NOAA Technical Memorandum NMFS-SEFSC-645

PROCEEDINGS OF THE THIRTY-THIRD ANNUAL SYMPOSIUM ON SEA TURTLE BIOLOGY AND CONSERVATION

2013 INTERNATIONAL
SEA TURTLE SYMPOSIUM
Baltimore, Maryland USA

5 to 8 February, 2013
Baltimore, Maryland, USA

Compiled by:
Tony Tucker, Lisa Belskis, Aliki Panagopoulou, ALan Rees, Mike Frick,
Kris Williams, Robin LeRoux, and Kelly Stewart

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

May 2013

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2013 INTERNATIONAL
SEA TURTLE SYMPOSIUM
Baltimore, Maryland USA

PRESIDENT'S REPORT (abridged*)

33rd Annual Symposium on Sea Turtle Biology and Conservation

"Connections"

2-8 February 2013, Baltimore, Maryland, USA

Raymond R. Carthy, President, ISTS

The 33rd Annual Symposium on Sea Turtle Biology and Conservation was held on February 2-8, 2013 in Baltimore, Maryland, USA. Baltimore is within the National Capital Region which is a hub for important scientific research, policy and decision-making by the nation's government and many leading conservation organizations. The pioneering 1st World Conference on Sea Turtle Conservation was held in Washington, D.C., 26-30 November 1979, and having this year's meeting in the National Capital Region just over 33 years later provided an inspirational link through time and location.

"Connections" was the theme for the Baltimore Symposium, and our focus for the meeting was to explore the biological and ecological linkages that sea turtles share with their environments, while also examining and celebrating the connections that they impose on us as we try to learn about and conserve them. The theme was evident in the attendance, the program, the special sessions and activities, and the partnerships that made the meeting a success. There were 1016 registrants, representing 67 countries, and an additional 130 local students and educators attended particular sessions. The program included 7 regional meetings, 5 workshops, 4 special sessions, and a Video Night. There were 144 oral presentations and 248 posters- an additional 53 talks were given during a three-day Terrapin, Tortoise and Freshwater Turtle Meeting preceding the main Symposium. Forty-three Vendors and Exhibitors, including many that were new to the event, contributed to an engaging venue. The National Aquarium in Baltimore was a key partner in hosting the Symposium, providing volunteer personnel and access to their facilities, and the Virginia Aquarium and Marine Science Center were strong partners in our education efforts.

The Symposium was held at the Baltimore Marriott Waterfront in Baltimore's Inner Harbor. The venue provided ample meeting and lodging space for the participants. The convenient facilities and the very accommodating staff were conducive to both intellectual and social interactions.

Educational Outreach: Positive local impact has become a strong tradition in hosting ISTS Symposia. In Baltimore we enjoyed proximity to Washington, D.C. and increased participation by government agencies and NGOs, but the primary outreach effort was a multi-faceted educational program. In cooperation with the Virginia Aquarium and Marine Science Center and the National Aquarium, a Teachers and Educators Workshop was held on February 2nd. Twenty-five local teachers and five Symposium participants learned techniques and received materials that will aid them in incorporating marine science, sea turtles, and the Chesapeake Bay into their curricula. Local schools (St. Demetrius Bilingual Day School, Poolesville H.S., South River High School, Furman Templeton Prep, Dr. Rayner Browne Academy, and Friends Meeting School) participated in a "Threats to Sea Turtles" Art Contest sponsored by ISTS, and the winning artwork was displayed at the Symposium. The opening session on Tuesday was followed by an early highlight- the "Sea Turtles Revealed" plenary was attended by 80 students and teachers from Baltimore middle and high schools (St. Demetrius Bilingual Day School, Dr. Rayner Browne Academy, Western High School, and Augusta Fells Savage Institute of Visual

Arts). The students engaged a panel of renowned sea turtle biologists and conservationists with a question and answer session where the panel was surprised to find themselves not only answering the usual “how big “ and “how old” queries, but pondering some of the same difficult ecological questions that drive their own work. The students and teachers that attended the Symposium's morning session had lunch with various biologists, graduate students and others in the sea turtle community as an opportunity for more personal "connections" between participants and students. Their lunch was followed by a trip to the National Aquarium. The “Sea Turtles Revealed” session and the “Sea Turtle Success Story” sessions on Tuesday afternoon were made available as a live webcast to 250 web sharepoints that were provided to schools, colleges, and universities.

ISTS Awards 2013: The 2013 ISTS Awards Committee was chaired by Sally Murphy and the members were Kimberley Maison, Stephen Dunbar, Jim Spotila, Dean Bagley, Ana Barragan, Ray Carthy, and Roldan Valverde. The Committee did an excellent job and presented this year’s meeting with an incredible group of awardees. The ISTS Lifetime Achievement Award was presented to Jack Woody for a career dedicated to sea turtle conservation, including establishment of the sea turtle program in the U.S. Fish and Wildlife Service, focusing attention on critical sea turtle conservation issues in Mexico and Central America, garnering international protection for Kemp’s and olive ridley turtles, and advocacy for TEDs. Hoyt Peckham received the ISTS Champions Award for his tireless work in tackling difficult and pressing conservation issues for North Pacific loggerhead sea turtles, and communicating effectively with stakeholders at all levels. There were two recipients of the Ed Drane Award for Volunteerism. Betsy Brabson was recognized as an outstanding volunteer Project Leader for the South Carolina Department of Natural Resources and for her role as a catalyst in protecting nesting beaches against invasive flora and fauna. Daniela Freggi was honored for her pioneering volunteer work in sea turtle veterinary care in Italy and as a dedicated promoter of national and international cooperation and skill exchange in the Mediterranean. The ISTS President’s Award was presented to Marydele Donnelly for over twenty-five years of profound involvement in global sea turtle conservation efforts, including successful support of the TED requirement for U.S. shrimpers, the InterAmerican Convention for the Protection and Conservation of Sea Turtles, and the U.S. Marine Turtle Conservation Act.

