu (<150) can be observed basking at Hoʻokipa throughout the day/night, the beach has become popular with visitors and residents, with upwards of 700 people on the beach each day. This has caused clashes between community members and visitors for use of the beach that is a popular spot for surfing, snorkeling, and fishing. As such, community monitoring and education outreach regarding honu have been conducted for the past 17 years in an effort to create a safe place for all viewers and the honu. Community members and visitors alike often ask questions about honu habits, particularly whether the same individuals are observed basking each day at Hoʻokipa. We chose photo-identification of individuals as the best, non-intrusive method to determine individual basking habits and frequency of re-sightings. Over the course of three months (July-September 2016), photographs of each turtle as it emerged onto the beach to bask were taken every four days between 0700 and 1900 using a Canon EF 75-300 mm f/4-5.6 telephoto lens. Only photos of the right side of the head were used in this analysis, since they could be reliably obtained due to the geography of Hoʻokipa and our goal to not disturb the honu. Images were imported into Image Based Ecological Information System (IBEIS) software for analysis. We cropped images within IBEIS to create 'chips' of only the turtle's head aligned with the ground. We used IBEIS's ranked match system to determine the 5 most likely matches for each image, visually confirming each match. Using this approach, we identified 156 different individuals basking at Hoʻokipa. We also used the frequency of sighting individuals to construct a mark-recapture analysis, with the individual days as our sampling interval. Using MARK, we estimated Hoʻokipa to have between 159 and 171 basking honu during this timeframe based on a closed captures analysis with equal probability of capture and recapture. This is a sizable population of basking turtles, especially since the majority of basking at Hoʻokipa occurs within an area less than 100 m2. Future studies will apply these modern techniques to the project's historical photographs, continuing cataloging basking honu across seasons and years. These data provide a baseline for investigating other aspects of honu basking, such as site fidelity, movements to other basking beaches over different temporal scales, and correlation of basking frequency with environmental variables. Our results offer valuable information regarding this understudied behavior of honu while also providing conservation managers with data for future actions. Finally, this project helps bridge the gap between community members and visitors by demonstrating proper honu observation and photography, while effectively communicating insightful scientific findings.

UNDERWATER IMAGE RESTORATION FOR SEA TURTLE PHOTO-IDENTIFICATION

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On the surface, sunlight appears as white light; however, it is a mixture of colors within the visible spectrum: red, orange, yellow, green, blue, and violet (ROYGBV). When light travels underwater, several factors alter its composition. As depth increases, long-wavelength colors such as red and orange are absorbed first, which causes underwater images to lose warm tones. In contrast, short-wavelength colors like blue and green penetrate deeper, resulting in images with a strong bluish or greenish colors. Another factor affecting image quality is the presence of suspended particles in the water. These particles scatter and reflect light multiple times before it reaches the camera sensor. As a result, unlike photographs captured in air, underwater images often exhibit low-quality features, including reduced contrast, blurred edges, and color distortion. These degradations make it difficult to perform underwater vision tasks accurately, such as object detection, species recognition, and particularly photo-identification of sea turtles. Sea turtle images taken at the surface are generally clearer, however, conducting photo-identification only on nesting beaches limits the dataset to adult females. Capturing photographs underwater, on the other hand, enables the identification of juvenile and male individuals, providing a more comprehensive view of the population structure. Therefore, improving the quality of underwater multimedia material is crucial to ensure accurate and reliable identification of sea turtle individuals. To address these limitations, in this work we present the application of an Automatic Underwater Image Restoration algorithm as one of the important stages within our Photo-Identification system. With the algorithm implemented at this stage, photographs of sea turtles taken underwater in various environmental conditions, at different depths, with lighting that varies according to depth and time of day, as well as different levels of water turbidity, are automatically restored. This algorithm uses an automatic adaptive depth field method with monocular depth estimation. With this algorithm, our Photo-Identification system does not require manual adjustments or especial equipment to capture depth distances in order to perform specific processing on the photographs. The application of an underwater image restoration algorithm as an initial stage of our sea turtle Photo-Identification system has demonstrated a significant impact on both visual image quality and the overall performance of individual identification. Automating this stage substantially reduces the human effort traditionally required in manual and semi-automated workflows, while simultaneously increasing the consistency and robustness of image processing under highly variable underwater conditions. Beyond visual enhancement, the obtained results indicate that systematic image restoration directly contributes to an improved capacity for the individual identification when compared to conventional procedures that do not incorporate restoration. This improvement is associated with the preservation and enhancement of critical morphological features, such as facial patterns, scale configurations, and contour structures that are essential for reliable individual matching. The quantitative analysis conducted confirms that the inclusion of this initial restoration stage consistently strengthens the performance of the Photo-Identification system, particularly in scenarios where image quality constrains traditional approaches.

STEREO-VIDEO DERIVED MORPHOMETRICS TO PREDICT BIOMASS OF SEA TURTLES

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Accurate biomass estimation is essential for understanding individual condition and population dynamics in sea turtles. Because body mass data are difficult to obtain from wild individuals, length–weight relationships are often used, but simple univariate models can be limited in accuracy. Remote photogrammetry provides a non-invasive alternative for collecting morphometric data, especially for sensitive or hard-to-capture species. This study evaluated which remotely measured morphometric parameters most accurately predict biomass in healthy green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles temporarily held in rehabilitation centers in Florida, USA. Using a stereo-video camera (SVC) system, we obtained 14 morphometric measurements from the carapace, flippers, and head regions, compared them to physically measured morphometrics, and physically measured biomass. Measurement accuracy was assessed for 72 individuals (juveniles n=42, subadults n=23, adults n=7) using mean percent bias (MPB) and standard deviation of percent bias (SDPB). We developed three machine learning models, generalized linear models (GLM), Random Forests (RF), and XGBoost (XGB), to predict biomass, and evaluated performance using RMSE, R^2, and mean absolute percent error (MAPE). Remote morphometrics exhibited low overall bias (MPB = 1.47%, SDPB = 11.1%), though errors were higher for body depth (MPB = 6.98%, SDPB = 13.3%) and rear flipper widths (MPB = 5.93%, SDPB = 20.9%). Our proposed framework uses machine learning combined with the least absolute shrinkage and selection operator (LASSO) to select the best subset and model. Overall, the RF model performed best compared to XGB and GLM. The RF complete model with 14 morphometrics (MAPE = 8.44%, RMSE = 7.38, R-squared = 0.95) was slightly better than a smaller model with seven morphometrics (MAPE = 8.91%, RMSE = 7.67, R-squared = 0.96), identifying straight carapace length (SCL) and head depth (HD) as the most informative predictors across species. By halving the morphometric features, we were able to maintain excellent predictive performance. Our findings highlight that incorporating multiple morphometrics beyond body length improves the accuracy of remotely derived biomass estimates, supporting non-invasive monitoring of sea turtle health and condition. Our study can be used to inform the priority of morphometric data collection for studies seeking to estimate biomass remotely. Predictive machine-learning models, which leverage existing biomass data, can advance the use of estimated biomass in sea turtle research globally.

NATAL ORIGIN OF HAWKSBILL TURTLES FROM COROA VERMELHA ISLAND, NOVA VIÇOSA, BA, BRAZIL

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Brazil hosts some of the most important nesting and foraging habitats for the hawksbill turtle *Eretmochelys imbricata* (Linnaeus, 1766) in the South Atlantic. Major nesting areas occur along the northern coast of Bahia and Sergipe and the southern coast of Rio Grande do Norte, while key foraging grounds include Fernando de Noronha (PE), Rocas Atoll (RN), and the Abrolhos Bank (BA). Despite this strategic importance, genetic connectivity between nesting and foraging areas along the Brazilian coast remains poorly understood, limiting the effectiveness of conservation planning for this critically endangered species. This study aimed to determine the natal origin of hawksbill turtles foraging at Coroa Vermelha Island, Nova Viçosa (Bahia), a coastal area adjacent to the Abrolhos Bank, using mitochondrial DNA (mtDNA) control region sequences. Blood samples were collected from 25 individuals captured during field expeditions conducted by the *Chelonia mydas* Project (Marcos Daniel Institute) between January 2020 and July 2024. Samples were obtained from live turtles using cast nets, preserved in liquid nitrogen, and stored at −80 °C. Genomic DNA was extracted, and an ~800 bp fragment of the mtDNA control region was amplified using primers LCM15382 and H950. Sequences were edited and classified following the haplotype nomenclature proposed by Arantes et al. (2020). Of the 25 samples, 22 were analyzed; three sequences corresponding to hybrid individuals were excluded. Three haplotypes were identified: EiA01 (N = 20), EiA09 (N = 1), and EiA32 (N = 1). Haplotype diversity (Hd) was low (0.17749), and nucleotide diversity was 0.00137, likely reflecting both regional oceanographic influences and the limited sample size. Mixed stock analysis indicated that 95.5% (21 of 22) of individuals originated from Brazilian nesting populations, primarily from Rio Grande do Norte, Ceará, Sergipe, and Bahia. All haplotypes belonged to the Atlantic I and Atlantic II clades, with EiA01 being dominant, supporting its proposed status as an ancestral haplotype widely distributed across Western Atlantic and Caribbean rookeries. These findings highlight Coroa Vermelha Island as an important foraging area predominantly used by hawksbill turtles originating from Brazilian nesting stocks, reinforcing the strong demographic connectivity between coastal foraging habitats and national nesting beaches. This connectivity underscores the need for integrated conservation strategies that link nesting beach protection with the management of foraging grounds, particularly in regions subject to coastal development, fisheries interactions, and reef degradation. Expanding genetic sampling at Coroa Vermelha Island and adjacent areas, such as the Abrolhos Archipelago and northeastern Brazilian reef systems, will improve resolution of stock contributions, support regional management units, and enhance conservation decision-making for hawksbill turtles at both national and Atlantic basin scales.

IDENTIFICATION AND DESCRIPTION OF NUCLEAR DNA HAPLOTYPES OF SEA TURTLE SPECIES INVOLVED IN INTERSPECIFIC CROSSING

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Sea turtles are crucial to the ocean's health, as they have a direct impact on other species and various ecological interactions. Most species are at some level of threat according to the IUCN, aggravated by human actions that generate environmental impacts and can lead to interspecific breeding, detrimental to the species' perpetuation. The Brazilian coast has the highest known rate of sea turtle hybridization in the world. The present study aimed to identify new reference haplotypes for species involved in interspecific crosses, using nuclear (nDNA: RAG1, RAG2, and CMOS) and mitochondrial (mtDNA: control region) genetic markers. Previous studies showed the existence of 16 nuclear haplotypes undescribed in the literature (RAG1=6; RAG2=2; CMOS=8), which prevents the confirmation of hybrids. The biological material used in the study was collected from pure individuals morphologically identified as *Caretta caretta* (N=40), *Chelonia mydas* (N=41), *Lepidochelys olivacea* (N=40), and *Eretmochelys imbricata* (N=2) from three localities in Brazil - Rio de Janeiro, Espírito Santo, and Bahia. Genomic DNA fragments from samples were amplified for the three nDNA and mtDNA markers. A total of 104 pure individuals were sequenced, enabling the identification and characterization of 12 previously unreported haplotypes: 2 for RAG1, 5 for RAG2, and 5 for CMOS. One haplotype from the CMOS region not previously described was found in both a pure individual and a hybrid. Using a haplotype network, 10 additional haplotypes (RAG1=4; CMOS=6) were assigned to their respective species based on phylogenetic similarity. This study identified new nuclear DNA haplotypes and added them to the reference database for hybrid recognition. While some unpublished haplotypes still need species confirmation, the results clarify the challenges of studying interspecific crosses. The expanded database will improve the identification of hybrid sea turtles and deepen the understanding of these crosses.

THE BASKING POPULATION AND MIGRATION TRENDS OF GREEN TURTLES ON MIDWAY ATOLL NATIONAL WILDLIFE REFUGE

Rachel Santulli

Midway Atoll National Wildlife Refuge

Green sea turtles (*Chelonia mydas*) spend the majority of their lifespan at sea foraging before returning to land to lay eggs. This results in the bulk of field research findings being obtained through data collection on either nesting females or through in-water capture experiences. The Northwestern Hawaiian Islands (NWHI) are one of the few places in the world with a population of basking green sea turtles, also known as the Hawaiian Honu, that gives researchers the unique opportunity to gather information on male, female, & juvenile turtles during the day and on land. Midway Atoll National Wildlife Refuge (MAWNR), a two-island atoll located within the NWHI totaling approximately 2.4 square miles in land coverage, has an important stretch of beach known as Hale Honu, meaning Turtle Home. Hale Honu extends about 250m along the northeast shoreline of Sand Island and is currently proposed by USFWS for critical habitat

designation as it serves as a favored honu basking area. In this study, we summarize Midway's basking data and report on turtle migration patterns (via flipper/passive integrated transponder tag/moto-tool # recoveries), sex ratios, and seasonality. Data collection efforts consist of weekly snapshot surveys, turtle processing censuses, incidental turtle counts, & game camera photos on Hale Honu beach. Results indicate highest basking densities occur on Midway Atoll during the winter season (December-February), with the largest count being 67 baskers at once. Peak basking hours for Midway's turtle population are approximately 12pm to 4pm, which is consistent with a 9-day basking study conducted in April 2010. Since 1967, 375 turtles have been tagged at Midway, with 238 tagged since 2019. Of known sex individuals, 79% have been female. Forty-six percent of Midway turtles tagged between 2019 and 2025 were not seen again after their initial year of sighting. In addition, only 13% of the tagged population was resighted on other islands, with 98% of them being female. Understanding the basking peaks in seasonality & time of day on Midway establishes a "tagging season", a period when efforts should be amplified to increase the number of tagged turtles prior to departing Midway. Further studies including satellite tagging and increased tagging events on both Midway and other Northwestern Hawaiian Islands are necessary to determine where the Midway population, particularly males, spends time away from the atoll, and to establish better connectivity between islands. By looking at Midway's basking trends & migration patterns, researchers can then develop a better understanding of the ecology, demography, and conservation needs of the threatened Hawaiian Honu.

EFFICACY OF SMALL MONEL FLIPPER TAGS IN A COASTAL GREEN TURTLE AGGREGATION

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Tagging of sea turtles and subsequent recapture of marked individuals allows researchers to better understand many aspects of population biology and dynamics, including site fidelity, distribution and migration patterns, reproductive output, growth rates, and changes in health. Externally-applied flipper tags have long been an important tool for large-scale marking of sea turtles because they are readily visible and relatively inexpensive compared to more permanent, intramuscular tagging using passive integrated transponder (PIT) tags. The earliest sea turtle tagging programs used copper, plastic, and Monel alloy tags adapted from livestock applications, and many programs now use either Inconel alloy or titanium self-piercing tags specifically designed for sea turtles. Current "standard tags" such as the Inconel 681IC style widely used in the United States are too large for use on dispersal stage and small coastal juvenile sea turtles (<30 cm straight carapace length, SCL), but smaller tags have been developed and permitted for use in recent years. During 2022-2025, the University of Central Florida Marine Turtle Research Group tagged 151 immature green turtles (*Chelonia mydas*; SCL: 28.2 +/- 2.5 cm SD) at Trident Basin, Port Canaveral, Florida, USA with style 1005-4 Monel tags on one or both front flippers, as well as PIT tagging each turtle. Our program subsequently recaptured 29 of the Monel-tagged green turtles, and two others were documented by other groups as live strandings, for a total of 31 recaptured individuals. In total, we recorded 43 recapture events (22 individuals recaptured once, 7 recaptured twice, 1 recaptured three times, and 1 recaptured four times) 47-762 days after Monel-tagging (mean: 297 +/- 159 SD). We observed that the small Monel tags were susceptible to biofouling and corrosion, becoming unreadable and/or brittle after as little as 1.5 to 6 months. We did not document any tag condition issues on Inconel-tagged green turtles recaptured during the same sampling sessions, and occasional biofouling was easily removed without damage to Inconel tags or impacting their readability. Based on our observations of recaptured green turtles at Trident Basin, we do not consider 1005-4 Monel tags to be a good option for marking these turtles because the tags can corrode quickly and can become pitted and unreadable after a short time in a marine

environment. We have also seen that repeated tagging (due to tag loss) may promote fibropapilloma growth in some individuals. These observations are at odds with conservation, given that the tags do not last very long and may cause harm to the turtles. As such, we have moved to PIT-tagging only for turtles 20-30 cm SCL, while also using Inconel tags on larger individuals. We recommend that other programs carefully consider the risks and benefits of using small Monel tags for monitoring immature sea turtles to ensure that an ethical balance is reached between identifying recaptures and responsible conservation research practices.