Archie Carr Student Awards: There were 50 oral presentations and 89 poster presentations submitted by students for consideration in the Archie Carr Awards. The winner for Best Biology Poster was Vanessa Bezy and Runners Up were Deasy Lontoh, Tomoko Hamabata, and Jake Lasala.Best Conservation Poster went to Nicole Reintsma. The Best Biology Oral was won by J. Roger Brothers. Nicole Mazouchova won the Best Biology Field-based Oral and Justin Perrault was Runner Up. The Conservation Oral winner was Elizabeth Bevan, and Francesc Domenech and Monette Schwoerer received Runners Up honors in Conservation Field-based Oral and Conservation Experimental Oral respectively.

(The full text of the 2013 President’s Report can be found in the Marine Turtle Newsletter.)*

COMMITTEES, CHAIRS, AND KEY ORGANIZERS

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Printed Program	Kelly Stewart, Michael Jensen

Africa Regional Meeting	Manjula Tiwari, Jacques Fretey, Angela Formia
Indian Ocean & Southeast Asia Regional Meeting	Lalith Ekanayake, Nadia Swidan
RETOMALA (Latin American Meeting)	Juan Manuel Rodriguez, Nineve Espinosa, Rocio Alvarez
WIDECAST (Caribbean) Regional Meeting	Karen Eckert
Mediterranean Regional Meeting	Paolo Casale
Pacific Island Meeting	Irene Kinan Kelly
Terrapin, Tortoise & Freshwater Turtle Meeting	Chuck Schaffer
Statistics & Data Analysis Workshop	Tomo Eguchi
Dive Behavior Workshop	Elizabeth Whitman, Junichi Okuyama
Sea Turtle Medicine Workshop	Daniela Freggi, Leigh Clayton
NMFS Permit Workshop	Amy Hapeman
Cultivating Resilience: Processes and Skills Workshop	Elena Mustakova-Possardt
IUCN Marine Turtle Specialist Group	Brian Hutchinson

EXECUTIVE COMMITTEE

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Wildlife Computers
Wildlife Rescue & Conservation Association
World Society for the Protection of animals
WWF

STUDENT AWARDS

There were 139 student presentations in the Archie Carr Prize Competition - 50 oral presentations and 89 posters. Award amounts: Winners = US $300 each, Runners-up = US $150 each. Grand total for all student awards = US $2400.

ORAL PRESENTATIONS

Winner- Biology Experimental: J. Roger Brothers, UNC-Chapel Hill, USA.
A mathematical model consistent with geomagnetic imprinting hypothesis of natal homing.

Winner- Biology Field-Based: Nicole Mazouchova, Temple University, USA.
Effects of granular incline angle on the locomotion of loggerhead sea turtle hatchlings in the field.

Runner Up- Biology Field-Based: Justin Perrault, Florida Atlantic University, USA.
Bioaccumulation and biomagnification of mercury and selenium in leatherback sea turtles: a cause for concern in this species.

Winner- Conservation: Elizabeth Bevan, University of Alabama-Birmingham, USA.
Implications of hatchling sex ratios and survival in the recovery program for the endangered Kemp's ridley sea turtle.

Runner Up- Conservation Field-based: Francesc Domenech, University of Valencia, Spain.
Incidental catch of the loggerhead turtle (*Caretta caretta*) by bottom trawling in the Valencian community.

Runner Up- Conservation Experimental: Monette Schwoerer, University of Central Florida, USA.
Shading in situ marine turtle nests: a potential practice to mitigate nest temperatures in response to climate change.

POSTER PRESENTATIONS

Winner- Biology: Vanessa Bezy, College of Charleston, USA.
Preliminary results: olive ridley sea turtle embryo mortality as a function of the nest microbial community at Ostional, Costa Rica.

Runner Up- Biology: Deasy Lontoh, Mos Landing Marine Laboratories, USA.
Variation in remigration interval is linked to the foraging destination of Western Pacific leatherback turtles.

Runner Up- Biology: Tomoko Hamabata, Kyoto University, Japan.
Genetic structure of green turtles nesting in Northwestern Pacific Ocean.

Runner Up- Biology: Jake Lasala, Georgia Southern Univeristy, USA.
New microsatellite DNA analyses may confound current population models for loggerhead sea turtles (*Caretta caretta*).

Winner- Conservation: Nicole Reintsma, Florida Atlantic University, USA.
Assessing a potential lighting problem for loggerhead hatchlings near the brightest lighthouse in the world: Arena assays at Hillsboro Beach, Florida, USA

ISTS AWARDS 2013

Chair- **Sally Murphy**
Members: Kimberly Maison, Stephen Dunbar, Jim Spotila, Dean Bagley, Ana Barragan, Ray Carthy, and Roldan Valverde.

President's Award

Marydele Donnelly

Ed Drane Award for Volunteerism

Betsy Brabson

Daniela Freggi

Life Time Achievement Award

Jack Woody

Champions Award

Hoyt Peckham

PLENARY AND SPECIAL SESSIONS

SEA TURTLES REVEALED: MARVELS, MYSTERIES, AND NEWS YOU CAN USE

Chair- **Blair Witherington**-Florida Fish and Wildlife Research Institute
Panel Members: **Bryan Wallace**-Oceanic Society, **Jeanette Wyneken**- Florida Atlantic University, **David Godfrey**- Sea Turtle Conservancy, **Kiki Jenkins**-University of Washington, **Pam Plotkin**- Texas Sea Grant, **Thane Wibbels**- University of Alabama-Birmingham, Baltimore middle and high schools.