EVIDENCE IN THE EGG: SPERM DNA IN THE PERIVITELLINE MEMBRANE IDENTIFY INDIVIDUAL BREEDING MALES*

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Sex in marine turtles is determined by incubation conditions, raising concerns of population feminization and loss of genetic diversity due to warming temperatures. Demographic data on breeding males are limited due to their relative inaccessibility. Hatchling sampling can inform multiple paternity (MP) and breeding sex ratios (BSR) but is logistically intensive, limiting the number of nests and populations analyzed. Here, we present a novel approach to characterize successfully breeding males by genotyping sperm trapped in the perivitelline membrane (PVM) surrounding the yolk of a single egg per clutch. We compared maternal genotypes via eggshells with PVM extract genotypes from 27 loggerhead turtle (*Caretta caretta*) eggs and 13 green turtle (*Chelonia mydas*) eggs from Melbourne Beach, Florida, USA, at 16 and 13 microsatellite loci, respectively. Sampled offspring genotypes (620 loggerhead and 1,117 green turtle) provided ground-truthing of PVM sperm allele detections. Paternity analyses resolved 39 loggerhead and 29 green turtle sires, all but two of which were correctly inferred via PVM allele calls. All paternal alleles representing single paternity clutches and primary contributors of multiply sired clutches were detected in the PVM genotypes except in one case of maternal DNA swamping of the PVM. Seven of eight sires that contributed ≤ 11% of offspring were detected via PVM genotyping, consistent with or slightly outperforming inferences based on subsampling 20 hatchlings per nest. PVM-inferred paternal genotypes from single-paternity clutches were > 99% concordant with reconstructed sire genotypes in both species. Although destructive to a single egg per clutch, this method is non-invasive to nesting females and hatchlings. Its scalability across space and time enables long-term monitoring of MP and BSR, key demographic metrics for assessing population viability under climate change. Male genotypes generated from the PVM in single paternity nests may also inform population assignment, assessments of genetic connectivity, and relatedness analyses.

LOUISIANA'S CHANDELEUR ISLANDS HOST A DEMOGRAPHICALLY DISCRETE NESTING POPULATION OF THE CRITICALLY ENDANGERED KEMP'S RIDLEY TURTLE

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The Kemp's ridley turtle (*Lepidochelys kempii*) is considered the most critically endangered marine turtle species globally, with a single recognized genetic stock. Here, we present evidence that the Chandeleur Islands, Louisiana support a demographically discrete nesting population. Aerial surveys conducted in 2022 (n=10) and 2023 (n=18) confirmed three and 12 Kemp's ridley nests, respectively. Surveyors located and collected samples from 14 of these following hatchling emergence or nest failure. Samples were analyzed via sequencing of the maternally inherited mitochondrial control region and attempted genotyping at 16 nuclear microsatellite loci. Baseline microsatellite allele frequencies from 31 foraging adults captured along the Louisiana and Mississippi coasts, known important developmental and foraging habitat for the species, were used to inform relatedness analyses of the Louisiana offspring. All Chandeleurs samples were fixed for control region haplotype Lk1.1, which was previously documented in only 3% of the individuals characterized in this species. Therefore, the Chandeleurs nesting population had significantly different haplotype frequencies compared to Rancho Nuevo and Texas nesting populations. No loggerhead turtle alleles were detected in any offspring, confirming that females were able to locate appropriate conspecific mates. Survey frequency and relatedness inferences suggest that a minimum of 10 individuals nested on the Chandeleurs in 2022 and 2023. These individuals appear to represent a cohesive population of females exhibiting strong natal site fidelity that warrant recognition as a distinct management unit. Documented nests likely represent an underestimate due to weather and substrate conditions that obscure crawls between surveys. Continued monitoring and sampling, ideally at increased frequency, is justified to better characterize the size, age, and dynamics of this population. The recognition of a demographically distinct population of Kemp's ridley turtles in the Chandeleur Islands emphasizes the importance of restoring this nesting habitat before it is lost.

HONOKŌHAU HARBOR: A FORAGING AND RESTING HOTSPOT FOR HONU‘EA HAWKSBILLS AND HONU GREEN TURTLES IN THE EXPANDING HABITAT WORLD OF HAWAIIAN SEA TURTLES

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Recent decades have brought about a substantially improved conservation outlook for green turtles (*Chelonia mydas*) and, to a lesser extent, hawksbill turtles (*Eretmochelys imbricata*) in the Hawaiian Islands. Expanding habitats, new foraging opportunities, and increasing numbers have been documented, providing frequent opportunities for residents and visitors to observe turtles in nearshore environments. While green turtles have long been known to use Honokōhau Small Boat Harbor in Kona, the occurrence of hawksbill turtles at this site is a relatively new phenomenon. This project involved weekly surveys of the harbor over a 16-month period, totaling 68 observation days, during which photographs were taken to identify each turtle primarily through flipper scale patterns. Turtle locations, behaviors, and additional observations were recorded. A total of 20 green turtles and 9 hawksbill turtles were individually identified. Findings from this work enhance our understanding of how both species use this anthropogenic harbor habitat and will support future efforts to protect these individuals and the resources they depend on.

UPDATED GENETIC ASSESMENT OF OLIVE RIDLEY SEA TURTLES IN EAST PACIFIC

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Olive ridley sea turtle (*Lepidochelys olivacea*) populations have experienced substantial declines, estimated at 30% worldwide. In early 80s, a bottleneck event was experienced in the Mexican Pacific due intensive exploitation which led to the decline of almost 2 million individuals. This study aimed to assess

the genetic diversity and population structure of olive ridley sea turtles in the East Pacific. To achieve this, we compiled previously documented worldwide mtDNA Control Region sequences from nesting beaches and feeding grounds. Juvenile, female and unborn hatchlings' muscle and blood tissue were collected in novel and previous sampling sites across the Mexican Pacific. We analyzed 222 sequences (604 bp) through DnaSP, Arlequin v3.5, Haploweb Maker and PopArt. Previously reported Lo46, Lo52, Lo59 and Lo61 and newly identified Lo51 haplotypes were detected alongside Mexican Pacific. No genetic structure was detected in the East Pacific RMU, suggesting a low degree of genetic differentiation, possibly due panmixia or recent colonization events. To facilitate comparative analyses in the East Pacific RMU, a standardized nomenclature for equivalent haplotypes is proposed. This study underscores the importance of continuous genetic monitoring to inform conservation efforts, management strategies, and improve understanding of this species. It may provide crucial data from novel localities and nourishes the existing genetic records of the olive ridley in the East Pacific.

CAMERA TRAPS: A NOVEL METHOD TO ESTIMATE NUMBERS OF NESTING SEA TURTLES*

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Monitoring marine megafauna is challenging as the majority of their time is spent underwater. For sea turtles, population estimates typically rely on track, nest or female counts on nesting beaches, yet these beaches are often remote, dangerous or difficult to access. With advances in technology, new remote sensing tools, such as drones and satellites, are improving how we monitor sea turtles. Here, we explore the use of camera traps as a simple, low-cost alternative for monitoring sea turtle nesting at a remote green turtle (*Chelonia mydas*) rookery in the Western Indian Ocean. On the island of Diego Garcia, Chagos Archipelago, we deployed 13 camera traps along a 2.8 km Index Beach during the 2021 and 2022 nesting seasons. Simultaneous foot patrols were conducted in April and May 2021, and August 2022 (14, 13, and 20 days, respectively) to evaluate the accuracy and reliability of camera trap monitoring. Track counts were highly comparable between methods during neap tides (mean ± SD: camera traps: 7.3 ± 12.9 tracks; patrols: 5.0 ± 4.0 tracks) and across full tidal cycles (camera traps: 5.5 ± 13.1 tracks; patrols: 3.9 ± 3.4 tracks). Using simulated data, we found that track count variability decreased in a power-law relationship with increasing coverage by cameras, suggesting that expanding coverage from 5% to 20% of the beach could reduce discrepancies. Camera trap data also revealed that track longevity remained similar across tidal phases (~2.8 days). Our findings demonstrate the strong potential of camera traps to complement traditional monitoring, particularly in remote or logistically challenging locations where continuous ground-based surveys are not feasible. The increased temporal coverage and reduced need for personnel make camera traps a valuable tool for detecting changes in nesting phenology and trends in abundance. By integrating camera traps into long-term monitoring, we can expand temporal coverage, reduce risk and cost, and capture continuous nesting dynamics, insights that are often missed by infrequent foot patrol surveys. We recommend further testing of this method across beaches of varying length and nesting density to refine its broader applicability. Ultimately, this work demonstrates how accessible technologies can bridge key monitoring gaps and strengthen assessments of sea turtles worldwide, particularly the most isolated rookeries.

AGAINST THE TIDE: HOW HAWKSBILL TURTLES PERSIST AMID SINGAPORE'S EXTREME URBANIZATION*

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Critically Endangered hawksbill turtles (*Eretmochelys imbricata*) face numerous threats that compromise egg and hatchling survival, particularly in highly urbanized coastal environments. Singapore offers a unique opportunity to study sea turtle reproduction under extreme urbanization, as nesting persists despite extensive coastal modification and land reclamation. This study aims to assess the past, present, and future of hawksbill turtle nesting in Singapore by integrating historical records, field observations, and predictive modeling to inform conservation planning. To reconstruct historical nesting habitats, we analyzed archival records and digitized a historical 1969 map to visualize the past sandy beach distribution. Contemporary nesting data (2019–present) were mapped alongside past and planned reclamation areas to assess spatial changes in available nesting habitat. Because nesting records in Singapore may be spatially biased due to limited survey coverage, we developed a drone-based monitoring workflow powered by a YOLO object detection model to automatically identify turtle nesting tracks from aerial imagery. This approach enables rapid, standardized, and georeferenced detection of nesting activity, expanding coverage beyond areas with regular human presence. To project future suitability of nesting sites in Singapore, we applied the Sea Level Affecting Marshes Model (SLAMM) to simulate habitat loss under sea level rise scenarios and modeled nest temperature profiles to evaluate thermal risks to hatchling development. Our analyses indicated that most nesting has occurred along East Coast Park, a reclaimed and heavily frequented beach, likely reflecting higher observer effort, while more natural southern beaches remain underrepresented in monitoring data. Sea level projections suggest that suitable nesting habitat will decline substantially, with future reclamation at East Coast Park expected to eliminate current nesting sites. Together, these findings highlight the growing importance of the Southern Islands for future nesting and underscore the need for proactive conservation planning that integrates historical context, emerging drone-based monitoring technology, and predictive modeling.

POPULATION GENOMICS OF HAWKSBILL TURTLES IN INDO-PACIFIC: IMPLICATIONS FOR CONSERVATION UNDER CLIMATE CHANGE*

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Genetic studies are essential for understanding population structure, connectivity, and demographic history, which are key factors that underpin the resilience of marine turtle populations in the face of environmental change. However, most marine turtle studies to date have relied on short genetic markers such as the mitochondrial control region and microsatellites. While valuable, these approaches provide only a partial and sometimes biased view of genetic diversity and demographic history, limiting our ability to detect fine-scale patterns that inform conservation. We generated a high-quality de novo genome assembly of a nesting hawksbill turtle (*Eretmochelys imbricata*) from Singapore using Oxford Nanopore PromethION and Illumina HiSeq X sequencing platforms. This assembly provided a robust foundation for

whole-genome analyses aimed at understanding the genetic diversity, relatedness, and demographic history of the hawksbill populations in Singapore and Japan. Hawksbill turtles nest in Singapore, and they represent a small and critically important population in the Indo-Pacific, offering a unique opportunity to build a comprehensive genomic dataset from accessible sampling. Two hawksbill samples from Japan were also included in the population genomic analysis. Mitochondrial DNA analyses identified six closely related haplotypes, including three novel haplotypes, one unique to Singapore. Whole-genome comparisons of 38 hawksbill individuals revealed low genetic diversity and extensive inbreeding, with most individuals sharing first-degree relationships. Notably, a multiple-paternity nest in Singapore involving closely related parents was identified, further supporting the population's high connectivity and limited breeding diversity. Demographic history reconstructions suggest that long-term population decline has been strongly shaped by past climate fluctuations. Moreover, signatures of positive selection were detected in genes linked to environmental sensing, environmental response, and natal behavior, reflecting the interplay between environmental pressures and adaptive responses in this vulnerable population. This study provides the first population-scale genomic characterization of hawksbill turtles in Singapore and in the Indo-Pacific region, uncovering critical conservation concerns. The combination of low genetic diversity and high inbreeding highlights the population's vulnerability to environmental change and anthropogenic impacts. Our findings have direct conservation implications, supporting the development of targeted strategies such as genetic monitoring and adaptive habitat management. Importantly, the genomic resources and insights generated from this study will contribute to regional and global conservation efforts, particularly in understanding how small, isolated marine turtle populations can persist or decline under climate change.

CHARACTERIZATION, DIVERSITY, AND GENETIC CONNECTIVITY OF LOGGERHEAD TURTLES IN BRAZILIAN FEEDING GROUNDS

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The loggerhead sea turtle (*Caretta caretta*) is one of five species of sea turtles found in Brazil, classified as "Vulnerable" by the IUCN's Red List of Threatened Species. Adults feed in neritic areas, while juveniles occupy both neritic and oceanic areas. Records of incidental bycatches by fishing occur in neritic areas along the Brazilian coast, from the northeast to the south, and in the oceanic environment by industrial fishing along the southern coast. These turtles are highly migratory and have a complex life cycle, which makes research on them difficult. Genetic studies have been providing new data on genetic diversity, connectivity, hybridization, philopatry, and phylogenetics. This study aimed to estimate the genetic diversity and connectivity of *C. caretta* stranded juveniles and adults in feeding grounds from Rio de Janeiro (RJ – N=20) and Paraná (PR – N=65) states in Brazil by using the mitochondrial DNA control region. The results demonstrate that the RJ and PR feeding grounds have moderate genetic diversity, a lack of genetic differentiation, and share most haplotypes, which indicates homogeneity. Animals from the RJ aggregation presented only haplotypes characteristic of Brazilian nesting grounds, but animals from PR presented, in addition to haplotypes characteristic of Brazilian nesting populations, haplotypes from the Pacific and North Atlantic nesting populations. Furthermore, one animal from the PR aggregation presented a haplotype characteristic of the species *Lepidochelys olivacea*. Samples from both aggregations were also compared with literature data from feeding grounds in Rio Grande do Sul (RS - Brazil's

southernmost state), the North Atlantic, the Mediterranean, and the Pacific. The regions of RJ, PR, and RS showed no genetic differentiation, indicating homogeneity along part of the Brazilian coast. Compared to the Brazilian locations, the North Atlantic, the Mediterranean, and the Pacific regions exhibited higher genetic differentiation. This study provided a better understanding of the feeding grounds diversity, detected evidence of hybridization with *L. olivacea*, and improved our understanding of the contributions from Brazilian and multiple ocean basins' rookeries to the SW Atlantic foraging aggregations.

READING BETWEEN THE LINES (OF ARRESTED GROWTH): GROWTH VARIATION AMONG LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) WITH VARYING STRANDING CONDITIONS IN THE U.S. GULF OF MEXICO

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Characterizing somatic growth variation in endangered marine species, such as sea turtles, provides valuable insight into population demographics, recovery potential, and vulnerability to environmental stressors. Further understanding how growth rates vary within populations is crucial for the conservation and management of endangered marine species, because it can help identify vulnerable life stages and inform species assessments. This study investigates somatic growth variation between "poor" and "good" condition loggerhead sea turtles (*Caretta caretta*) upon stranding in the Northwestern Gulf of America (GoA) during an Unusual Mortality Event (UME) that spanned 2022–2024. During this stranding event, stranding frequencies in this region were three to four times higher than previous five- and ten-year averages, with 70% of the affected turtles being underweight or heavily fouled with epibiota. Humeri were dissected and cleaned post-mortem from 21 stranded loggerhead sea turtles collected in Texas and Florida between 2022 and 2023, representing a range of stranding conditions. Nutritional status was subjectively assessed during necropsy throughout the UME based on body fat and muscle mass, using a five-point scale (1 = poor condition, 5 = robust condition). Scores for individuals in this study ranged from 1 to 5, with the majority of samples falling between 1 and 2. Bones were processed using skeletochronology, which involved thick sectioning, decalcification, thin sectioning, and imaging of stained bone sections. Consensus ages were determined by three independent readers through identifying annually deposited growth rings, known as Lines of Arrested Growth (LAGs). Body sizes (Straight Carapace Length; SCL cm) were back-calculated through established relationships between LAG diameter and SCL, with samples ranging from 55.2 cm to 87.5 cm in length, so each LAG has a SCL estimate at the time of deposition. Annual somatic growth rates (cm SCL · yr−1) were calculated by subtracting body sizes from successive LAGs, yielding long-term, individual growth trajectories. We will use linear regression to compare growth rates among stranded turtles based on stranding condition score and stranding year, including age and size as random effects. We will also collate growth data across turtles by stranding condition and use time series analysis to identify significant breakpoints in each collection of growth histories. By interpreting skeletal growth patterns, we can reconstruct individual age profiles and further understand growth variation among varying body conditions and stranding year, which will further inform the population's age structure. Skeletochronology is a vital tool for understanding sea turtle population age structures, growth variation, and sexual maturation, as well as informing conservation decisions for long-lived species with limited life history data. Comparing growth patterns between healthy and unhealthy turtles will provide new insights into causes of this unusual mortality event. This research will provide essential baseline information on

loggerhead sea turtle age structure and growth dynamics in the Northwestern GoA, advancing our understanding of, and contributing to the development of more effective conservation and recovery strategies for this threatened population.

WHERE DO LOGGERHEAD TURTLES FORAGE IN THE ATLANTO-MEDITERRANEAN REGION? THE POWER OF INDIVIDUAL GENOMIC ORIGIN ASSIGMENTS*

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Sea turtles are highly migratory species, with nesting sites and foraging areas often separated by vast distances. Since individuals from different breeding populations can share foraging grounds, accurately inferring their natal origin is crucial to unveil the effect of bycatch for effective management and conservation. Population genetic studies on loggerhead sea turtles have predominantly relied on Mixed Stock Analysis (MSA) based on the mitochondrial DNA (mtDNA) control region D-loop. However, this approach only estimates the proportion of individuals in a foraging area that originate from different nesting sites, with large confidence intervals. Conversely, novel genomic methodologies, such as 2bRAD, provide individual origin assignments, offering a more detailed understanding of population structure. Here, identified the origin of 309 individuals from twelve different foraging grounds: two in the Atlantic (Galicia and Canary Islands), two in the transition between the Atlantic and Mediterranean (two Andalusian populations separated by the Strait of Gibraltar), and eight in the Mediterranean (Valencia, Balearic Islands, Catalonia, Lampedusa, Thyrrhenian Sea, western Aegean Sea, eastern Aegean Sea and Israel). To do so, we used a previously validated baseline built with samples from regular nesting sites in the Mediterranean

and the Atlantic regions using 2bRAD libraries. We genotyped our individuals and performed individual origin assignments following a hierarchical structure, first the three regional management units that could contribute to the unknown foraging individuals (North East Atlantic, North West Atlantic, and Mediterranean), and then narrowing to a subregional level within the Mediterranean (Libya, Greece, and Levant). The resolution of the individual assignments also allowed for a fine-scale geographic analysis, when combined with the exact location of each stranding individual, and a size distribution for each origin, when combined with the Curved Carapace Length (CCL) of each individual. Our analyses showed an overall high heterogeneity of origin across foraging areas from the Atlantic to the eastern Mediterranean. We detected significant changes in foraging ground composition compared to past studies, with a global decrease in individuals assigned to the northwestern Atlantic origins and an increase in individuals from the north eastern Atlantic Nesting populations. In addition, we reported distinct contributions from the subRMUs at the three Mediterranean subregional levels, with a particular increase in the contribution of Levantine sites to Western Mediterranean foraging areas, and the presence of admixed individuals. Globally, the combination with biometric data indicated that different origins within the same foraging area do not distribute randomly across size classes. In summary, our study strongly suggests temporal and spatial shifts in the composition of Mediterranean foraging grounds. And size distribution is important. Additional future research is advisable to fully understand these shifts and their implications.

PERFORMANCE OF OVERWINTERING GREEN TURTLES AT THE SOUTHERN LIMIT OF THEIR DISTRIBUTION IN THE WESTERN ATLANTIC: INSIGHTS INTO THE BRUMATION STRATEGY

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Juvenile green turtles in Uruguayan coastal waters (35°S, 55°W) exhibit brumation, a behavioral strategy that allows them to cope with low winter temperatures at the southernmost limit of their distribution during winter. Individuals displaying this behavior were identified by the presence of unusual benthic epibiota characteristic of prolonged winter dormancy. The heavy epibiotic load mirrored the local benthic hard-bottom community (e.g., cirripeds, hydrozoans, mussels, polychaetes, crabs, and macroalgae) and contrasted with the typical obligate commensal epibionts of green turtles (e.g. Chelonibia testudinaria, Platylepas spp.). High epibiont loads were observed in inactive individuals, likely reflecting reduced activity but a definitive physiological brumation marker need to be assessed. This condition was described and identified previously, but the ecophysiological consequences remain unclear. Here, we assessed the effects of brumation on body condition and performance in juvenile green turtles overwintering in Uruguayan coastal habitats. We analyzed two datasets provided by the NGO Karumbé between January

2002 and September 2025: (1) stranded turtles recorded by the National Stranding Network, and (2) scientific captures from the Mark–Recapture Program. For each turtle, biometric data, photographs and epibiont samples were collected. In 2025, we incorporated blood samples to characterize the hematological and biochemical profiles of brumating individuals using a portable blood gas analyzer (Seamaty VG1). A total of 309 turtles (4.82%) showed evidence of brumation (B) among all individuals recorded in Uruguay. Of these, 205 were stranded (167 alive, 38 dead) and 104 were captured alive. Brumating turtles weighed, on average,0.92 kg less than non-brumating (NB) individuals of equivalent length. The Body Condition Index (BCI) differed significantly between both groups (LRT = 4.005, $P < 0.0001$, [average±SD B=1.25 ± 0.20; range 0.82–1.59, n = 114]; [average±SD NB=1.35 ± 0.15; range 0.57–1.98, n = 2461]). Among recaptured individuals, 17 were identified as brumating, several of which displayed improved body condition upon recapture. Blood analyses from six brumating turtles—identified by their distinctive epibiont assemblages—revealed reduced metabolic activity, with lower oxygen uptake and decreased PO_2 (71.5 ± 6.71), accompanied by a slight increase in blood pH (mean = 7.56 ± 0.09). This alkalinization at low temperatures reflects increased CO_2 solubility and reduced H^+ concentration. Packed cell volume (PCV) was lower in brumating turtles (22.8 ± 9.0%) than in active individuals (31.4 ± 4.2%), consistent with suppressed erythropoiesis. Moreover, brumating turtles reduce or cease feeding, and their lower lactate levels indicate metabolic depression with reduced glycolysis and anaerobic metabolism. Overall, our findings indicate that brumation entails an energetic cost. However, about half of the recaptured turtles showed improved body condition after resuming activity, suggesting partial recovery. We find an individual described as brumating in 2019 and later captured after migration to Parana (Brazil) with an improved BCI demonstrating a flexible strategy. Brumation may represent an optional overwintering strategy, influenced by annual environmental variability and individual condition which highlights the complex interplay between environmental constraints and behavioral plasticity. Better characterizing alternative overwintering strategies—such as migration or brumation—and their ecological implications is crucial to predict population responses to climatic variability and anthropogenic pressures in this transitional coastal region of the Southwestern Atlantic.

TRACE | NON-INVASIVE TAGGING OF LOGGERHEAD SEA TURTLE HATCHLINGS USING EDNA FROM SAND TRACKS

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The early life stage of sea turtles remains one of the least understood phases of their life cycle, primarily due to the challenges of suitable tagging methods for hatchlings. This knowledge gap limits our ability to assess survival, dispersal, and recruitment into adult nesting populations. We hypothesised that environmental DNA (eDNA) recovered from sand within hatchling emergence tracks in the Mediterranean can be used to assign haplotypes, enabling individual genetic tagging during emergence. Previous pathological research in Northeast Florida has shown that eDNA recovered from sand samples can reliably assign sea turtles to both haplogroups and haplotypes, and has suggested that future integration with deepened population genetics analysis could bring highly important information on loggerhead populations. During the 2025 nesting season in the Maltese Islands, Europe, sand samples from emergence tracks of *Caretta caretta* hatchlings and adjacent nearshore water samples were collected. The

methodology follows a strictly non-invasive approach, with all eDNA collected passively from naturally disturbed sand. DNA extraction and amplification are being performed using a highly polymorphic mitochondrial D-loop marker previously validated in population genetics studies of *C. caretta*. This approach aims to determine whether haplotypes can be reliably retrieved from emergence track substrates, providing the first assessment of eDNA-based genetic tagging for sea turtle hatchlings in Europe, enabling the potential detection of haplotypes diversity within and between nests. We expect to investigate whether an emergence-track substrate can reliably yield haplotypes from individual hatchlings. If this is the case, then results will provide the foundation for future longitudinal monitoring and genetic mark-recapture studies. The results will inform the development of a scalable, innovative tagging approach that could be applied across Mediterranean rookeries, and used in case a nesting female could not be identified, improving our understanding and monitoring of population connectivity and nesting-site fidelity in a critical region for *C. caretta*'s nesting and population dynamics. If validated, this non-invasive approach could provide a new method for both genetic tagging of individuals and for population-level analyses, enabling capture-recapture studies, without handling hatchlings, relying on invasive sampling or biological matter from the nests.

MULTIPLE PATERNITY AND BREEDING SEX RATIOS OF LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) IN THE SOUTHWESTERN INDIAN OCEAN*

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iSimangaliso Wetland Park in South Africa is the highest latitude nesting beach for the critically endangered leatherback sea turtle (*Dermochelys coriacea*). This site is a United Nations Educational, Scientific and Cultural Organizations (UNESCO) World Heritage Site and provides protection for sea turtles and their habitat against numerous threats. However, despite more than six decades of conservation and monitoring, this Regional Management Unit (RMU) has shown little evidence of population growth with less than 100 females nesting per year. Long-term data indicates that reproductive output is high, nesting female abundance is stable and hatchling sex ratios are mostly balanced. However, data collection has been limited to one sex (females) because males remain at sea. It is therefore difficult to estimate key demographic parameters such as breeding sex ratio and its influence on effective population size. Assessing male contribution, which can now be done with molecular techniques, is therefore required to gain a more comprehensive understanding of the demographics of this population. This study used Genotyping-in-Thousands by sequencing (GT-seq), a high-throughput SNP (Single Nucleotide Polymorphism) genotyping method that uses targeted amplicon sequencing, to determine the genetic 'fingerprint' of fathers of sampled hatchlings and mothers, and thus indirectly census the number of breeding males, assess multiple paternity and estimate the breeding sex ratio of leatherback sea turtles in the Southwestern Indian Ocean (SWIO). Using 93 SNP loci, we analysed 739 hatchlings from 50 nests across eight nesting seasons (between 2010-2023) at iSimangaliso Wetland Park. We found that 34% of nests had more than one sire. Six males mated with several females (11% polygyny), of which two mated with different females across different seasons. We also found a significant positive relationship between the number of males siring a clutch and size of the nesting female. Lastly, the breeding sex ratio was between 1.47 and 2.25 males per female. Previous biotelemetry studies found that individuals are diffusely distributed around the nesting beach and mate-encounter rates are therefore probably low. It was concluded that reduction in effective population size because of biased sex ratios here is less than 10% and unlikely to be limiting population

growth for the SWIO leatherback RMU. Instead, a male biased sex ratio would be a plausible explanation for the apparent lack of population recovery and growth as measured by female census on the nesting beach because a higher proportion of males are produced but remain undetected on the nesting beach. It was also concluded that the panel of SNP markers originally developed for another population of leatherbacks (St. Croix, US Virgin Islands) could be successfully used to infer parentage for the SWIO leatherback RMU, highlighting the conservation value of using molecular techniques to assess male contribution to the population without ever directly observing them. Furthermore, these results highlight the importance of understanding local population characteristics to inform region-specific conservation strategies and ensure efficient conservation and management of leatherback sea turtles in the Southwestern Indian Ocean.

Rehabilitation and Veterinary Care

ULTRASONOGRAPHIC EVALUATION OF GASTROINTESTINAL DYSFUNCTION IN RESCUED OLIVE RIDLEY SEA TURTLES (*LEPIDOCHELYS OLIVACEA*): IMPLICATIONS FOR SEA TURTLE CONSERVATION

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The olive ridley sea turtle (*Lepidochelys olivacea*) is a widely distributed marine species, primarily inhabiting the Pacific and Indian Oceans. Despite their ecological importance, turtles often exhibit non-specific clinical signs and due to the presence of carapace and plastron, physical examination alone provides limited diagnostic information. This study describes normal ultrasonographic appearance of cervical structures and gastro-intestinal organs of seven rescued olive ridley sea turtles that were stranded during the nesting season along Tamil Nadu coast as well as rehabilitated by the Trust for Environmental and Education (TREE) Foundation, Vettuvankeni, Chennai. Ultrasonographic examinations were conducted using a multi-frequency probe (3.5–7.5 MHz) with ten soft-tissue integumentary areas serving as acoustic windows. The esophagus was imaged through the cervical-ventral window, the stomach via the left axillary window, and the liver and gallbladder through the right axillary window. Both large and small intestines were visualized through pre-femoral and post-femoral acoustic windows bilaterally and organ measurements and observations of gastrointestinal dysfunctions were recorded to establish baseline ultrasonographic parameters for these rescued individuals. The findings highlight the importance of diagnostic potential in ultrasonography as a non-invasive, conservation-oriented tool for evaluating coelomic organ health, thereby enhancing clinical management and improving rehabilitation outcomes in vulnerable olive ridley sea turtles.

MICROBIOME AND HEALTH: SEQUENCING THE GUT MICROBIOME OF GREEN SEA TURTLES SUFFERING FROM EMERGING GASTROINTESTINAL DISEASE

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Few studies have examined how gastrointestinal disease affects the gut microbiome and long-term health of sea turtles. In contrast, research in humans has shown that disease can disrupt the gut microbiota, leading to dysbiosis, a microbial imbalance in the gastrointestinal tract. Dysbiosis is commonly associated with disease in animals but can also be exacerbated by environmental stressors and dietary changes. The gut microbiota plays a critical role in regulating nutrient uptake, metabolism, and overall physiological health. This PhD project aims to address key knowledge gaps regarding the impact of disease on gut health in green sea turtles. It will also contribute to understanding what constitutes a healthy gut flora across three green turtle populations along the east coast of Queensland, Australia.

BLOOD BIOCHEMISTRY VALUES FROM OLIVE RIDLEY TURTLES (*LEPIDOCHELYS OLIVACEA*) UNDER REHABILITATION IN THE MALDIVES

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The olive ridley turtle (*Lepidochelys olivacea*) is the most widely distributed sea turtle species. It is one of the five sea turtle species present in Maldivian waters and the most frequently admitted to local rescue and rehabilitation centres. Classified as Vulnerable by the IUCN, olive ridleys face multiple anthropogenic threats, with entanglement in marine debris being the leading cause of admission. Blood biochemistry is a valuable tool for assessing health status in animals under rehabilitation and for supporting clinical decision-making. This study presents preliminary blood biochemistry data from 10 adult olive ridley turtles (7 females and 3 males; mean straight carapace length 60 ± 2.9 cm) undergoing rehabilitation at the Atoll Marine Conservation Centre in the Maldives. Most individuals (8/10) were admitted following entanglement incidents resulting in severe injuries, including amputations of one or two flippers, while two turtles were admitted with mild shell fractures suspected to be caused by watercraft strikes. Only samples collected after clinical stabilization were included in the analysis. At the time of sampling, turtles were in appropriate body condition, external wounds had healed, all pharmacological treatments had concluded, and no clinical signs of disease were present other than buoyancy disorders, which were observed in 9 out of 10 individuals. Blood samples were collected from the external jugular vein into lithium heparin tubes, centrifuged to obtain plasma, and analyzed using an MNCHIP CV5 veterinary chemistry analyzer. The following biochemical ranges were recorded: total protein 31.5–56.6 g/L, albumin 7.8–22.1 g/L, globulin 14.9–39 g/L, glucose 5.97–11.21 mmol/L, uric acid 2.5–56.6 µmol/L, aspartate aminotransferase (AST) 76–608 U/L, creatine kinase (CK) 232–1507 U/L, potassium 3.82–5.6 mmol/L, sodium 122–148 mmol/L, chloride 100–129 mmol/L, calcium 1.76–2.38 mmol/L, phosphorus 1.8–2.98 mmol/L, and total bile acids 1.28–8.74 µmol/L. Most values fell within ranges previously reported for olive ridley turtles from wild populations in the Pacific Ocean. Minor deviations included a slightly elevated albumin and lower chloride and phosphorus values. No clear relationship was identified between electrolyte values and buoyancy disorders. The lowest phosphorus concentrations were recorded in turtles that had spent the longest time in rehabilitation, suggesting a possible influence of husbandry practices in captivity; however, some more recent admissions also showed reduced phosphorus levels compared to wild Pacific populations. The highest AST value was considered an outlier from a turtle admitted with shell fractures and was accompanied by a CK value near the upper range, most likely reflecting muscle damage. The small sample size limits the establishment of reference intervals for olive ridley turtles from the Indian Ocean under rehabilitation. Although these turtles exhibit biochemical profiles comparable to those of wild Pacific populations, it remains unclear whether observed variations reflect population-level differences or individual clinical conditions such as buoyancy disorders, amputations, or shell fractures. Further studies including larger sample sizes, rehabilitated turtles, and wild Indian Ocean populations are needed to support the evaluation of rehabilitation protocols and to provide baseline biochemical data for olive ridley turtles under human care.