SEA TURTLE CONSERVATION SUCCESS STORIES

Chairs- **Hoyt Peckham**- Center for Ocean Solutions and SmartFish, Lekelia Jenkins-University of Washington
Moderator- **Juliet Eilperin**- Washington Post
Invited Speakers:

THE SUCCESS OF THE US MARINE TURTLE CONSERVTION ACT AND ITS UNCERTAIN FUTURE
Marydele Donnelly, Sea Turtle Conservancy

CONSERVING SEA TURTLES BY LAND AND BY SEA IN PERU
Joanna Alfaro, ProDelphinus and University of Exeter

BUILDING SUSTAINABLE TED PROGRAMS WORLDWIDE
Marlene Menard, US Department of State/Office of Marine Conservation

THE GOOD, THE BAD, AND THE UGLY: CONSERVING SEA TURTLES IN NICARAGUA
Jose Urteaga, Fauna and Flora International

THE DECLINE AND RISE OF A SEA TURTLE: HOW KEMP'S RIDLEYS ARE RECOVERING IN THE GULF OF MEXICO
Larry Crowder, Center for Ocean Solutions

BRAZIL'S SEA TURTLES ARE NOW WORTH MORE ALIVE: TAMAR'S SOCIAL PRODUCTION CHAIN
Neca Marcovaldi, Projecto TAMAR

UNDERSTANDING RESILIENCE: CORE CONNECTIONS THAT SUSTAIN
Speaker- **Elena Mustakova-Possardt Spoke as special session and workshop**

SATELLITE TELEMETRY (PRESENTATIONS ARCHIVED ON SEATURTLE.ORG)
Chairs: **Brian Stacy and Kristen Hart**

ECOLOGICAL IMPLICATIONS OF BIOTELEMETRY DRAG IN MARINE TURTLES
T. Todd Jones, NMFS

OVERVIEW OF TAG TECHNOLOGIES: A MANUFACTURER'S PERSPECTIVE
Thomas Gray, Desert Star

TAG SELECTON AND TECHNIQUES FOR SATELLITE TRACKING SMALL HARD-SHELLED SEA TURTLES
Kate Mansfield, Florida Atlantic University and **Erin Seney**, Erin Seney Consulting

TAG SELECTION AND TECHNIQUES FOR SATELLITE TRACKING LARGE HARD-SHELL SEA TURTLES
Kristen Hart, USGS

USE OF SATELLITE TELEMETRY TO DETERMINE SEA TURTLE MORTALITY
Yonat Swimmer, NMFS

AN UPDATE ON LEATHERBACK TURTLE SATELLITE TRACKING TECHNIQUES
Sabrina Fossette, NMFS

VIDEO PRESENTATIONS

Les Amis de la Nature (Friends of Nature), Epidosde 2: Mayumba
Aimee Sanders, Gabon Sea Turtle Partnership & Wildlife Conservation Society

3M Project
Anfani Msoili, Association for the Social-Economic Development of Itsamia

Europa: 40 Years of Scientific Adventure
Jerôme Bourjea, Alefa Production and Kélonia

Ulithi Marine Turtle Project
Jennifer Cruce & JR Rulmal, Ulithi Marine Turtle Program & Oceanic Society

Tracking the Nicaraguan Eastern Pacific Hawksbills
Jose Urteaga, Eastern Pacific Hawksbill Initiative & Flora & Fauna International

Moochula- Giving Hawksbill Sea Turtles Hope
Barry Erdeljon & Sarah Gulick, Marymount University

A Non-Invasive Approach to Documenting Human Interactions with Nesting Sea Turtles
Ray Mojica & David Godfrey, Barrier Island Ecosystem Center & Sea Turtle Conservancy

Verde Salaje
Veronica de los Llanos & Belen Orsin, CNAC, Morocota Films & Xenon Films

Our Dreams Don't Age
Neca Marcovaldi, Projecto TAMAR

Karumbé, Tortugas Marinas del Uruguay
Daniel Gonzalez-Paredes, Karumbé

Los Amigos De Las Tortugas (Turtle's Friends)
Augustin Balestini, Programa Regional de Investigatción y Conservación de Tortugas Marinas de Argentina & Reserva Natural Bahia Blanca,Bahía Falsa, Bahía Verde

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Anatomy, Physiology, Health

STEROIDOGENIC EXPRESSION OF PROGESTERONE RECEPTORS DURING THE GONADAL DIFFERENTIATION IN THE GREEN SEA TURTLE, *CHELONIA MYDAS*, RAS AL-HADD, OMAN

Issa S. Al-Amri[1], I.Y. Mahmoud[1], B. Al-Farsi[2], S.N. Al-Bahry[2], B. Al-Sumri[3], M.A. Al-Kindi[4], and S.K. Al-Musharafi[5]

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[3] Department of Histopathology, Sultan Qaboos University Hospital, Muscat, Oman
[4] Department of Pathology, Sultan Qaboos University, Muscat, Oman
[5] Sur College of Applied Sciences, Sur, Oman

Steroidogenesis and progesterone receptors have not been studied in the green turtle. A total of 150 eggs from green turtles, *Chelonia mydas*, were collected at random following oviposition from different nests at Ras Al-Hadd Reserve during June 2010. The eggs were placed in an incubator set at 30^{o}C. Under this high temperature all hatchlings were females. Eight to ten eggs were examined every 48h for determination of embryonic differentiation. Prior to day 20, the gonads were undifferentiated. However, between day 20-30 which is called the thermosensitive period (TSP), the undifferentiated gonads developed to primary ovarian organ. Using immunohistochemistry technique, the progesterone receptors (PRs) were strongly expressed during this period and throughout the incubation period which is also indicative of steroidogenic activities such as the appearance of the ulturastructural steroidogenic features. The PRs remained strongly expressed for the rest of the incubation period. However, prior to day 20, the PRs expressed weakly which indicates the lack of gonadal differentiation. The appearance of the ovarian follicles in the ovarian stroma is a clear indication that steroidogenic activity is already in process during the TSP. Results from this study are in agreement with the detection of progesterone receptors using immunoblotting technique in both female and male embryos.

HEAVY METALS DETECTION BY X-RAY MICROANALYSIS IN FRESHLY LAID EGGS OF THE GREEN TURTLE, *CHELONIA MYDAS*, AT RAS AL-HADD, OMAN

Salma K. Al-Musharafi[1], Saif N. Al-Bahry[2], Ibrahim Y. Mahmoud[3], Issa S. Al Amri[3], and Abdulaziz A. Al-Kindi[3]

[1] Sur College of Applied Sciences, Sur, College of applied Science, Sur, Oman
[2] Department of Biology, College of Science, Sultan Qaboos University, Muscat, Oman
[3] Department of Biological Science and Chemistry, University of Nizwa, Oman

Freshly laid eggs from the green turtle (*Chelonia mydas*) were collected at random from different nests immediately after oviposition at Ras Al-Hadd reserve. Eggshell of the green turtle is made up of three major porous layers, the loose calcareous layer, the compact middle layer with multistrata and the fibrous innershell membrane. The layers from each eggshell sample were analyzed separately for the detection of heavy metal using Oxford energy dispersive X-ray spectrometer (EDS). The heavy metal spectrum x-microanalysis as well as other elements spectrum of elemental was analyzed. Al, S, Si were the dominant. The heavy metal percentage weight revealed that S, Si and P were the dominant. The presence of these heavy metals may have detrimental effect on the health of the embryo during the incubation period.

THE IDENTIFICATION OF PROGESTERONE RECEPTORS IN THE EMBRYONIC MALE USING HISTOLOGICAL AND IMMUNOHISTOCHEMICAL TECHNIQUES IN THE GREEN TURTLE, *CHELONIA MYDAS*, RAS AL-HADD, OMAN

Abdulaziz Y. Alkindi[1], I.S. Al-Amri[1], I.Y. Mahmoud[1], S.N. Al-Bahry[2], S. Al-Yaqoobi[2], and B. Al-Sumri[3]

[1] Department of Biological Sciences and Chemistry, University of Nizwa, Oman
[2] Department of Biology, Sultan Qaboos University, Muscat, Oman
[3] Department of Histopathology, Sultan Qaboos University Hospital, Muscat, Oman

Immediately after oviposition, 150 eggs were collected at random from different nests of the green turtle, *Chelonia mydas*, during June 2011 and were placed in the incubator set at constant temperature (26^{o}C) to develop embryonic males only. Between day 20 – 30 of incubation, which is known as the thermosensitive period (TSP), the embryos were examined histologically for the presence of gonadal differentiation. A total of 8-10 eggs were examined every 48h for the condition of the embryonic differentiation. As a result, all the embryos examined after day 20 showed gonadal differentiation which consequently differentiated into testicular tissues. In addition, it was confirmed that the testicular tissues were steroidogentically active using the immunohistochemistry technique for the presence of progesterone receptors, which strongly expressed throughout the thermosensitive period. Prior to day 20 the progesterone receptors were weakly expressed without any steroidogenic activity. In summary, the testicular tissue followed the same pattern of development as ovarian tissue, even though the incubation period was longer in males (60 days) compare to females (50 days). The seminefrous tubules of the medulla were fully developed after day 20 in connection with the strong progesterone receptor expression and the presence of ultrastructural steroidogenic features. These conditions remained for the rest of the incubation period. Results from this study are in agreement with the detection of progesterone receptor using immunoblotting technique in both female and male embryos.

PRELIMINARY RESULTS: OLIVE RIDLEY SEA TURTLE EMBRYO MORTALITY AS A FUNCTION OF THE NEST MICROBIAL COMMUNITY AT OSTIONAL, COSTA RICA

Vanessa S. Bézy[1], Roldán A. Valverde[2], and Craig J. Plante[3]

[1] Graduate Program in Marine Biology, College of Charleston, Charleston, SC
[2] Southeastern Louisiana University, Hammond, Louisiana, USA
[3] College of Charleston, Charleston, SC

The olive ridley sea turtle population at Ostional, Costa Rica exhibits mass nesting events (arribadas) estimated at up to 500,000 nesting females over a period of only seven days. Despite the large population of nesting females, concern remains that the low hatching success (8%) at this beach is not enough to sustain the population long-term. Several studies have suggested that embryo mortality is associated with the high microbial load resulting from the decomposition of eggs broken by overlapped nesting due to the high nest densities characteristic of arribada events. Thus, a legalized community-based egg harvest program is aimed at reducing the number of nests destroyed while providing the funds to support local infrastructure and family income. However, no previous research has directly quantified microbial abundance and the associated direct and/or indirect effects on hatching success in situ. This study aims to determine the impact of microbial abundance on hatching success by monitoring natural nests and applying experimental treatments to reduce the microbial load of the sand into which nests are relocated. Preliminary

results show no significant differences in nest temperature or oxygen content across experimental treatments, yet a marked increase in hatching success was observed in sand treated with a bleach (NaOCl) solution. Natural nest observations revealed a significant spatial variation in hatching success in association with significant differences in the organic matter content, temperature, and pO2 of the nest environment. The mean pO2 of nests in the high nest density area was also significantly lower in the 1st and 2nd half of incubation (15.43 kPa, p=0.001; 12.27 kPa, p=0.003; respectively), whereas nest temperatures were the highest and exceeded the lethal limit (35ºC). The oxygen levels and hatch rates observed in natural nests are drastically lower than those previously observed when isolating nest density alone as a factor affecting hatch rates. These preliminary results suggest that microbial abundance and other factors associated with nest destruction at such high nest densities are likely responsible for the low hatching rates observed at Ostional. Another field season is planned for 2013 and the molecular analysis to quantify the microbial abundance in nest sand is on-going. Ultimately, treatments that successfully increase hatching success could be applied as a management technique to improve hatching success at arribada beaches and in hatcheries experiencing microbial infestations. This study will help identify a relationship between hatching success and the microbial community of the sand while ensuring the sustainability of the egg harvest as a conservation strategy. Acknowledgements: Funds to support field research for this study were provided by: National Geographic Young Explorers Grant (C220-12), USFWS Marine Turtle Conservation Act (96200-0-G037), and College of Charleston Graduate Research Awards. Funds to support this presentation were provided by the College of Charleston Graduate School and Graduate Student Association, International Sea Turtle Society, International Sea Turtle Symposium, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics and CLS America.