HEALING OF SEVERE SHELL TRAUMA IN *CHELONIA MYDAS*: A CASE REPORT FROM RIO DE JANEIRO, BRAZIL

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Marina da Glória, located in the city of Rio de Janeiro (Brazil) was inaugurated in 2016 and is part of the largest marina network in Latin America. It has 220 wet slips and offers extensive nautical services and serves as a departure point for boats engaged in various activities, such as tourism, fishing, sports, and leisure. Additionally, this area hosts a significant population of *Chelonia mydas* (green sea turtle), which use the shoreline for feeding and shelter. Due to heavy vessel traffic, these animals are susceptible to trauma from collisions, often suffering severe injuries, such as mutilated body parts caused by boat strikes. However, green sea turtles are remarkably resilient, and is possible to observe severely injured individuals still swimming in search of food. This study aims to report the clinical treatment applied for the healing of a complete carapace fracture in a juvenile *C. mydas* weighing 13.9 kg. The rescue took place at Marina da Glória on February 19, 2025, by the field team of Section 14 of the Santos Basin Beach Monitoring Project, and initially was treated by the veterinary medical team of the Stabilization Unit of Rio de Janeiro, based at Santa Úrsula University, as part of this same project. During the initial examination, the fracture was identified as approximately 20 cm in length, affecting the second central scute and extending to the third and fourth right lateral scutes. The treatment protocol included analgesia, non-steroidal anti-inflammatory drugs, multiple cycles of systemic antibiotic therapy, such as the use of Clindamycin 150 mg/ml, Enrofloxacin 10%, and Ceftazidime 10 and, most importantly, topical wound management. Topical care consisted of a routine wound cleaning with antiseptic solution and the application of debriding, moisturizing, healing, and anti-inflammatory agents, emphasizing a collagenase 0.6 U/g ointment as well as a commonly used in Brazilian medicine containing 10% papain and 30 % propolis. Additionally, dietary supplementation and metabolic support were provided. Despite the slow healing process due to the severity of the lesion, the positive progression of this case suggests a favorable prognosis for the eventual reintroduction of this individual, which remains under rehabilitation to date. From the beginning of treatment until the preparation of this report, it is possible to identify approximately 80% healing of the lesion. The turtle remains active, with good swimming ability and voluntary feeding. Although the anamnesis is uncertain, it is highly probable that this individual was affected by anthropogenic interaction, leading to a collision with a vessel at the location where it was rescued. Therefore, it can be concluded that the applied clinical treatment was effective in promoting successful carapace healing.

ANESTHESIA USE AND FIELD BASED LAPAROSCOPY IN GREEN (*CHELONIA MYDAS*) SEA TURTLES*

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Sex determination in immature sea turtles continues to be a challenge due to their external monomorphism and lack of heteromorphic sex chromosomes. Laparoscopy is used as a tool for gross visualization of the gonads for sex determination, and in some cases, biopsy collection for histological determination. As this procedure continues to be utilized in field-based settings, modifications can be made to the current techniques to improve anaesthetic induction and anaesthetic plane, while balancing the necessity of rapid and safe recovery for prompt patient release. This study demonstrates that a preoperative combination of Ketamine and Dexmedetomidine intravenously (IV), combined with a postoperative intramuscular (IM) injection of Atipamezole provides rapid induction of anaesthesia and a rapid recovery in green (*Chelonia mydas*) sea turtles that can be utilized in field settings. Thirty-five green sea turtles were captured and transported to a shore-based field site for laparoscopic sex determination. Thirty-three turtles received 2mg/kg of Ketamine and 10 mcg/kg of Dexmedetomidine IV preoperatively and 100 mcg/kg of Atipamezole IM postoperatively. In addition, all turtles were given a local anaesthetic injection of 1 mL 2% Lidocaine and 1 mL 8.4% Sodium Bicarbonate, a 25mg/kg Oxytetracyline injection IM for bone marking and as a presurgical prophylactic antibiotic, and a 2mg/kg Ketoprofen injection IM for postoperative analgesia. The turtles were placed on the restraint device approximately 3-5 minutes after the initial preoperative injections of Ketamine, Dexmedetomidine, and Oxytetracycline where the laparoscopic procedure was performed. Immediately following the procedure, Atipamezole and Ketoprofen were administered. Twenty-six turtles had the time of their initial respiration recorded, and on average it took approximately 17 minutes post-sedation. Fourteen turtles had the time of their submersion/float test recorded, and on average it took 61 minutes post-sedation for the turtle to be recovered enough to submerge and swim normally. Different levels of the anaesthetic plane were achieved, likely dependent on the success of the IV injection of the sedation drugs. However, most turtles had minimal to no movement throughout the procedure. In addition, all turtles that underwent the laparoscopy procedure recovered uneventfully and were released back into the wild the same day. In conclusion, a preoperative combination of Ketamine and Dexmedetomidine, combined with a postoperative injection of Atipamezole provides safe and rapid induction, an adequate anaesthetic plane, and a rapid recovery in green sea turtles that is manageable to achieve in a field setting.

HARMFUL ALGAL BLOOM CASE IN OAXACA, MEXICO. DIAGNOSIS & TREATMENT

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Between December 2019 and January 2020, more than 200 died from harmful algal blooms (HABs) at the coast of Oaxaca, Mexico, primarily affecting green turtles but also some olive ridleys. During a two-week period, 20 affected alive green turtles were rescued and treated, with 11 of them having survived and recovered within 3-4 weeks. Necropsies had revealed stomachs and intestines filled with salps, a plankton known to transport red tide toxins, and hemorrhagic gastroenteritis. The experience gained in this event prompted a treatment based on gastric lavage and hematological analysis and to foster the exchange of experiences among professionals. The primary objective had been to establish a definitive protocol for the care of turtles affected by HABs. This protocol is expected to be highly beneficial for the Mexican Turtle Center and other veterinarians, as it had described the mechanism of action of paralytic toxins and treatments using commonly available medications, allowing for adaptation based on each professional's resources.

ASSESSMENT OF WOUND VITALITY IN SEA TURTLES INJURED BY WATERCRAFT STRIKES AND DREDGING OPERATIONS IN VIRGINIA, USA (2015-2023)

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Anthropogenic trauma is a significant threat to sea turtles along the coast of Virginia. The Virginia Aquarium Stranding Response Program (VAQS) documents dozens of stranded turtles each year with external trauma consistent with vessel interactions (watercraft strike or dredge injury), including partial remains obtained from hopper dredges by Protected Species Observers. Attempting to assess wound vitality to characterize external vessel interaction injuries as antemortem (before death), perimortem (around the time of death), or postmortem (after death) is imperative to understanding the impacts of these sources of anthropogenic trauma on sea turtle populations. Well-preserved carcasses may demonstrate gross evidence of wound vitality, including hemorrhage, evidence of exsanguination, and presence of fibrin/exudate. However, gross evaluation of injuries is often obscured by decomposition, sediment entrainment, and degloving of tissues. Histologically, muscle fibers damaged during the antemortem and perimortem periods show evidence of contractile potential at the time of injury. This is known as supravital response. Therefore, histopathologic identification of supravital response in muscle along wound margins can aid wound vitality assessment in classification of timing of traumatic injury relative to death. Between 2015-2023, sea turtle carcasses with external injuries consistent with watercraft strike (n = 46) or recovered from active hopper dredges (n = 25) were examined and sampled by VAQS personnel. In addition, one sea turtle from each category that were examined alive and later died were sampled. Longitudinal samples of

damaged muscle fibers were collected at wound margins and evaluated by a veterinary pathologist for evidence of supravital response. On histologic evaluation, seventy-two percent of turtles stranding with watercraft strike injuries and sixty-five percent of dredge interaction cases were positive for supravital response. The aforementioned sediment entrainment that is characteristic of hopper dredge interactions, as well as carcass storage conditions, extended sampling timeline, inaccurate identification of muscle tissue and wound margin, and poor or inconsistent sampling technique, can result in false-negative or inconclusive results for supravital response. However, our results suggest that the majority of traumatic watercraft and dredge injuries to sea turtles in Virginia are occurring in the antemortem or perimortem period, with vessel interactions often resulting in life-threatening injury. Comparisons of gross findings, including hemorrhage, exsanguination, and inflammation, with histopathology findings are ongoing. Preliminary results show that hemorrhage is the most common of these findings in cases with positive supravital response results via histopathology. Finally, we aim to provide recommendations for examination, documentation, and sampling of these animals to stranding responders and Protected Species Observers to inform conservation management of dredging and boating activities in Virginia.

HEART RATE IN JUVENILE KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*) TURTLES: ESTABLISHING REFERENCE INTERVALS FOR REHABILITATION ASSESSMENT

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Hundreds of sea turtles enter rehabilitation facilities throughout the United States each year due to stranding or other health concerns. Heart rate (HR) is an important physiological parameter for evaluating the health and recovery of sea turtles under human care. However, published data on HRs of Kemp's ridley sea turtles (*Lepidochelys kempii*) are scarce, and standardized reference values are lacking. To establish baseline cardiac data and assess potential covariate effects, we measured HR (beats per minute, bpm) in juvenile Kemp's ridley sea turtles (straight carapace length (SCL) 23.0-38.0 cm; mass 2.0-8.8 kg) considered clinically convalescent at the New England Aquarium Quincy Animal Care Center following recovery after initial stranding due to cold stunning in November to December. HR was measured using a handheld Doppler during routine handling for periodic examinations (n=44 individuals in total sampled in three different years). Several associated covariates were recorded to examine potential influences on HR, including pre-handling behavior, time out of water, level of handling during HR measurement, water temperature, body mass (kg), or body size (SCL). One HR measurement per individual was randomly selected to ensure independence among samples. None of the tested covariates significantly influenced HR (all $p > 0.05$), indicating that HRs collected under comparable conditions could be pooled even when complete covariates were unavailable. Accordingly, additional HR measurements were incorporated to increase statistical power (total n=77; SCL 22.0-38.4 cm; body mass 1.8-9.4 kg), resulting in a resting HR reference interval of 31–55 bpm for juvenile Kemp's ridley sea turtles. The resulting reference interval overlaps but is narrower than previously reported Kemp's ridley HRs. Although this reference interval may not reflect true resting cardiac function, these data provide a practical benchmark for evaluating cardiac physiology during rehabilitation, given the widespread availability and non-invasive nature of handheld Dopplers. Due to observed individual variability, HR should be interpreted in conjunction with other clinical and behavioral indicators. Further work should be considered to establish comparable reference intervals for additional sea turtle species undergoing rehabilitation.

CONSERVATIVE MANAGEMENT OF A COMPLEXE HUMERAL FRACTURE IN A LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*): A CASE REPORT

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The bone healing process in sea turtles remains poorly documented and long bone fractures represent complex cases that require specific management in rehabilitation settings. Invasive procedures must be carefully considered to avoid further harm, and close collaboration between sea turtle veterinarians and orthopedic surgeons is essential for successful fracture handling. This case provides valuable insight into the potential for full functional recovery through a non-invasive rehabilitation approach despite the absence of complete bone healing or the development of hypertrophic nonunion. Jenna is a 65.8kg subadult loggerhead sea turtle (*Caretta caretta*) admitted to Kelonia, the Sea Turtle Observatory (Reunion Island), after being incidentally caught in longline fishing gear. Following surgical hook removal from the beak and three weeks of rehabilitation, caregivers reported pain signs during handling and particularly affecting the left flipper. Clinical examination revealed an absence of mobility and swelling in the proximal half of the left forelimb. Diagnostic imaging, including radiography and computed tomography (CT), confirmed a complex, mildly displaced, medio-diaphyseal humeral fracture with a fracture line extending to the distal epiphysis and the elbow joint. Handling by caregivers was minimized, ketoprofen (NSAID) was administered q3dx4 followed by q7dx6 and the turtle was kept in an individual 3m3 tank to limit swimming activity and reduce flipper load until signs of bone healing could be assessed. One month after admission, Jenna resumed feeding, and her weight increased by 25% in 12 months of rehabilitation. Radiographic follow-ups were performed at months 2, 4, 6, 9, 13 and 15 post-diagnosis showing progressive union of the distal articular fracture line and remodeling of the humeral structure. However, the transverse healing line presented signs of moderate hypertrophic nonunion. A CT scan was also conducted to assess overall reorganization of the humeral structure and flipper anatomy associated with the bone healing process. Clinical condition gradually improved two weeks after diagnosis and after three months, Jenna was transferred to a larger individual tank (10 m3). One month later, when further mobility was reported, she was transferred to a collective pool (306 m3) and handling was avoided for an additional month. Although fracture healing was not complete, full recovery of swimming ability was reported after 12 months of rehabilitation. Although surgical stabilization through osteosynthesis might have promoted complete bone healing, several factors did not favor surgical stabilization for Jenna: the fracture's complexity and mild displacement, the limited surgical access to the humeral shaft because of the overlying carapace and the dense musculature, the remaining growth of the turtle requiring implant removal surgery, the perioperative risks and postoperative care requirements and the feeding recovery few days after the diagnosis of the fracture. Therefore, a conservative, non-surgical approach was adopted by the multidisciplinary team composed of Kelonia's rehabilitation team, experienced sea turtle veterinarians, and board-certified orthopedic surgeon, with the opinion of other international sea turtle experts. It was based on a multimodal assessment (clinical evaluation, imaging results, perioperative context, opinions from various experts) and previous successful reports of conservative fracture management in sea turtles.

FATAL MYCOLICIBACTERIUM FORTUITUM INFECTION IN AN OLIVE RIDLEY IN SOUTHEASTERN BRAZIL

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Nontuberculous mycobacteria (NTM) are opportunistic pathogens widely distributed in the environment and increasingly recognized as a significant public health concern. Found in water and soil, these organisms spread through contact or inhalation and can cause diseases ranging from subclinical infections to fatal outcomes. NTM have been reported in a diverse array of hosts, extending from terrestrial reptiles to marine species such as sea turtles. In reptiles, disease typically presents with gray-white visceral or subcutaneous nodules; histology shows granulomatous inflammation with multinucleated giant cells and usually lacks calcification. On May 26, 2025, an adult olive ridley (*Lepidochelys olivacea*) found stranded in Cabo Frio, Rio de Janeiro, Brazil, was admitted to the Instituto Albatroz Rehabilitation Center in emaciated, dehydrated, and lethargic condition. Baseline hematologic values were unremarkable (RBC 0.90 x 10^6/µL; PCV 42%; WBC 7,000/µL; total protein 5.0 g/dL), but coelomic radiographs revealed diffuse increased pulmonary radiopacity with thickening of the alveolar septa, consistent with an inflammatory/infectious process. Blood cultures yielded no growth. The turtle received supportive care, including intravenous fluids, parenteral nutrition, and empirical amikacin sulfate (5 mg/kg every 72 h), but died six days later. Postmortem examination was performed using standard techniques immediately after death. Grossly, multiple granulomas measuring approximately 0.1–0.5 cm in diameter were observed. The lesions were diffusely distributed over the serosal surfaces of the coelomic viscera. For mycobacterial isolation, samples were decontaminated with 0.75% hexadecylpyridinium chloride (HPC); supernatants were plated on Stonebrink and Lowenstein–Jensen media and incubated at 37°C for up to 90 days. DNA from isolates was extracted using the DNeasy Blood & Tissue Kit (Qiagen). The Mycobacterium genus was confirmed by TB multiplex PCR, and the probable species was determined by sequencing the rpoB. Histopathology showed granulocytic coelomitis with abundant septate fungal hyphae. Necrosis, small aggregates of bacterial bacilli, and occasional infiltrates of necrotic leukocytes were also noted. Although tissue samples were negative by Ziehl-Neelsen stain, the result may reflect a low bacillary burden in the samples or bacteria in a non-proliferative state, which are harder to stain. Additionally, severe enteritis was observed, characterized by large aggregates of oval protozoal structures consistent with coccidia and occasional bacillary clusters amid a moderate granulocytic and lymphocytic infiltrate. Overall, the findings indicated a systemic bacterial infection, with an opportunistic fungal infection in the coelomic cavity and severe coccidial enteritis. Laboratory analyses are underway to identify the fungal agent and to confirm and characterize the coccidia.Culture yielded Mycolicibacterium fortuitum (formerly, Mycobacterium fortuitum), confirmed by molecular assays. The source is unknown but may be anthropogenic (e.g., wastewater or landfill leachate). Expanded surveillance in wild sea turtles is needed to clarify the epidemiology and pathogenic role of NTM in marine fauna.