THE MICRONUCLEUS TEST: A RELIABLE TOOL FOR HEALTH SCREENING OF GREEN TURTLES

Virginia Borrat[1], Silvia Villar[2], Gustavo Martinez Souza[3], and Alejandro Fallabrino[4]

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The green turtle (*Chelonia mydas*) is catalogued ¨Endangered¨ in the UICN red list. Uruguay is an important area of feeding and development of juveniles, which are mainly concentrated in Cerro Verde and La Coronilla (Dept. de Rocha). Sixty animals were analyzed, the samples were collected at different sites: Pesquero and Cerro Verde, located in a sandy beach affected by a freshwater discharge (Andreoni Canal) derived from man-made canals built for agricultural activities. These discharges have been documented as strong modifiers of sandy beaches, affecting nutrient regimes, habitat features and the resident biota. It has been observed that individuals sampled at mentioned sites remain for at least one season there. To analyze the genetic health of the species, we used the micronucleus (MN) test in peripheral blood, following the rules of the CHEA (Uruguay). The presence of micronuclei at cellular levels indicate a DNA loss, and proof of micronucleated erythrocytes in peripheral blood provides clear and definitive results, with the possibility of working in vivo, and requires only a drop of blood. Additionally, a sediment screening for chemical elements were done for Pesquero, Cerro Verde and the discharge channel, through energy dispersive spectroscopy (EDS) with a Thermo Scientific probe coupled to a Jeol 5900 LV SEM. The results indicate the presence of thallium in the channel and Pesquero, which coincides with higher frequencies of MN, i.e. greater genetic damage. Thallium has been used for decades as a rodenticide (pesticide; organic metalloid). Currently, its use is prohibited in several countries in Latin America and it was declared a toxic element by ATSDR (Agency for Toxic Substances and Disease Registry of the United States). However, at present some substances which are used as fertilizers and soil improvers for agricultural have been developed and contain thallium, copper, manganese, silicon, nickel, tin, barium and molybdenum (several such elements are also considered toxic in high concentrations). They are used mainly in potato, sorghum and rice. The pesticides are often used for the same crop simultaneously, creating an additive genotoxic effect. It may also occur synergism: the combined effect of two or more chemicals is greater than the sum of the effects of each separately, or the enhancer; which occurs when an agrochemical does not have genotoxic effect but in combination with another compound is much more toxic (even genotoxic). The results show that when the distance is greater from the discharge channel, there is a decrease in the frequency of micronucleated cells and total MN. Also, individuals kept in captivity for rehabilitation, have shown a dramatic decrease in the frequency of MN in blood.

THE EFFECTS OF TRACKING DEVICES ON ATLANTIC GREEN (*CHELONIA MYDAS*) SEA TURTLE DIVE BEHAVIOR IN RELATION TO CARAPACE SENSITIVITY*

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Tracking devices have become increasingly important for insight into aquatic species behavior. The main behavioral patterns of these species are challenging to study because the behaviors occur while the species are submerged and out of view. Sea turtle dive behavior has been well investigated in the wild using tracking devices such as data loggers, satellite-linked transmitters, and animal-borne video. ‘Instrumented’ turtles are studied for the purpose of extrapolating behavior to untagged individuals; therefore, it is crucial to consider the degree to which results are biased by the effects of tracking device attachment. We monitored the behavior of a captive Atlantic green sea turtle (*Chelonia mydas*) for 60 days using a specifically designed ethogram. A neutrally buoyant mock tracking device was constructed of PVC and small weights. The device was attached to the subject’s carapace via neoprene and epoxy. Observations occurred before and after mock tracking device attachment to assess behavioral changes due to presence of the device. Interaction with the current line, which provides outflow of the tank’s filtration system, and interaction with a PVC enrichment structure were both deemed as behaviors associated with carapace irritation relief. Three behaviors changed significantly after device attachment: amount of time spent swimming increased and interaction with the current line and PVC increased as well. The alteration in behavioral activity may indicate that a tracking device attached to a wild turtle can skew dive data as a result of behavior changing due to carapace irritation; however, the small sample size and the duration of this study must be considered as they can both significantly impact results. This project is of considerable interest to the scientific community in regards to the potential of tracking devices affecting behavior of sea turtles. Acknowledgments: We would like to thank the following institutions for their continuous support as well as financial contributions: Sea Turtle Inc. and its staff, volunteers, and interns; Eckerd College; and the International Sea Turtle Symposium and its chairs as well as the travel grants committee. Additionally, none of this would have been possible without the five other wonderful, hardworking interns who donated their time and energy: Lauren Miller, Anthony Gillis, Sharon Lee, Sarah Nevison, and Alexis Bergman.