DETERMINING THE BEST CLINICAL HEALTH PREDICTORS OF BODY CONDITION IN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*)*

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As facultative endotherms, leatherback sea turtles (*Dermochelys coriacea*) develop thick peripheral fat layers similar to the blubber of marine mammals for thermoregulatory, structural, and energetic support. This adaptation allows them to forage in cold temperate waters and sustains them while fasting during long-distance migration to nesting beaches. It is suspected that they may reach a nutritional threshold on foraging grounds that signals adequate energetic reserves for remigration and reproduction; however, there are no standardized methods for body condition assessment in this species. Leatherbacks undergo substantial cyclical changes in body condition as they gain and lose fat reserves, characterized by the relative prominence of the dorsal carapacial ridges, roundness or concavity of soft tissue, and visible skeletal features. Previous research in leatherbacks validated the use of ultrasound as a non-invasive diagnostic tool for measuring subcutaneous fat. The goal of this study was to evaluate multiple predictors of body condition in leatherbacks. For inclusion of leatherbacks across a broad spectrum of nutritional conditions, we sampled foraging, nesting, bycaught, and dead stranded immature and adult leatherbacks of both sexes from the Western Pacific and Northwest Atlantic populations (n=113). Field techniques for safely weighing leatherbacks on a capture boat and nesting beach were further refined. We developed an objective species-specific body condition scoring (BCS) system to standardize visual assessments of individual turtles with detailed descriptions and reference images. Morphometric measurements (mass, straight and curved carapace length and width, and neck circumference), calculated body condition index (BCI; mass/straight carapace length3 x 10,000), and ultrasound fat depth were collected. Ultrasound fat depth ($r = 0.58$, $p < 0.001$) and BCS ($\chi^2 = 17.93$, $p < 0.01$) were positively associated with BCI, indicating that both measures may serve as reliable proxies for body condition. Relationships between blood chemistry analytes and body condition were evaluated using BCI as the reference metric in a subset of turtles with complete data (n=29). A multiple regression model including blood urea nitrogen (BUN), cholesterol, uric acid, triglycerides, and beta-hydroxybutyrate (BHB) explained 80% of the variation in BCI. Triglycerides ($p < 0.001$) had the largest effect, followed by BHB ($p < 0.01$), a ketone produced from fat metabolism when glucose is limited. BUN ($p < 0.001$) and cholesterol ($p < 0.01$) were also significant predictors. Uric acid was included in the model but not significant ($p = 0.16$), and packed cell volume was considered but not retained as a predictor. These findings provide a framework for objectively evaluating the body condition of wild foraging, nesting, stranded, or entangled leatherbacks in a field or rehabilitation setting. At the level of the individual, body condition may serve as a valuable indicator of health status and foraging success, predict the timing of remigration, and provide context for interpretation of fluctuating lipophilic contaminants. On a population scale, body condition trends can highlight periods of ecosystem resource limitation, disease, and oceanographic change, as well as inform population abundance estimates for the conservation and management of this endangered species.

REHABILITATION OF THE UK'S FIRST OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*); A CASE STUDY FROM THE ANGLESEY SEA ZOO & MARINE RESOURCE CENTRE, UK

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In November 2016, an adult female Olive Ridley sea turtle (*Lepidochelys olivacea*), weighing 21 kg, stranded on the coast of Anglesey, North Wales. This represents the first ever record of an Olive Ridley in the UK since records began in 1748, and the first ever UK live stranding of this species, presenting a unique challenge for local rehabilitation efforts. The stranding occurred during an extreme El Niño event, which likely transported the turtle from West African waters into unusually cold UK seas, resulting in cold-stunning. The Anglesey Sea Zoo, a small marine aquarium specialising in cold water UK native marine species, faced significant challenges throughout the rehabilitation efforts. With only four full-time husbandry staff and limited infrastructure, the team improvised equipment, including a custom incubator for gradual re-warming, adapted a display tank for rehabilitation, and leveraged community engagement to source fresh fish and raise funds for essential equipment. On arrival, the turtle was torpid, hypothermic, and dehydrated. Initial stabilisation included subcutaneous and intracoelomic fluids, intramuscular antibiotics, corneal lubrication, and careful temperature-controlled re-warming. Early feeding was limited to fresh fish fillets, with gut motility supported using metoclopramide. By two weeks post-stranding, the turtle exhibited severe positive buoyancy with a pronounced list, preventing sustained submersion. Corrective measures, including reduced-salinity water and a shell-weighting system, gradually improved buoyancy, allowing the turtle to dive and retrieve food from the tank floor, though prolonged submersion remained impossible. To assess the underlying cause and potential for release, a CT scan was arranged, requiring a 5-hour overland transfer to a facility with suitable imaging capabilities. Results showed tearing of the left lung which was showing signs of healing, likely caused by a rupture through sudden pressure changes, and the resultant air in the body cavity was causing positive buoyancy. Recovery after imaging showed substantial improvement in buoyancy, allowing moderate submersion, and provided a positive indication of the turtle's potential for longer-term recovery and eventual release. After seven months, the turtle was transferred to the Centro de Recuperación de Fauna Silvestre in Gran Canaria. Despite initial stability, health declined, and necropsy revealed severe granulomatous pneumonia and fibrinopurulent arthritis, highlighting underlying chronic pathology not apparent during rehabilitation. The experience has directly informed protocols for subsequent sea turtle rehabilitations, enabling the Anglesey Sea Zoo to achieve a number of other successful repatriations, including the first successful rehabilitation and repatriation of a Kemp's Ridley sea turtle from the UK for immediate release back into the wild. The Anglesey Sea Zoo has fully committed to sea turtle conservation, with plans to build the UK's first dedicated sea turtle rehabilitation centre now underway, establishing a foundation for managing future out-of-range strandings. This case demonstrates that, even in a small temperate facility with limited resources, cold-stunned tropical sea turtles can be successfully stabilised and rehabilitated, providing a template for managing future strandings that emphasises innovation, community engagement, collaboration both locally and internationally, and adaptive care.

STRANDING AND OUTCOME DATA FOR COLD-STUNNED SEA TURTLES IN MASSACHUSETTS, 2008-2022: EVOLUTION OF MANAGEMENT METHODS IN RESPONSE TO INCREASING CASELOADS AND COVID-19 PANDEMIC*

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Over a 15-year period (2008–2022), 7802 cold-stunned sea turtles were found stranded in Massachusetts, of which 5028 (64%) were found alive. Annual stranding numbers increased over time, averaging 214 turtles per year during the first five years of the period (median 193), and 759 turtles per year during the last five years of the period (median 826). Species composition included 87% Kemp's ridley turtles (*Lepidochelys kempii*, of which 64% were alive), 8.2% loggerhead turtles (*Caretta caretta*, of which 68% were alive); 4.5% green turtles (*Chelonia mydas*, of which 67% were alive); 0.3% undetermined species (of which 46% were alive), and one deceased hawksbill turtle (*Eretmochelys imbricata*). Live turtles were evaluated and medically stabilized at a primary care facility and treated for pathologic conditions such as acidosis, dehydration, reduced renal function, pneumonia, and sepsis. Treatments included gradual warming, closely monitored progressive swimming, cardiorespiratory support, fluid therapy, antimicrobials, and additional medications based on physical examination, radiographic, clinical pathologic, and microbiologic findings. After stabilization for days to weeks, most turtles (70%) were transferred to secondary care facilities for further care, while others remained at the primary care facility to complete rehabilitation. Overall, 76% of turtles admitted alive were released to the wild after rehabilitation, generally within three to eight months of stranding, including 75% of Kemp's ridley turtles, 86% of loggerhead turtles, and 78% of green turtles. Most deaths for all species occurred at the primary care facility within the first four days of hospitalization, often due to severe respiratory and metabolic acidosis, hypoxia, and hyperkalemia. After stabilization and transfer to secondary facilities, 91% of Kemp's ridleys, 97% of loggerheads, and 96% of green turtles were later released. Medical management protocols were adjusted over time due to the increasing caseload and the COVID-19 pandemic, yet success rates remained high. Adjustments included, but were not limited to, expanded use of the Incident Command System for personnel organization and operational efficiency; reducing efforts for turtles with grave prognoses; more rapid warming, swimming, and exposure to full salinity (warmed to 22°C–24°C over three days vs. five days; often in water continuously at full salinity within 2 days); and curtailed diagnostic testing during periods of intense caseload. In more recent years, if individual assessment was precluded by caseload, turtles received pre-determined fluid therapy (Day 1: lactated Ringer's solution (LRS) with 2.5% dextrose 20 ml/kg subcutaneously [SC]; Day 2 and Day 3: LRS 20 ml/kg SC; individual adjustments thereafter) and cardiac support (Day 1: if heart rate <10/minute, epinephrine 0.1 mg/kg intramuscularly; individual adjustments thereafter). Initial antibiotic use evolved over time to increase the dosing interval

(oxytetracycline 42 mg/kg every 6 days SC diluted in at least 5 ml/kg LRS) and to reduce handling requirements (stable at room temperature, long shelf-life, no reconstitution). This study indicates that rescue and rehabilitation of cold-stunned turtles in Massachusetts and secondary facilities results in a high rate of release, and that management protocols can be thoughtfully refined to retain high success rates despite increasing caseload and operational restrictions.

QUANTIFYING AGGRESSIVE INDIVIDUALS IN CAPTIVE GREEN SEA TURTLE HATCHLINGS WITH GLMM*

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Individual variation is rarely considered in captive reptiles, partly due to the stereotype that their behavior and cognitive abilities are relatively simple compared with those of other vertebrates. However, reptiles exhibit consistent individual differences that can lead to welfare challenges. In captive sea turtles, aggressive individuals are anecdotally reported to impose stress or injury risks on conspecifics, yet such differences have rarely been quantified. Therefore, this study quantified individual differences in conflict frequency among captive green sea turtles using GLMM that account for individual variation. Seven captive green sea turtles housed at the Sea Turtle Park, Mie Prefecture, Japan, were studied. All individuals originated from the same nest and wear reared under identical conditions from August 2023. During the study period, their SCL ranged from 14.4 to 21.5 cm. Experiment were conducted across five periods between October 2024 and June 2025. In each period, 21 round-robin contests were performed over 7 days. Contests were scheduled in 3 blocks (09:00-12:00, 12:00-15:00, 15:00-18:00), and all individuals were fed ad libitum at 18:00 each day. In each contest, two individuals were placed in a 1-ton white tank. Interactions were classified as visual displays or soft contact, passive staring, and aggressive interactions. The individual retreating by orienting its carapace toward the opponent was designated as the loser. A negative binomial GLMM was used to analyze the number of wins by an acting individual against a target individual in each contest. Experimental period, date, time block, differences in SCL, and behavioral pattern were included as fixed effects, while identities of the acting and target individuals were included as random effects. Marginal and conditional coefficients of determination were calculated to assess model explanatory power. A total of 6,379 interactions were recorded, and a clear winner was identified in 5,105 cases. Contest frequency decreased with growth ($p = 0.04$) and increased with time since feeding ($p = 0.04$), whereas experimental date within a period ($p = 0.16$) and SCL differences ($p = 0.31$) had little effect. Models including only fixed effects showed limited explanatory power ($Rm2 = 0.25$), whereas inclusion of random effects substantially improved the power ($Rc2 = 0.83$). Variances of random effects with the acting individual ($\sigma2 = 2.23$) was greater than that associated with the target individual ($\tau2 = 0.31$), indicating that conflict was more strongly linked to individual aggressiveness. Conditional mode estimates further revealed that three individuals exhibited higher frequencies of aggressive interactions, and that excluding these individuals would reduce aggressive interactions by 77%. These results demonstrate that individual differences in aggressiveness can emerge even under uniform genetics and rearing conditions, and that aggressive individuals can impose risks on conspecifics. Identifying and excluding aggressive individuals may therefore be effective in reducing conflict. In addition, the importance of early-stage conflict mitigation and avoiding hunger were highlighted. Future studies examining less observable traits, such as swimming performance or stress responsiveness, may further clarify the mechanisms underlying aggressive behavior and support more individualized management practices that better accommodate individual needs.

REVIVING THE DROWNED: LUNG LAVAGE AS A NEW CLINICAL AND CONSERVATION TOOL FOR SEA TURTLES*

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Drowning following incidental capture in fishing gear remains one of the leading causes of mortality in sea turtles worldwide. In the Mediterranean Sea alone, an estimated 132,000 sea turtle interactions with fisheries occur annually, with more than 44,000 resulting in death. Mortality primarily arises from forced apnea and trauma-related complications, frequently followed by secondary drowning associated with pulmonary injury such as edema, aspiration, or infection, which may lead to delayed mortality days to weeks after the event. Although fishermen often release entangled turtles immediately after capture, post-release survival remains largely undocumented, and the extent of sublethal effects is poorly understood. Conventional cardiopulmonary resuscitation (CPR) is rarely effective in chelonians due to the inaccessibility of the heart beneath the rigid carapace; however, pulmonary resuscitation and assisted ventilation can occasionally restore spontaneous respiration. Despite these interventions, prognosis for drowned or near-drowned turtles remains poor, with high mortality rates even under intensive care. To address this clinical and conservation challenge, a novel lung lavage resuscitation procedure was developed and implemented at Israel's Sea Turtle Rescue Center (Israel Nature and Parks Authority) between 2017 and 2025. The technique was applied to 85 sea turtles—75 loggerhead (*Caretta caretta*) and 10 green turtles (*Chelonia mydas*)—admitted in critical condition following confirmed drowning events. The procedure begins with endotracheal intubation and gentle suctioning to remove seawater and fluid from the lungs, followed by assisted ventilation using an Ambu bag. A modified bronchoalveolar lavage (BAL) is then performed, involving the controlled instillation of sterile 0.45% sodium chloride solution—approximately 1% of the turtle's body weight—into the lungs. This process dilutes and mobilizes obstructive mucus, promotes osmotic clearance of residual salts and seawater, and reopens airways to restore pulmonary ventilation and gas exchange. Following lavage, turtles receive isotonic fluid therapy (0.9% sodium chloride; 4–5% of body weight, administered intracoelomically), are maintained in an oxygen-enriched environment for 24–48 hours, and receive a two-week course of antibiotics. Individuals are monitored for one month prior to release to ensure the absence of pulmonary edema or secondary complications. Of the 85 treated turtles, 59 (69.4%) were successfully resuscitated, achieved full recovery, and were released back to the sea. Twelve individuals were equipped with satellite transmitters, and post-release tracking confirmed normal movement patterns and diving behavior for several months, indicating full physiological recovery. These results establish lung lavage as a safe and effective resuscitation technique for drowned sea turtles, offering a practical and replicable solution with significant implications for both veterinary medicine and marine conservation. We propose that all sea turtles suspected of drowning should receive lung lavage treatment at specialized rehabilitation centers, and that simplified versions of the technique could be adapted for use by trained fishermen at sea. Adoption of this method has the potential to transform global post-bycatch response protocols, converting previously fatal incidents into recoverable cases and substantially improving survival outcomes for threatened sea turtle populations.

FROM CAPTIVITY TO THE OPEN SEA: REHABILITATION AND POST-RELEASE MONITORING OF TWO LONG-TERM CAPTIVE LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) FROM SARDINIA, ITALY

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Rehabilitating sea turtles after long-term captivity represents one of the most complex challenges in marine wildlife management. In 2011, two adult *Caretta caretta*, named Gavino and Genoveffa, were confiscated from a private aquarium in Sardinia (Italy) where they had been kept illegally for about 25 years in substandard environmental and welfare conditions. The aquarium lacked adequate thermal control, UVB lighting, and proper water filtration, and the turtles were fed an unbalanced diet. Both animals exhibited signs of severe malnutrition, poor muscle tone, and Metabolic Bone Disease (MBD). This study describes their long-term rehabilitation, release, and post-release monitoring through satellite telemetry. Rehabilitation involved gradual reconditioning in progressively larger tanks and confined mesocosm waters, controlled exposure to natural light and temperature, and balanced feeding with mixed fish and crustaceans. Continuous veterinary monitoring guided the recovery process. Following an extended rehabilitation period at the Sinis Rescue Centre (CReS), partly prolonged while awaiting judicial authorization for release and subsequent review by the CITES Commission, both turtles were equipped with satellite transmitters and released on 9th October 2021 from Cabras, western Sardinia. The release decision was guided by an ethical framework balancing animal welfare, conservation goals, and precaution, and was implemented only after formal judicial de-seizure and authorization from the competent national authority. Satellite telemetry was employed to evaluate survival, orientation, and re-adaptation to natural marine life, providing a quantitative measure of rehabilitation success after decades of captivity. Satellite transmissions lasted 374 days for Gavino and 341 days for Genoveffa, providing extensive post-release data. Gavino travelled approximately 8,000 km (averaging 22 km per day), moving westward from Sardinia toward the Balearic Islands, along the Spanish, Algerian, and Moroccan coasts, crossing the Strait of Gibraltar and entering the Atlantic Ocean, with the final signal received about 2,000 km east of Puerto Rico. Genoveffa remained in neritic waters around Sardinia for approximately seven months before heading south toward Algeria, covering about 3,000 km (averaging 9 km per day). Dive data revealed typical *Caretta caretta* activity patterns, with mean depths of 21 m for Gavino and 19.5 m for Genoveffa, and maximum depths of 66 m and 80 m, respectively. The remarkable recovery of these two turtles, after decades of inadequate captivity, demonstrates the resilience of *Caretta caretta* and the success of long-term, multidisciplinary rehabilitation efforts. This experience underscores the importance of collaboration among international, national, and regional authorities, and the operative role of the CReS, operating within the Regional Network for the Conservation of Marine Fauna of Sardinia. The case of Gavino and Genoveffa represents one of the few documented examples worldwide of loggerheads returning to full oceanic life after more than thirty years in captivity, offering valuable insights for future rehabilitation and release strategies.

BLOOD GAS AND POTASSIUM LEVELS AT INTAKE AS PREDICTORS OF POOR SURVIVAL FROM COLD STUNNING IN BOTH KEMP'S RIDLEY AND GREEN SEA TURTLES IN NEW YORK*

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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 U.S. coastline are juvenile Kemp's ridleys (*Lepidochelys kempii*), and Atlantic greens (*Chelonia mydas*). Turtles in this study were rescued and rehabilitated by the New York Marine Rescue Center (NYMRC). After intake, turtles were warmed, and given supportive care, over a period of 5 days. This study examined 8 blood parameters in surviving and non-surviving turtles to determine whether intake values could predict poor recovery potential in these 2 species. Previous studies have examined similar measurements in cold stunned Kemp's, but not greens. Our 3 hypotheses were: 1) key intake/day 1 blood parameters in non-survivors will be different than in survivors (and may be used to predict poor rehabilitation outcomes), 2) key blood parameters will change over 5 days of warming in survivors or from intake to death in non-survivors, and 3) trends will differ in Kemp's ridley and green sea turtles, reflecting species-specific differences in their cold stun response and recovery. Over the course of 6 cold stun seasons from 2019 to 2024, a total of 157 turtles (97 Kemp's ridley: 73 survivors, 24 non-survivors, and 60 Atlantic green: 51 survivors, 9 non-survivors) were admitted live, and had their blood sampled. The 8 blood parameters reported from samples at intake (Day 1) and when turtles were warmed to optimal body temperature (Day 5) or died in house (Days 1 through 4) were hematocrit (%), white blood cells (thds/cmm), glucose (mg/dL), potassium (mmol/L) and bicarbonate (mmol/L), pCO2 (mmHg), pO2 (mmHg), and pH (the last 3 measures being temperature corrected to the individual's body temperature). Percent change in each parameter from intake to warming or intake to death was calculated. Data from turtles that survived warming was compared to those that died in house (survivors vs. non-survivors), and across the 2 species. Over this 6-year period, cold stunned greens had a higher survival rate of warming (85%) than Kemp's (75%). Hematological findings suggested that non-surviving Kemp's ridley turtles had statistically lower intake pH, PO2, and glucose, and higher PCO2 and K+ than those that survived the warming process. Interestingly, while green sea turtles also show higher PCO2 and K+ in non-survivors, there were no other differences in remaining blood parameters as compared to survivors. All blood measurements changed with warming or at death, and percent change of measurements illustrated species-specific trends. Kemp's ridleys showed a greater number of differences in percent change between survivors and non-survivors than did greens. Together, our findings suggest that while each species differed in their response to rehabilitation from cold stunning, two easily measured intake blood parameters (PCO2 and K+) could provide a triage tool to identify patients that are unlikely to survive early warming. These findings contribute to our understanding of the process of recovery from cold stunning, and support broader conservation efforts of these species in the northeastern U.S.

FROM STRUGGLE TO SURVIVAL: CORTICOSTERONE CHANGES IN COLD-STUNNED SEA TURTLES DURING REHABILITATION

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Sea turtles naturally produce the steroid hormone corticosterone, which circulates in the bloodstream and regulates energy metabolism, immune function and general physiological homeostasis. In the northeastern U.S., cold stunning - a process like hypothermia - causes sea turtles to strand in the late fall and winter. This stressful cold exposure also triggers corticosterone production. Life stages and species most prone to stranding from cold stunning on New York's beaches are juvenile Kemp's ridleys and Atlantic greens, along with subadult loggerheads. This study documented the change in plasma corticosterone that sea turtles experienced following rescue and rehabilitation. The goal was to document how levels change over time, and to correlate intake plasma levels to successful rehabilitation across the 3 species by comparing survivors to non-survivors. Over a period of 6 cold stun seasons (2019-2024), blood samples were obtained from all live stranded cold stuns by staff from the New York Marine Rescue Center (NYMRC). Samples were taken at 2 additional intervals - after the animal was warmed to optimal body temperature (Day 5, 24˚C), and shortly before the individual's release following rehabilitation (6-9 months post-rescue). Animals that died during early rehabilitation were sampled post-mortem. Plasma samples were processed using a Corticosterone ELISA kit (Enzo Scientific) optimized for vertebrate use. In all species, corticosterone levels were indeed highest at intake and showed a progressive decrease over time. Loggerheads and greens lowered corticosterone significantly at warming and did not further decrease for the remainder of the rehabilitation period. Kemp's ridleys exhibited higher average corticosterone levels once warmed and took longer to decrease than greens and loggerheads. In non-survivors, intake and post-mortem corticosterone were similar for all species. Non-surviving Kemp's had significantly lower corticosterone than survivors at intake, suggesting physiological compromise and a possible blunted stress response. Non-surviving loggerheads may have had higher corticosterone at intake however the sample size (N=4) was quite low. Analysis of this data will allow us to further understand cold stunning stress, and how survivors and non-survivors differ in their hormone status. This study contributes to a broader understanding of the cold stun response and recovery in 3 species of hard-shelled sea turtles that are prone to stranding in the northeastern U.S.

PHOTOGRAMMETRY AS A TOOL FOR SEA TURTLE CONSERVATION

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Photogrammetry is a tool that is used across many industries to accurately document, track, measure, and 3D model objects of all sizes. Recently, photogrammetry has gained popularity in coral reef restoration, cetacean research, and other marine conservation initiatives. While these uses are unique in their

application, it is just beginning to scratch the surface of the possibilities for photogrammetry in conservation. The Marine Institute at the Maui Ocean Center operates a sea turtle rehabilitation center where they rehabilitate injured turtles, most commonly for foreflipper strangulation injuries. When patients are admitted for care, they typically present with significant edema, necrosis, and reduced range of motion. After the release of the strangulation, a rapid reduction in edema, followed by tissue granulation, and swift healing is observed. As part of our rehab approach MOCMI utilizes red and blue light laser therapy alongside therapeutic flipper massage to support rapid swelling reduction and tissue regeneration. While laser therapy is commonly used and well studied in other animals, it is relatively unstudied in marine turtles with little published evidence. To investigate this approach, MOCMI has been preparing its processes, data records, and therapeutic regimens for clinical analysis of the efficacy of laser therapy use in foreflipper strangulation recovery. A key piece of this study is the precise measurement of edema and its associated reduction over time. Yet, the ability to precisely measure irregularly shaped foreflippers is a limiting factor for meaningful data outcomes. Photogrammetry was identified as a promising non-invasive tool to precisely measure the volume of the injured flipper, over time, in association with the prescribed therapy. Through this pilot trial, we were able to successfully measure volumetric reduction in edema over time. This pilot serves as our first attempt in utilizing photogrammetry in the clinical setting as a tool to measure, document, and model marine turtles through their journey under our care. This presentation will provide a brief overview of photogrammetry, its use in this case, and potential uses within sea turtle conservation.

NEUROINVASIVE SPIRORCHIIDIASIS IN GREEN SEA TURTLES (*CHELONIA MYDAS*): RED SEA AND MEDITERRANEAN CASES CAUSED BY *LEAREDIUS LEAREDI**

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Spirorchiid blood flukes are widespread in sea turtles, causing disease and mortality across multiple ocean basins. Besides being leading parasitic causes of strandings, these infectious agents can induce endocarditis, vasculitis, thrombosis, aneurysms, and disseminated granulomatous inflammation, all of which may severely compromise the survival of affected turtles. In advanced cases, the infection may extend to the central nervous system, producing multifocal granulomatous meningitis or meningoencephalitis, sometimes resulting in neurologic dysfunction and death. Herein, we report two severe cases of spirorchiid infection caused by *Learedius learedi* in Mediterranean and Red Sea green sea turtles (*Chelonia mydas*). The Red Sea case involved bilateral blindness associated with extensive granulomatous lesions containing intralesional trematode eggs in the optic nerve, eyes, spleen, heart, and lungs. The Mediterranean case, recently documented in a stranded turtle from the eastern basin, was characterized by diffuse granulomatous meningitis, with trematode eggs embedded within the leptomeninges and neural tissue, confirming the parasite's neurotropic potential. Molecular identification based on 28S rRNA and cytochrome oxidase I (COI) gene sequences matched *L. learedi* reference isolates from GenBank. The concurrent documentation of systemic and neurologic involvement highlights the ability of *L. learedi* to disseminate widely and invade multiple organ systems, including the central nervous

system. Altogether, these findings underscore the need to recognize *Learedius learedi* as a systemic and potentially neuroinvasive parasite of sea turtles. Enhanced molecular surveillance and targeted pathological investigation are critical for early detection, improved case management, and the long-term conservation of these threatened marine species. Moreover, implementing routine deworming protocols and parasitological screening in rehabilitation centers is essential to reduce reinfection risk, prevent parasite transmission among captive turtles, and ensure the safe release of rehabilitated individuals back into the wild. Continuous surveillance in such facilities provides a valuable early-warning system for emerging or re-emerging parasitic threats within regional turtle populations.

HEALTH ASSESSMENT OF ADULT FEMALE KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*) SEA TURTLES NESTING AT PADRE ISLAND NATIONAL SEASHORE, TEXAS, USA*

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Health assessment of nesting sea turtles is an important aspect of population conservation measures, allowing us to generate a population-specific baseline health database which in turn can be used to inform conservation and threat mitigation strategies. We conducted a health assessment of N = 57 adult female Kemp's ridley (*Lepidochelys kempii*) sea turtles nesting at Padre Island National Seashore during 2023–2025. Physical examination was performed to evaluate body condition and document any external lesions or abnormalities including external tumors associated with fibropapillomatosis (FP). Nearly all turtles (with two exceptions) were determined to be in good body condition and successfully nested. Whole blood samples were collected from the external jugular vein using aseptic technique. Packed cell volume, complete blood cell counts with differentials, serum vitamin D and calcium concentrations, plasma biochemistry, and plasma protein electrophoretograms were determined and evaluated for trends. Plasma samples were also tested for antibodies to chelonid alphaherpesviruses 5 (ChHV5; the virus associated with FP) and ChHV6 (e.g., lung-eye-trachea virus) using enzyme-linked immunosorbent assays. Six turtles (11%) had external tumors consistent with FP; five (9%) tested positive for antibodies to ChHV5, and 27 (47%) tested positive for antibodies to ChHV6. Welch's t-tests revealed that blood urea nitrogen was significantly lower in turtles with FP than in non-tumored turtles (P = 0.03); no other analytes significantly differed between the two groups. Tumor biopsies collected from three turtles tested positive for ChHV5 DNA via quantitative polymerase chain reaction, and resultant sequences showed confirmatory 100% identity. Fibropapillomatosis is an emerging disease of concern in this critically endangered nesting aggregation, and its role in Kemp's ridley turtle survivorship and reproductive success warrants further investigation. Continued collection of these health data and archival samples will enable population managers to evaluate systematic differences between aggregations, investigate biological pathways linking determinants to health outcomes, and better understand how different determinants influence health outcomes over time and across sea turtle life history stages.

FIVE YEARS OF SEA TURTLE REHABILITATION ON MAUI (HI)

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Sea turtle rehabilitation is a proven tool to aid in the preservation of marine turtle populations regionally. In 2020, The Marine Institute at the Maui Ocean Center (MOCMI) opened the first sea turtle rehabilitation center in Hawaii outside of the federal government. Between 2020 and 2025, this facility served as the only sea turtle rehab center in Hawaii and has rehabilitated turtles from five of the eight major Hawaiian Islands. The primary cause of sea turtle stranding in Hawaii is near-shore recreational fishing practices and accounts for 78.6% (n=1,255) of all strandings encountered by MOCMI during this period. Between 2020-2025, MOCMI rehabilitated 197 sea turtles, 99% of which are Green turtles (*C. Mydas*) using a conservative approach that includes flipper massage and red and blue light laser therapy. 84% (n=165) of patients were admitted due to fishing gear interaction, 25.88% (n=51) required surgical amputation, and 97% (n=1,388) of all turtles recovered alive (n=1,421) were successfully returned to the wild. This presentation will cover historical data, rehabilitation approaches used at our facility, lessons learned, and potential paths forward to aid in the management of this threatened population.

FIRST COMPREHENSIVE CLINICAL HEALTH ASSESSMENTS OF THE LARGEST KNOWN GREEN SEA TURTLE (*CHELONIA MYDAS*) ROOKERY IN THE RED SEA

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Introduction: Two species, the green (*Chelonia mydas*) and hawksbill sea turtle (*Eretmochelys imbricata*), nest along the Saudi Red Sea coast varying in abundance and distribution, yet nothing is known about the health of these nesting populations. One of the most significant *C. mydas* rookeries in the Red Sea is located at Ras Baridi on the central Saudi coast. This location is also home to a major cement producing facility that has important national strategic significance. Methods: SHAMS/KAUST Center for Veterinary Care and Ocean Health applies a One Health approach to marine animal and ecosystem fitness. Consistent with this approach, full comprehensive clinical examinations were conducted on twenty nesting *C. mydas* during a single season at Ras Baridi, Kingdom of Saudi Arabia, following the American Society for Veterinary Clinical Pathology (ASVCP) Guidelines. Complete physical and cardiopulmonary and partial neurological examinations were performed on all individuals, and blood, interstitial fluid and colonic samples were collected for analysis. The following indices were measured to establish clinical Reference Intervals (RI) in this cohort: Hematology – Packed Cell Volume, White Blood Cell Count, Heterophils (mature, immature, toxic), Eosinophils (mature, immature, toxic), Basophils, Lymphocytes, Monocytes, Immature

Red Blood Cells; Biochemistry: Glucose, Alkaline Phosphotase, Amylase, Aspartate Aminotransferase, Beta-hydroxybutyrate, Calcium, Phosphorus, Gamma-Glutamyl Transferase, Lipase, Triglycerides, Apoprotein B and a, Symmetric Dimethylarginine, Uric Acid, Creatine, Creatine Phosphokinase, Total Bilirubin, Blood Urea Nitrogen; Protein Electrophoresis: Total Protein, Albumin, Globulins (Total, Alpha-1,-2, Beta, Gamma), Albumin:Globulin Ratio; Proteomics: C-reactive Protein, Calgranulin MRP-25, Serum Amyloid A, Heat Shock Protein 70, C1q-like Protein; Gut Microbiome: distal colonic microbial composition, diversity and relative abundance.* Results: Clinical RI were established for nesting *C. mydas* in the central Saudi Red Sea following (ASVCP) methodology. Notable clinicopathological findings included eosinophilia, lymphocytosis, hyperuricemia, hyperproteinemia, hypertriglyceridemia, hyperlipemeia, elevated C-reactive Protein, elevated Serum Amyloid A, and elevated Heat Shock Protein 70. Notable clinical examination findings included acute pulmonary disease (n=3), and limb (n=1) and carapacial (n=1) trauma. Conclusions: Most of the clinicopathological findings in the cohort are consistent with similar findings from gravid *C. mydas* reported in other locations. Novel pathological findings of acute pulmonary disease, diffuse inflammatory status and renal dysfunction may indicate local environmental stressors that influence clinical health and reproductive success. This is the first comprehensive health report of its kind applied to a nesting sea turtle cohort and provides a baseline for longitudinal study of this vulnerable population of nesting *C. mydas* in the Kingdom of Saudi Arabia.

JORGE THE TURTLE: A CONSERVATION AMBASSADOR REWILDED AFTER 40 YEARS IN CAPTIVITY

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In April 2025, an adult male loggerhead turtle (*Caretta caretta*) named “Jorge” was released off the coast of Mar del Plata, Argentina, after spending over 40 years in captivity. Originally captured incidentally in 1984 in El Rincón estuary (Bahía Blanca), Jorge had lived in an aquarium in Mendoza, hundreds of kilometers from the sea and in low-salinity conditions. In 2021, a multidisciplinary team from the Centro de Rehabilitación de Fauna Marina Aquarium (CRFMA), together with staff from the Mendoza city government, initiated a comprehensive evaluation and rehabilitation process to assess the turtle’s potential return to the wild. The readaptation process began in Mendoza, where Jorge underwent gradual acclimation to seawater salinity and medical monitoring to correct electrolyte imbalances caused by decades in low-salinity water. After his transfer to Mar del Plata Aquarium in 2022, the stabilization of plasma electrolytes was achieved, with sodium (156.5 mEq/L; reference range 146.1–166.8), potassium (4.8; 3.3–6.3), and chloride (113.5; 106.6–120.6) reaching normal values for wild loggerheads. From October 2022 to April 2025, structured environmental enrichment (EE) sessions were implemented three times per week, including swimming endurance training, prey capture of live crustaceans and fish, and tactile stimuli to promote natural behaviors and improve physical condition. Prior to release, he was fitted with a satellite tag to monitor post-release behavior and migration. Approximately four months after his release, Jorge has traveled over 4,000 km, with his most recent recorded position in Guanabara Bay (Rio de Janeiro, Brazil), a known foraging area for the species. Stabilized health parameters and sustained post-release migration

were used as key indicators of rehabilitation success. His journey provides valuable insight into the viability of reintroducing long-term captive individuals and highlights the role of satellite tracking in post-release monitoring. This exceptional case of a turtle reared in captivity for over four decades highlights both the challenges and the potential of long-term rehabilitation protocols. Thanks to the work of a multidisciplinary team in Argentina and the local outreach efforts of the ASO network, Jorge has become a powerful ambassador for sea turtle conservation in the region, demonstrating the importance of combining science, animal welfare, and public engagement to advance marine conservation efforts.