CLINICAL CONDITION IN OLIVE RIDLEY SEA TURTLES (*LEPIDOCHELYS OLIVACEA*) IN GUASAVE, SINALOA, MEXICO

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During 2011-2012 ten cases were submitted to the CIIDIR-IPN Sinaloa for rehabilitation. These turtles were found stranded on nearby beaches with strong signs of disease. All of the turtles were olive ridleys (*Lepidochelys olivacea*) and displayed the same clinical condition with few differences - including severe emaciation and dehydration, low reactivity and no signs of traumatic lesions. One of them presented carapace lesions with transparent and inodorous fluid. They didn´t respond to any treatment and finally died. At necropsy they also shared common lesions and evidence of chronic renal infection and subequent damage. Clinical tests were done in order to determine the cause but we still have not identified the source of the infection. It's very important for us to know if any similar conditions have been submitted to another rehabilitation centers and if they could determine the causes, particularly because olive ridleys are dying fast and in terrible conditions without a precise identified pathogen, pollutant or toxin that causes this kind of damage.

NOVEL MICROBIAL POPULATIONS RECOVERED FROM FAILED LOGGERHEAD SEA TURTLE NESTS (*CARETTA CARETTA*) ON JEKYLL ISLAND, GA

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The composition and diversity of microbial populations present in loggerhead sea turtle nests is part of an ongoing investigation of egg failure. Unhatched eggs are often characterized by the presence of black, yellow or red areas on the shell or inside the eggs assumed to be associated with bacterial or fungal invasion of the nest. Loggerhead nests in Georgia have averaged 66% nest success. It is consistent, yet, lower than the estimated 80% for sea turtle populations worldwide. The goals of this project were to substantiate anecdotal reports of microbes in sea turtle nests using molecular techniques, investigate and compare microbial populations in nests found in Georgia and elsewhere, and assess the potential role of opportunistic pathogens in egg failure. In 2010, unhatched loggerhead eggs were collected from six nests that had completed incubation on the North, Central and Southern regions of Jekyll Island. Fluid was collected aseptically and used to extract both DNA and RNA. Thirty eight DNA samples were screened by PCR using fungal-specific primers (ITS5F and ITS4Rev) that amplify the internal transcribed spacer (ITS) region. Of the 11 samples of DNA cloned and sequenced, five different genera were detected. However, 77% of the samples had 99-100% identity with *Fusarium solani*, a microbe suspected of causing embryonic

mortality in sea turtle nests in the Pacific and Mediterranean. Thirty bacterial groups were detected based on 395 16S rRNA sequences analyzed. Nine groups were recovered from multiple nests and seven of these groups were ≥ 99% identical to known or suspected pathogens - including members of *Vibrio*, *Enterobacter*, *Pseudomonas*, *Stenotrophomonas*, *Hahella*, *Achromobacter* and *Klebsiella*. The detection of *Hahella chejuensis* is of interest since it produces a prodigiosin (red pigment) which inhibits the growth of certain cell types and has immunosuppressive activity. Forty DNA samples were screened using PCR primers specific to *H. chejuensis*, and PCR products were produced from all eggs containing a pink-red biofilm or fluid. The use of molecular identification and species specific primers and probes have revealed the first known accounts of *Fusarium* infection and the presence of *Hahella* in sea turtle nests in the southeastern US.

BENEFITS OF A COMPLETE X-RAY EVALUATION TO ASCERTAIN THE POSITION AND ORIENTATION OF FISHING HOOKS IN INTRACOELOMATIC ESOPHAGUS TISSUES OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*)

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Radiographic studies are among the most important diagnostic procedures in the clinical evaluation of sea turtles. The anatomical structures for which it is possible to obtain an optimal assessment by radiographic examination are respiratory tract, digestive tract, skeleton, carapace, and plastron. The fundamental and indispensable projections for a proper radiographic estimation of the body are dorsoventral view, vertical beam, horizontal beam, lateral view, and craniocaudal view. Radiographs in the dorsal-ventral projection usually allow achieving the detection of fishhooks in the various sections of the digestive tract. In fact, hooks are poorly detectable in other projections due to the intense radiopacity determined by the superimposition of other anatomical structures, and to the inability to set the radiographic cassette in strict contact with the body of the animal. On the contrary, when the hooks are stacked in the esophagus wall, especially in the intracoelomatic tract, images in the dorsoventral beam do not allow to ascertain if the tip or the hook barbs are dangerously close to airways (trachea and bronchi) or great vessels (brachycephalic trunk). Without this information, the surgeon risks to cause irreparable injuries during the removal of the hook. On the other hand, a complete radiographic study in two orthogonal projections is invaluable to correctly assess position and orientation of the hook to properly schedule the surgery. The present study included 21 loggerhead sea turtles (*Caretta caretta*) referred to the Department of Veterinary Medicine of Bari University (Italy), which showed drifting longlines hooks located in the caudal cervical or intracoelomatic esophagus subsequently to a first radiographic evaluation in dorsoventral beam. The other radiographic projections were obtained in horizontal beam lateral view, with turtles set on a radiolucent support (plastic box) with the surface of the radiographic cassette adherent to the lateral margin of the bridge. In order to reduce the overlap of soft tissues of the pectoral girdle, the front flippers were forward stretched below the neck, and temporarily wrapped together with self-adhesive elastic bandage. X-ray images were obtained with a digital acquisition system, which allowed improving contrast and brightness of images by graphic processing. The opportunity to evaluate different radiograms obtained in two orthogonal projections has allowed to precisely locate the position of hook, shank and bend with respect to the horizontal midsagittal plane of the animal, the orientation of the tip (cranially, caudally or laterally), and above all the closeness to vital anatomical structures. These significant assessments have allowed choosing the most appropriate surgical approaches, and to avoid dangerous intraoperative maneuvers during removal of hooks.

EPIBIONTS OF NESTING FEMALE OLIVE RIDLEYS, *LEPIDOCHELYS OLIVACEA*, IN PLAYON DE MISMALOYA, JALISCO, MÉXICO

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The presence of epibionts on marine turtles has been used for different purposes, such as biogeographic indicators, migration routes and movements of pelagic life stages. With the goal to know the richness and species distribution of epibionts, specimens were collected from 163 female *L. olivacea* from a total of 178 turtles observed nesting in the Playon de Mismaloya, Jalisco, representing 91.5% of the total sample. The study period was in 2004, 2006 and 2007 during the months of July to December. The epibionts were collected directly from the soft parts (neck and flippers) and the hard parts (carapace) of the turtle, and were preserved in 70% alcohol. The total of epibionts collected was 2,567, corresponding to 10 species, the most abundant was the ruby-eyed amphipod, *Podocerus chelonophilus*.

PERCEPTION OF DIMETHYL SULFIDE (DMS) BY LOGGERHEAD SEA TURTLES: A POSSIBLE CUE FOR LOCATING FORAGING AREAS

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During their long-distance migrations, sea turtles of several species feed on jellyfish and other invertebrates that are particularly abundant in ocean regions characterized by high productivity. An ability to distinguish productive oceanic regions from other areas, and to concentrate foraging activities in locations where prey density is highest, might therefore be adaptive. The volatile compound dimethyl sulfide (DMS) is released by phytoplankton and accumulates in the air above productive ocean areas such as upwelling and frontal zones. In principle, DMS might therefore serve as an indicator of a good foraging area for turtles. To determine whether turtles perceive DMS, juvenile loggerhead turtles (*Caretta caretta*) were placed into a water-filled arena in which DMS and other odorants could be introduced to air above the water surface. Turtles exposed to air that had passed over a cup containing 10 nM DMS spent more time at the surface with their noses out of the water than did control turtles exposed to air that had passed over a cup containing distilled water. Odors that do not occur in the sea (cinnamon, jasmine, and lemon) did not elicit increased surface time, implying that the response to DMS is unlikely to reflect a generalized response to any novel odor. The results demonstrate for the first time that sea turtles can detect DMS, an ability that might enable turtles to identify favorable foraging areas.

THE GENTLE TREATMENT OF SEA TURTLE LESIONS BY HYPERMIX, A NEW BOTANICAL PRODUCT FROM ITALY

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We tested a new botanical medicine produced in Italy on 10 sea turtle lesions - monitoring the wound healing, and comparing the results with previous procedures. Turtle lesions have healed in a shorter time and with the use of fewer antibiotics.

FIBROPAPILLOMAS IN GREEN TURTLES ALONG THE COAST OF THE CONGO-BRAZZAVILLE. SEVEN YEARS OF OBSERVATIONS GIVE AN INSIGHT INTO A RISING ISSUE IN CENTRAL AFRICA

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The first observation of tumors consistent with fibropapillomas in Congo occurred in Nov 2005 on a juvenile green turtle incidentally captured in traditional fishing nets in the Loango bay. Existence of cutaneous fibropapillomas (FP) in sea turtles was known as early as 1938. Since then it has emerged, from the 1980's as a significant worldwide epizootic, mainly in Green turtles. The main and best known epizootic took place in Hawaii. A long-term follow up of the cancer has also been implemented in Florida. The disease has been described all around the world: in the Caribbean, Brazil, Atlantic coast of Costa Rica, California, Pacific Coast of Mexico, Australia and India. The report of the disease on the west coast of Africa (Eastern Atlantic) is more recent. The disease was diagnosed and histologically characterized in green sea turtles at Corisco bay, in the Gulf of Guinea, on the border between Equatorial Guinea and Gabon. Data collected over seven years (1998 – 2006) on the green turtle population of Corisco Bay reveal a 17% prevalence of probable fibropapillomatosis in captured turtles. It was then observed in Mayumba National Park in the South of Gabon just north to the Congo coast. In 2009 the disease was also described in green turtles in Principe Island. From 2005 to 2012 in Congo, the Renatura NGO has implemented a programme designed to release turtles incidentally caught in traditional fishing nets. The Sea Turtle Release Programme allowed for more than 10,000 observations of green turtles to be made. Observation took place mainly at The "Pointe Indienne" and in the Loango Bay which is an important feeding ground for green turtles and hawksbill turtles located 40km north to Pointe Noire. The study of the recapture events shows that the FP frequency in green turtles rises from 2005 to reach 15% on 2009. It decreases afterward and it is around 8% in 2012. Thanks to a generalized linear model, we studied the factors that influence the occurrence and gravity of FP such as the month of observation (seasonality), the year of observation (trend), curved carapace lengths and maturity status of individuals, the presence of concomitant lesions or parasites, previous Monel tagging and time since tagging, number of observation on the capture site and time spent since the first observation on the capture site. The influence of FP on growth was also assessed in comparing the growth curve in healthy turtles and affected turtles.