A LOW-CODE APPROACH TO SEA TURTLE FIELD RESPONSE AND CASE MANAGEMENT

Josh Switzer, Dustin Paradis

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The Marine Institute at the Maui Ocean Cetner, a Maui-based 501c3 nonprofit, conducts sea turtle stranding response and rehabilitation in close coordination with NOAA's Pacific Islands Fisheries Science Center. Data associated with sea turtle strandings and rehabilitation was historically managed through spreadsheets, paper forms, and disconnected digital folders. This led to data fragmentation, inconsistencies, and difficulties tracking individual turtles over time or analyzing program outcomes. In many legacy systems like this, key updates and follow-up information must be entered across separate data sources, introducing delays and gaps that obscure a complete case history. To solve this, we designed a unified digital system to streamline sea turtle field response workflows, improve data integrity, and enable long-term case tracking. While existing platforms offer valuable tools for clinical recordkeeping or data management, we found few options that could support the full workflow from field to release in a mobile-friendly, role-specific format suitable for both volunteers and staff. Using a low-code approach built on Microsoft Power Platform, we developed a mobile-friendly system to capture and manage stranding response data from initial hotline reports through field assessment and rescue. Canvas apps allow field responders to enter structured data directly from mobile devices, including photos, tag IDs, and GPS-linked observations. All records feed into a centralized Dataverse backend with relational links between hotline calls, field responses, and individual turtles. The data model allows multiple events to be linked to a single turtle record, supporting longitudinal tracking across rescues, rehabs, and recaptures. Backend automation helps maintain data consistency with minimal manual effort. The platform supports real-time data access, searchability across past cases, and consistency in data entry. Volunteer and staff workflows are separated by role, improving usability while maintaining secure, controlled data access. The new system has significantly improved data quality, reduced duplication, and eliminated reliance on paper forms or loosely managed spreadsheets. Real-time visibility into field activity and case status has improved internal coordination and enabled faster reporting for grants and outreach. Individual turtles can now be tracked across multiple encounters, with full histories including photos, tags, and notes, all accessible through a unified profile. The structured backend also supports long-term flexibility; data fields can be added or removed without disrupting past records, allowing the system to evolve with program needs while preserving continuity. The platform is designed to expand modularly, with additional components planned to support rehabilitation workflows and medical records. This approach provides a sustainable, cost-effective model that could be adapted by other small organizations facing similar operational challenges in wildlife response and care.

RETROSPECTIVE STUDY INTO THE HEALTH STATUS OF *CARETTA CARETTA* ON THE ISLAND OF BOA VISTA, CAPE VERDE, FROM 2019-2025 TO AID THE ESTABLISHMENT OF A RESCUE CENTRE

Harrison Watler

Turtle foundation, United Kingdom

The health status of the sea turtles on Boa Vista, Cape Verde, has often been overlooked. It is one of the largest Loggerhead (*Caretta caretta*) rockeries in the world and as such is of huge importance for the preservation of the species. Due to the changing landscape of the growth in tourism it is key to understand the current health status of those turtles that are nesting. Along the coastline there is many 'at risk' areas where the is a high density of turtles nesting which often leads to traumatic injuries. Up until now there has been no dedicated facility on the island to help those injured turtles. The aim of the turtle foundation is to establish a sea turtle dedicated rehabilitation centre. In order to understand if this was needed on the island a retrospective look into the available data from the Turtle foundation was analysed. The data was analysed for injured turtles, 'lost' turtles and turtles found dead. Paper records were analysed from 2019-2021 with electronic records from 2023-2025 analysed. It must be noted that there has been a number of paper records that have been destroyed due to floods and so there is some gaps in the data but this brief analysis enables the necessary insight needed. Data from turtles found on beaches patrolled by The Turtle Foundation was analysed and split into key categories of the type of injury. This included initially traumatic injuries, injuries of natural causes, lost turtles and turtles found dead. The traumatic injuries were then further analysed by type of injury – shell injury, flipper damage or damage to the head or neck. It was found there was an average injury rate of 4.98% from 2019-2021.From 2023-2025 there was a sharp increase in the number of injured cases however this has coincided with the introduction of the electronic recording system and may explain the increase. From 2023-2025 130 turtles were rescued, 112 were found injured and 40 found dead. Reasons behind this and further analysis is explored in the presentation. From this I explore the challenges with establishing a rescue centre alongside how to plan for treatment of those upcoming patients. It is also key to understand that the data analysed is from the accessible data available from the Turtle foundation who cover approximately 1/5 of the nesting beach on Boa vista. Further work is needed for collaboration between organisation to understand the full picture. I also explore key cases seen in 2025 to highlight the key issues seen in Boa vista and the challenges of medically treating these patients.

FIRST GREEN SEA TURTLES (*CHELONIA MYDAS*) AND A HAWKSBILL'S SEA TURTLE (*ERETMOCHELYS IMBRICATA*) REHABILITATED: THE LAUNCH OF THE SEA TURTLE RESCUE AND REHABILITATION PROGRAM IN PERU

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Sea turtles population and biological studies are largely recognized and distributed along Peru, especially focused on the northern coast, however little is known about the health of sea turtle species and their presence in the central coast of Peru. This work aims to present the first cases under long-term "ex-situ" rescue and clinical rehabilitation of two Green sea-turtles (ORCT-215/ORCT-230) and one Hawksbill's sea turtle (ORCT-224) that initiated the long-term Sea Turtle Rescue and Rehabilitation Program in Peru. All of the specimens were juvenile females rescued from the coast of Lima (12º13'08.61"S 76º00'11.49"W

– 12º35'10.87"S 76º42'17.41"W). Critical data was acquired from the stranded specimens: carapace length, body biometrics, species, gender, geo-position location and a stranding code. Physical examination, hematology analysis, and x-ray review were conducted for clinical diagnosis. The sea turtles were found with plastic ingestion present in the enterogastric chambers towards the duodenum, suffering of focalized intestinal inflammation, secondary infection, secondary pneumonia and sea turtle exhaustion syndrome. All received medical treatment including parenteral enrofloxacin antibiotic and dexamethasone anti-inflammatory, supported with isotonic sodium chloride 0.9% fluids given through gastric tube for a gastro-intestinal wash and oral hydration combined with assisted feeding, according to the species diet, receiving algae for *C. mydas* and muzzles for *E. imbricata*, Treatment was conducted in a three-phase progressive rehabilitation protocol for the assessment of movement response, swimming and diving capacity, and feeding behavior, followed with programmed resting times in shallow, medium and deep salinized pools respectively. The sea turtle patients ate by themselves after 5 days of rehabilitation. All three were released in the ocean streams of coastal waters with a plastic tag number for follow up. These cases became a milestone in public awareness as more citizens have taken part of our Stranding and Conservation Network reporting over 382 sea turtle strandings, actively participating in over 48 beach first aid and disentanglements while following instructions to assist sea turtles in their return to the beaches of Lima city where sea turtles are rarely seen. This Program has become an unprecedented step forward for sea turtle conservation in Peru.

RAPID FIELD-DEPLOYABLE DETECTION OF MARINE PATHOGENS USING INSULATED ISOTHERMAL PCR: APPLICATIONS FOR SPIRORCHIID BLOOD FLUKES AND CHELONID HERPESVIRUS 5

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Emerging and endemic pathogens are increasingly recognized as significant threats to marine megafauna, with direct implications for biodiversity conservation and ecosystem health. Spirorchiid blood flukes and chelonid herpesvirus 5 (ChHV5) contribute to high morbidity and mortality in sea turtles through vascular disease and fibropapillomatosis, respectively. Traditional diagnostic methods for these pathogens are constrained by reliance on centralized laboratories, skilled personnel, and intact sample quality, limiting timely detection during stranding events and conservation interventions. Insulated isothermal polymerase chain reaction (iiPCR) provides a rapid, portable alternative capable of DNA detection under field conditions, requiring minimal technical expertise. Here, we developed and validated iiPCR assays for spirorchiids and ChHV5. The iiPCR assays detected all five major spirorchiid species (Ct ~35) as well as ChHV5 (Ct ~34), demonstrating broad applicability of the platform across taxonomically distinct marine pathogens. These findings establish iiPCR as a reliable diagnostic platform for marine wildlife health surveillance. By enabling near real-time, on-site detection, this platform enhances the capacity of conservation programs to identify outbreaks rapidly, allocate resources effectively, and implement mitigation strategies. Beyond clinical diagnosis, iiPCR strengthens long-term epidemiological monitoring, facilitates early warning systems for population-level threats, and supports evidence-based conservation medicine. Consequently, iiPCR represents a critical advance in safeguarding sea turtles, taxa already under pressure from climate change, habitat degradation, and anthropogenic stressors.

FIRST DETECTION OF A HAEMOCYSTIDIUM (MALARIA-LIKE) PARASITE IN FLATBACK (*NATATOR DEPRESSUS*) AND GREEN (*CHELONIA MYDAS*) TURTLES IN WESTERN AUSTRALIA*

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Malaria and related haemosporidian parasites are widely distributed in reptiles but have not previously been reported in sea turtles. During baseline health surveys of sea turtles in Western Australia (WA), intraerythrocytic parasites consistent with Haemocystidium spp. were detected in blood films from flatback (*Natator depressus*) and green (*Chelonia mydas*) turtles during routine screening and confirmed by molecular testing. A total of 130 blood samples collected from foraging and nesting turtles between 2016 and 2020 were screened via nested PCR targeting the mitochondrial cytb gene, including 105 flatbacks, 20 greens, and five olive ridleys (*Lepidochelys olivacea*). The parasite was detected exclusively in foraging turtles, with a combined prevalence of 16.9 % (22/130), comprising 17 immature greens (77 %) and five mature flatbacks (23 %). Parasitaemia observed microscopically was generally low-grade, with most infections classified as mild. Two Haemocystidium genotypes (A and B) were identified, with genotype A most prevalent. Phylogenetic analysis revealed close genetic relationships with Haemocystidium species from freshwater and terrestrial turtles, suggesting an ancient and potentially widespread lineage among aquatic turtles. Preliminary analyses found no association between parasite presence or grade and health indicators, including body condition and haematological and biochemical parameters, indicating that infection is currently incidental. However, haemosporidian infections in reptiles can cause anaemia and other physiological changes, particularly under conditions of stress or immunosuppression, so continued surveillance will be important to detect potential shifts in infection dynamics under changing ecological conditions. Based on transmission pathways in other reptiles, infection is likely vector-borne, potentially involving dipteran insects or aquatic ectoparasites associated with coastal and intertidal foraging habitats. This study provides the first confirmed detection of Haemocystidium parasites in sea turtles and establishes an essential health baseline for understanding infectious disease risks. Given the limited understanding of sea turtle diseases, the establishment of baselines like this is critical for detecting changes in pathogenicity and informing conservation-health monitoring under future environmental change.

ENTERIC AND SYSTEMIC COCCIDIOSIS IN HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*): A CASE SERIES FROM A FLOOD-RELATED STRANDING EVENT IN QUEENSLAND, AUSTRALIA

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Coccidiosis is a significant protozoal disease of green turtles (*Chelonia mydas*) in Australia and globally, associated with enteric and systemic infections and documented mass mortality events. While well documented in green turtles, coccidiosis has not previously been confirmed in hawksbill turtles (*Eretmochelys imbricata*). Here, we report a case series of two hawksbill turtles, representing the first confirmed diagnoses of coccidiosis in this critically endangered species. Severe flooding and extreme weather occurred across southeast Queensland during 2021–2022, resulting in widespread seagrass loss and an increase in marine turtle strandings in the Great Sandy Marine Park (Fraser Coast region). Disease investigations were undertaken to examine causes of morbidity and mortality among stranded turtles during this period. Histopathological examination of 160 stranded turtles during this event identified coccidiosis in only a small number of cases, indicating that these findings represent isolated infections rather than a population-level driver of the stranding event. During histopathological examination, coccidia were identified in two hawksbill turtles, prompting further targeted pathological and molecular investigation. Both hawksbill turtles were found in poor body condition, with one animal found dead and the other moribund and euthanised on arrival. External, gross necropsy, and histopathological findings were consistent with descriptions of enteric and systemic coccidiosis in green turtles. Both individuals exhibited heavy epibiotic growth, and gross examination revealed severe ulcerative and necrotising gastroenteritis. Histopathology demonstrated abundant intralesional apicomplexan protozoa within the intestinal epithelium in both cases, with extraintestinal dissemination to viscera identified in one individual; moderate numbers of mixed bacteria were present within superficial ulcerative crusts, consistent with secondary opportunistic invasion, and no fungal or acid-fast organisms were identified. Concurrent spirorchiid trematode infections were present and may have contributed to disease severity or complicated the pathological interpretation. Molecular screening confirmed coccidia DNA in both individuals, with sequencing aligning with known sea turtle coccidia lineages. Further analyses to refine taxonomic resolution are ongoing. Although limited by a very small sample size (n=2), this case series highlights the importance of integrating veterinary necropsy, histopathology, and molecular diagnostics during mass stranding events, particularly following major environmental disturbance, to detect emerging or previously undocumented diseases. These findings support enhanced surveillance of stranded hawksbill turtles, routine incorporation of molecular screening into necropsy workflows, and consideration of co-infection dynamics to inform clinical triage, rehabilitation decision-making, and conservation health monitoring.

PACKED CELL VOLUMES AND TOTAL SOLIDS OF STRANDED SEA TURTLES IN NORTH CAROLINA, USA FROM 2022 THROUGH 2024

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Packed cell volumes (PCV) and total solids (TS) offer insight into the health of stranded sea turtles. Packed cell volume measures the percent of red blood cells in a blood sample. It can help to identify anemia, dehydration, and more. Measured in grams per deciliter (g/dL), total solids indicate the concentration of proteins, lipids, and other dissolved components in a plasma sample. It can help to identify hydration and nutrition status. Monitoring these parameters throughout an animal's rehabilitation offers veterinarians a quick, easy, and inexpensive way to assess health. The Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSTRRC) is nonprofit sea turtle conservation organization in North Carolina, USA whose mission includes rescuing, rehabilitating, and releasing stranded sea turtles. Founded in 1997, KBSTRRC offers a long term data set of sea turtles in rehabilitation. The 2019 implementation of RaptorMed, a medical records database, is allowing exploration of blood value trends over time. Since 1997, KBSTRRC has admitted 1,671 sea turtles, including greens (*Chelonia mydas*), loggerheads (*Caretta caretta*), and Kemp's ridleys (*Lepidochelys kempii*). Three years of data (2022-2024) were analyzed to evaluate admit PCV and TS. Only turtles with both admission and disposition dates within this range were included. Turtles that died or were euthanized within 24 hours were excluded from the analysis. The analysis reviewed records from 34 loggerheads, 87 Kemp's ridleys, and 209 greens. Loggerheads had the lowest average admit PCV and greens had the highest. Loggerheads had a PCV range of 4-40% and a TS range of 0.0-5.0 g/dL. The average PCV was 21% and the average TS was 3.1 g/dL. Kemp's ridleys had a PCV range of 13-38% and a TS range of 1.6-5.3%. The average PCV was 26% and the average PCV was 3.2%. Greens had a PCV range of 15-47% and a TS range of 0.6-4.1g/dL. The average PCV was 29% and the average TS was 2.3 g/dL. These ranges far exceed reference interval values of sea turtles considered to be healthy. Across species, average admit PCV values for cold stunned turtles was higher than average admit PCV values for debilitated turtles (30% and 26% respectively). Debilitated turtles are more anemic than cold stunned turtles, which may account for the difference. Average admit PCV values for hooked turtles was higher than average admit PCV values for boat struck turtles (26% and 21% respectively). Hooked turtles may be less anemic than boat struck turtles, which may account for the difference. Interpreted within the context of other diagnostics including blood chemistry and cause of stranding, PCV and TS values in rehabilitating sea turtles aid veterinary decision making and facilitate release decisions. This summary presents our first in depth review of packed cell volume and total solids in sea turtles admitted to the KBSTRRC. We hope continued data examination will offer additional insight into bloodwork trends of stranded animals.

Social, Economic, and Cultural Studies

A SPACE FOR BOTH OF US: QUALITATIVE PARTICIPATORY MAPPING OF AN IMPORTANT MARINE TURTLE AREA TO INFORM MARINE AREAS IMPORTANT FOR PEOPLE AND TURTLES*

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Important Marine Turtle Areas (IMTAs) are discrete boundaries in local seascapes that have been identified as important for the conservation of marine turtles, or as seascapes where marine turtles are culturally important to local communities. We integrated qualitative research methods into participatory mapping techniques to understand the values of local stakeholders across the Semporna seascape in Sabah, Malaysia, with regards to sea turtles and how they may want a biologically-derived IMTA modified to reduce its impacts on their livelihoods. We conducted semi-structured interviews with 18 local stakeholders who work or live alongside marine turtles in Semporna, including local fishers, conservation organizations, researchers, government agencies, and tourist operators. As part of a participatory mapping exercise, participants were asked to use paper maps to indicate areas that were important to them, their communities, or their livelihoods. Interviews were audio-recorded, transcribed verbatim, and translated into English, while paper maps were later digitized into GIS software. Interview data were analyzed using Applied Thematic Analysis. Themes emerging from this analysis were subsequently linked to spatial features identified by the participants. Finally, we compared the biologically-derived IMTA with the modified IMTA boundaries. Our findings revealed several themes across space, including conservation-focused themes such as regions of biodiversity and marine turtle aggregations, as well as themes that transcended material values, such as cultural, familial, and historical importance. Participants highlighted areas where there may be an overlap of differing values, such as areas of where conservation and sea turtles are abundant overlap with where there are known destructive extractive methods such as fish bombing. Our study highlights the importance of understanding the spatial values of local stakeholders across a seascape to inform protected areas that are just and equitable for both marine turtles and people.

ONLINE NEWS COVERAGE OF SEA TURTLES AND PLASTIC POLLUTION REVEALS A FAILURE TO ENGAGE READERS ACROSS THE POLITICAL SPECTRUM*

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Online news coverage plays an important role in shaping public awareness, discourse, and policy. Information provided in news articles can vary depending on the political bias of a source, and readers tend to seek out information that aligns with their political beliefs. Over the past decade, sea turtles have become increasingly associated with the anti-plastic movement. Solutions to plastic pollution may focus on strategies tied to individual behavior (e.g., reduce, reuse, recycle) or systemic change (e.g., voting, legislation). Here, we examine the behavioral framing surrounding how solutions to marine plastic are presented in online news articles covering sea turtles and plastic pollution. Using content analysis, we analyzed 132 articles from 12 politically diverse news sources (left-leaning, no bias, right-leaning) to investigate 1) the solutions (individual or systemic) to marine plastic offered to readers; and 2) framing elements that may influence reader desire to participate in those solutions. Our results reveal that articles across the political spectrum largely fail to employ frames that may engage readers with solutions to plastic pollution, with substantial differences in how political biases influence the reporting of solutions.

PARTICIPATORY SCIENCE ON KNOWLEDGE, CONSUMPTION AND ATTITUDES TOWARDS SEA TURTLES IN NORTHEAST MEXICO AND SOUTHEAST USA

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The history of marine turtles is marked by centuries of exploitation, resulting in dramatic population declines worldwide. For centuries, coastal communities have harvested sea turtle meat, eggs, and oil, while using shells and skin for ornaments, tools, and trade. As a result, six of the seven sea turtle species are currently listed on the IUCN Red List. The Gulf of Mexico (GoM) is a critical region for conservation, as it hosts five species: Kemp's ridley, hawksbill, green, leatherback, and loggerhead. The most notable case is the Kemp's ridley, endemic to the GoM, where ~90% of females nest at Rancho Nuevo Beach Sanctuary (RNBS), and ~3% at Padre Island National Seashore (PAIS). Recent estimates show that populations remain 90% below historic levels prior to 1960s. In this regard, RNBS and PAIS illustrate the ecological and conservation interdependence of Mexico and the U.S. Effective conservation requires linking

ecological research with human behavior and community engagement. Citizen surveys and interviews are critical tools to understand perceptions, knowledge, and willingness to change practices. Evidence shows that when communities are engaged through participatory science or education, they develop stronger stewardship values. However, most of the studies done in GoM focus primarily on biological monitoring, with less emphasis on community perspectives. This study aims to evaluate community knowledge, consumption and attitudes regarding sea turtles in Texas, USA and Tamaulipas, Mexico using citizen surveys. The study was conducted under an Institutional Review Board permit. We carried out an anonymous 23-question survey to assess demographics, general knowledge about sea turtles, past and current consumption of turtle meat, eggs, and byproducts, and future interest in participatory conservation, including one attention-check question. Surveys were conducted in public spaces in Northeast Mexico (Rancho Nuevo, Aldama, Ciudad Victoria, Tampico, Altamira, Reynosa) and South Texas (Corpus Christi, Hidalgo County region). English and Spanish, physical and online versions were offered across locations. Surveys were carried out in 2023. A total of 261 surveys were obtained, with an average of 39 per sampling location. Nineteen surveys failed the attention-check question, resulting in n=242. The analysis of this data will provide insight into the sociocultural similarities and differences on sea turtle knowledge, attitudes, and practices per region in Mexico and the U.S. It will provide evidence of cases of illicit consumption and use per region. As well as report willingness and opportunities for community participation and targeted outreach per region. Results will reveal how knowledge, culture, and locality shape conservation behaviors. By producing biologically relevant and socially actionable data, this study will inform NGOs and agencies to identify where consumption persists, where misconceptions remain, and where communities are most willing to engage. Coastal residents engaged in sea turtle conservation often feel unheard; survey data could validate their role and support partnerships with NGOs. Findings can help strengthen binational collaboration, guide outreach strategies, and empower residents to participate in conservation strategies for long-term turtle recovery. Over time, this study could serve as a baseline for evaluating conservation campaign effectiveness.

FISHING FOR SOLUTIONS: INCORPORATING FISHERS' PERSPECTIVE INTO BYCATCH REDUCTION STRATEGIES IN THE MEXICAN PACIFIC*

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Sea turtle bycatch is a pressing ecological, social, and economic challenge for fishing communities in the Mexican Pacific. While important steps have been undertaken over the last three or more decades to improve the selectivity of fishing gears, their adoption and implementation remain low due to economic and social challenges. As part of MARES Comunidad, a binational conservation initiative promoting sustainable fisheries and reducing sea turtle bycatch, we conducted 578 surveys across 62 artisanal fishing communities in eight Mexican states in 2021-2022. The surveys included questions to capture fishers' perspectives on bycatch and its drivers, impacts, and potential solutions, which were measured on a scale of agreement (disagree to agree). Survey responses indicated a minimum annual bycatch of 3,320 turtles in the surveyed area, with 80% of the turtles being released alive. While all fishing gears were reported to interact with turtles, gillnets and longlines were most frequently involved. Bycatch affected all sea turtle species, with olive ridleys (*Lepidochelys olivacea*) and green turtles (*Chelonia mydas*) most frequently impacted, reflecting their abundance in the region. Fishers' perceptions of bycatch were predominantly negative, expressing anger, sadness, and fear, with some responses highlighting economic concerns. Positive emotions were reported mainly when turtles were released alive, while about one-fifth of responses were neutral or factual, indicating a perception of bycatch as inevitable. Respondents tended to agree that overlap between fishing grounds and turtle feeding areas was a major driver of bycatch (50% agreement; ANOVA, $p < 0.001$). They also recognized bycatch as both an economic and ecological problem, citing gear damage (55% agreement) and harm to marine species (53%), with significant variation across project areas ($p < 0.0001$). Furthermore, 74% of participants identified industrial fisheries as a major contributor to bycatch ($p < 0.001$), and 89% agreed that effective solutions require collaboration among all actors. Proposed solutions (n=452) spanned 24 categories, with the most frequently mentioned being restricting or reducing non-selective fishing gears, modifying gears, and enhancing collaborative research. When fishers were asked about incentives to reduce bycatch, economic support to switch gears, scholarships for youth, and capacity building were the most frequently mentioned options. Exploratory, descriptive analysis of open-ended responses highlighted the prominence of gillnets in bycatch, the non-intentional nature of interactions, the difficulty of solving such an issue, and the critical role of government officials listening

to fishers' proposals. Overall, this work demonstrates that sea turtle bycatch is not solely an ecological problem; it is intrinsically social and economic, requiring bottom-up, integrative solutions. Engaging fishers as active participants in designing interventions is crucial to ensure that strategies improve both fishing practices and community wellbeing, but to do so, we first need to understand their perceptions of bycatch and potential solutions. By emphasizing collaboration, local knowledge, and shared responsibility, sustainable fisheries and effective bycatch mitigation can be achieved.

SOCIO-CULTURAL DRIVERS OF LEATHERBACK TURTLE USE AND CONSERVATION IN BURU ISLAND, MALUKU PROVINCE, INDONESIA

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The Western Pacific subpopulation of leatherback turtle (*Dermochelys coriacea*) is critically endangered, with overutilisation identified as its primary threat. The Northern shore of Buru Island, Maluku Province, Indonesia was a previously undocumented and only locally known nesting site of leatherback turtles (locally known as teteruga salawaku) until it was made known on a national and global scale in 2017 when WWF-Indonesia initiated a beach monitoring programme. In 2017, ~59% of nests were initially illegally harvested, but today, it has reportedly ceased. Cultural and socio-economic dynamics significantly shape conservation efforts, understanding them is therefore paramount to ensuring the long-term success and potential replicability of conservation programs. This study investigates: (1) the socio-cultural, historical, legal, and political factors that are associated with leatherback turtle utilisation in Buru, (2) the conditions and frameworks that explain the cessation of turtle and egg illegal harvest, and (3) the perspectives that are represented or marginalised in existing documentation. Using qualitative document analysis, this research project looks at historical archives, government records, conservation reports, legal documents, and media sources. The analysis is guided by an interdisciplinary framework that draws on political anthropology, anthropology, green criminology, and sociology. Documents are analysed across different temporal periods (from pre-colonial times, through the New Order political era, to contemporary conservation efforts) and across multiple geographic scales (from village to national level). These documents are currently being analysed, and the results will be shared during the symposium. The results of this work will also be shared with Buru community members, government agencies, non-profit organisations, and relevant stakeholders.

SOCIAL LANDSCAPE OF CONSERVATION: TRACING THE TRANSFORMATION OF SEA TURTLE CONSERVATION IN SEBUBUS VILLAGE, PALOH, WEST BORNEO

Retno Kusuma Ningrum, Dwi Suprapti

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Sebubus Beach, located in Paloh, West Kalimantan, is an important nesting habitat for sea turtles, with a hotspot area extending approximately 19.3 km. Historically, sea turtle eggs were heavily poached in this area, potentially contributing to population declines. The full legal protection of sea turtles in Indonesia since 1990 has marked a baseline shift in how these species are utilized and valued. This study aims to understand the socio-cultural, historical, legal, and political factors associated with sea turtle utilization in Sebubus Village and to examine the conditions and frameworks that explain the cessation of egg poaching. We employ qualitative document analysis using historical archives, government records, conservation

reports, legal documents, and media sources. In addition, interview surveys is used to validate and complement the findings. The collected documents and interview data were analyzed using framework and thematic analysis, combining deductive coding based on predefined categories (historical, legal, and socio-cultural) with inductive coding to identify emerging themes. This mixed approach enables comparison across time periods and data sources, revealing the social, cultural, and political factors that have influenced the transition from turtle egg exploitation to protection in Sebubus Village. Preliminary findings indicate that traditional cultural practices persist but have been adapted to align with conservation values, where the use of turtle eggs in their cultural festival (Festival Lempar Talok Panyok) has been replaced with imitation eggs (ping-pong balls). In addition, a community commitment to release more than 20,000 hatchlings in 2025 demonstrates a clear shift from egg consumption to active protection. The local perception of turtles has also transformed, with communities now gaining both social and economic benefits from turtle conservation and eco-tourism. Additional findings will be presented during the symposium, highlighting the social dimensions that underpin conservation efforts and their importance for ensuring long-term success and potential replicability in other coastal communities.

BEYOND THE SHELL: EXPLORING THE DIMENSIONS OF SEA TURTLE TAKE IN BOCAS DEL TORO, PANAMA

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Illegal take is one of the major threats that sea turtles face worldwide. In Bocas del Toro, Panama, the use of sea turtles has historically played an important role in the local economy and culture. During the 1960s, the region was one of the main exporters of tortoiseshell. Understanding the motivations behind the illegal take of sea turtles is essential for developing effective conservation and management strategies, particularly considering Panama's new 2024 law for the protection of sea turtles. This study first applied the IPOACHED framework, which predicts that species that are in-demand, passive, obtainable, all-purpose, conflict-prone, hide-able, extractable, and disposable are more susceptible to poaching and therefore more vulnerable. We then conducted twenty-five semi-structured interviews with key informants, including members of native families, sea turtle consumers, sea turtle sellers, NGO personnel, and local authorities, to explore local perceptions of the illegal take of sea turtles in Bocas del Toro. This study was approved by the Institutional Review Board (IRB-24-0388). Verbal consent was obtained before interviews, participation was voluntary, anonymity was guaranteed, and participants could choose not to answer specific questions. Our findings indicate that of the four species present in Bocas del Toro, green, hawksbill, leatherback, and loggerhead turtles, three were targeted. Semi-structured interviews were analyzed using MAXQDA. Applying the framework, we found that the hawksbill, green, and leatherback

turtles were perceived as valuable, passive, available, usable, concealable, removable, and disposable, aligning with most of the key vulnerability factors. However, the methods of obtaining these species differ by location. Hawksbill turtles were often taken from nesting beaches, while green turtles were caught at sea, a more challenging process. The leatherback turtle, on the other hand, was commonly targeted for its eggs. According to participants, the illegal take of sea turtles was closely linked to their historical and cultural significance in the region. The high number of hawksbill and leatherback turtles on nesting beaches, along with the strong cultural ties people in Bocas del Toro have with these species, have made them recurrent targets. Nevertheless, the intensity and methods of take vary across locations. The take and trade of sea turtle products, such as meat, eggs, and oil, operate through established networks, supporting the framework's findings that sea turtles are both concealable and disposable. Participants remarked that the ban on tortoiseshell trade negatively affected their economy and livelihoods, and many expressed confusion about why trade was no longer permitted, since they perceived sea turtles as abundant. Finally, participants noted that illegal take continued to supply illicit markets of meat, eggs, tortoiseshell, and other products on the islands. Our findings highlight the importance of integrating local knowledge with theoretically grounded frameworks to identify current and emerging threats to sea turtles. This approach provides a replicable model for understanding how the illegal take and trade of sea turtles operate and underscores conservation gaps that must be addressed for more effective management.

FISHER PERCEPTIONS REGARDING ADOPTION OF SEA TURTLE BYCATCH REDUCTION TECHNOLOGIES*

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The incidental capture and mortality of non-target species (i.e., bycatch) in fisheries contributes to marine population declines worldwide. To mitigate impacts on vulnerable marine species and ecosystems, bycatch reduction technologies and gear modifications (BRTs) have been developed and tested in several fisheries with the intention of reducing bycatch. However, adoption of BRTs is minimal across many regions, especially in small-scale fisheries of developing nations. In this study, we report fishers' perceptions of the benefits and challenges of using BRTs as long-term conservation tools. We conducted 98 structured interviews with small-scale Mexican fishers across 11 fishing communities via purposive and snowballing techniques using a mixed-methods approach. We quantified fisher responses to closed-ended questions and used inductive coding to identify themes from fishers' open-ended responses. Over half of fishers interviewed (61.2%) were familiar with BRTs for sea turtles and other endangered species. Most fishers preferred using BRTs voluntarily (67.3%) rather than a mandate by local governments (29.6%). Fishers commonly reported that the main advantages of using BRTs was the ability to protect the environment and reduce bycatch. In contrast, perceived challenges of long-term BRT use related to experiencing reductions in target catch, changes in traditional fishing practices, and the adaptability of BRTs to their fishing gear. When fishers were asked to identify forms of compensation they would prefer when adopting BRTs, fishers reported receiving fishing equipment and materials, financial support, and enhanced market value for their catch. Fisher recommendations for encouraging the adoption of BRTs included dissemination of BRT study results, teaching fishers about BRTs more broadly, and fostering personal connections with fishers. Our findings highlight the importance of understanding fishers' perceptions when promoting the adoption of BRTs to develop viable, community-supported solutions to mitigate sea turtle bycatch.

FROM AWE TO ACTION: HOW ECOTOURISTS CONNECT WITH SEA TURTLE CONSERVATION AT THE WORLD'S DENSEST LEATHERBACK NESTING BEACH*

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Grande Riviere, Trinidad and Tobago, is home to the world's densest nesting beach for endangered leatherback turtles. Due to the concentration of leatherbacks on a small (~ 1 km) stretch of beach, Grand Riviere is a major destination for leatherback ecotourism. While ecotourism is often promoted as a strategy for conservation and community development, little is known about the motivations and attitudes of the tourists who visit. Here, we address these knowledge gaps by examining why tourists visit Grande Riviere and how interacting with leatherbacks affects their attitudes and willingness to support conservation efforts. We designed a pre- and post-tour survey for visitors participating in a guided leatherback nesting tour in collaboration with the Grande Riviere Nature Tour Guide Association. (IRB STUDY00022193 - Trinidad and Tobago Forestry Division A043026) Surveys captured demographic information, motivations for travel, conservation attitudes, emotional responses to turtle encounters, and willingness to pay for tours. Using a mixed-methods approach of quantitative methods and qualitative coding of open-ended responses across 300 surveys revealed that most respondents were from Trinidad and Tobago, in the 25-34 year age range, and held a bachelor's or advanced degree. Additionally, in thematically coding using Lisa Campbell's 2006 Environmental Values Indicators, we found that the driving motivations for visitors were seeking a relaxing nature experience, general interest in animals, and experiencing the culture of Trinidad and Grande Riviere. Our results provide valuable insights to the community of Grande Riviere and its leatherback ecotourism industry. This data can expand conservation efforts by advancing leatherback ecotourism in this critical habitat.

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