SERUM BIOCHEMISTRY PROFILE FOR NESTING HAWKSBILLS (*ERETMOCHELYS IMBRICATA*) IN RIO GRANDE DO NORTE, BRAZIL*

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Forty one nesting females of *Eretmochelys imbricata* were sampled from Barreira do Inferno and Pipa, located in the State of Rio Grande do Norte, Brazil, from January to March 2011 and from January to March 2012 respectively. Blood samples (10 ml) were withdrawn from the dorsal cervical sinus into tubes without anticoagulant. The triglycerides (1033 mg/dl ± 202) and cholesterol concentrations (287 mg/dl ± 42) were significantly higher than in literature. Both are likely to be raised in nesting females due to vitellogenesis. The average values for total protein were 5.45 g/dl ± 0.63 and 2.11g/dl ± 0.43 for albumin. Serum protein levels are often elevated during the reproductive season due to vitellogenesis, which requires increased protein synthesis. Additionally, elevated albumin may be associated with increased demand for egg production. On the other hand, urea values (20.6 mg/dl ± 4.2) were slightly lower than those reported for adult individuals of *Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata* and *Lepidochelys kempii*, outside reproductive period. Mean uric acid values (0.95 mg/dl ± 0.17) were slightly higher than those reported for nesting leatherbacks. Even higher values were found in juvenile green turtles (1.5 mg/dl ± 0.6) probably because young *C. mydas* are primarily carnivores and according to literature, carnivorous reptiles have higher uric acid blood levels. Moreover, uric acid levels are expected to be higher in foraging sea turtles, as the animals feed daily. The mean calcium (11.6 mg/dl ± 0.25) and phosphorus (11.3 mg/dl ± 1.4) values were similar to those reported for reproductively active leatherbacks. Both minerals are likely to be elevated in nesting sea turtles due to vitellogenesis and egg production. The mean sodium (139.6 mEq/l ± 3.5), and potassium levels (5.09 mEq/l ± 0.76) were also similar to reports for nesting sea turtles. The average values for Alanine aminotransferase (ALT) reported here fall within the range found for nesting leatherbacks and loggerheads. The Aspartate aminotransferase (AST) activity (55.4 U/l ± 17.1) was low when compared to other studies. Although little is known about the tissue distribution of AST in sea turtles, AST concentrations are not considered to be organ-specific in reptiles. Alkaline phosphatase (ALP) activity (15.9 U/l ± 3.7) was similar to that suggested for adult sea turtles. Furthermore, ALP is associated with increased osteoblastic activity. Thus, it is probable that animals in development stage show higher enzymatic levels, since osteoblasts are responsible for bone matrix synthesis. The serum Gamma-glutamyl transferase (GGT) activity (10.8 U/l ± 2.4) was similar to literature, although GGT is not a parameter frequently used to evaluate sea turtles health conditions, since it is normally low. Biochemical intervals reported here represent normal parameters for nesting hawksbills. However, there is still little published information regarding hawksbills biochemical profiles and further studies are urgently required. To our knowledge, this is the first study to report on biochemical reference intervals for nesting hawksbills in the southeastern Atlantic Ocean.

PRELIMINARY STUDY OF ORGANIC AND INORGANIC POLLUTANTS IN MARINE TURTLES FROM MAURITANIA (WEST AFRICA)

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Mauritania is an arid country of West Africa bordered by an almost straight 754 km-lengh beach along its Atlantic seashore. The entire coastline is scarcely inhabited by humans except for a few villages and fisherman's camps, as for the two larger urban zone: Nouakchott (the capital) and Nouadhibou) of which the population is estimated close to one million inhabitants. Sporadic and scattered *Chelonia mydas* and *Caretta caretta* nests have been observed along the border between Senegal and the Baie du Lévrier. Between Nouakchott and Nouadhibou, the National Park of Banc d'Arguin is of particular and important conservation concern since its classification by IUCN as one of the main feeding areas of *Chelonia mydas* in the world. The important fishery activities in the Mauritanian waters pose a significant threat to immature and adult marine turtles which are trapped in artisanal and industrial fishing nets. As a consequence, a lot of individuals become stranded along the coast. Incidentally, the poor facilities setting up for treating the urban wastes (e.g. domestic, agricultural and industrial wastes), especially in Nouakchott and Nouadhibou, and offshore waste produced by oil platforms contribute to increase the existing marine pollution. By June 2012, 62 dead stranded marine turtles were observed on a stretch of coastline of about 200 km and, included 59 greens (51 immature and 8 adult individuals), 2 loggerheads and 1 leatherback turtle. Ten fresh turtles were necropsied and tissues were collected (i.e. pectoral muscles, liver, kidneys and fat) as well as the stomach content. Samples were kept frozen (-20°C) in Nouakchott until analysis for organic and inorganic pollutants (Laboratory of Oceanology, ULg, Belgium), by one of us. The aim of the present study is to determine the pollutant pattern of marine turtles inhabiting the Mauritanian coasts, both on their nesting and feeding ground. Furthermore, opportunities for discussion should be given for both marine turtle and environmental conservation guidelines.

SEDATION AND ANESTHESIA OF HATCHLING LEATHERBACK SEA TURTLES

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Sedation or anesthesia of hatchling leatherback sea turtles was employed to acquire auditory evoked potential (AEP) measurements in air and in water to assess their hearing sensitivity in relation to potential consequences from anthropogenic noise. Although hatchling hard-shelled sea turtles are amenable to light physical restraint for AEP measurements, leatherback hatchlings proved refractory to physical restraint alone, with myogenic artifact masking AEP signals. To reduce artifacts caused by muscle movement, we

sedated hatchlings with midazolam 2 or 3 mg/kg IV for in-air (n = 7) or in-water (n = 11) AEP measurements, and anesthetized hatchlings (n = 5) with ketamine 6 mg/kg and dexmedetomidine 30 µg/kg IV reversed with atipamezole 300 µg/kg half IM and half IV for in-air AEP measurements. Midazolam-sedated turtles were also physically restrained with a light elastic wrap. For in-water AEP measurements, sedated turtles were submerged 14 cm and brought to the surface every 45 – 60 seconds, or whenever they showed intention signs for breathing, and not submerged again until they took a breath. Underwater tests did not exceed 60 min. Time to effect, time to full recovery, heart rates, respiratory rates, post-procedure venous blood gasses (pH, pCO2, pO2, HCO3-, lactate), number of movements disturbing AEP measurements (in-air only), and subjective quality of release were recorded. Heart rate and blood gases were measured from an additional six hatchlings after nest emergence to compare with sedated and anesthetized turtles. Both sedation with midazolam and anesthesia with ketamine-dexmedetomidine were successful for allowing AEP measurements in hatchling leatherback sea turtles. Disruptive movements were less frequent with anesthesia than with sedation in the in-air group. Post-procedure temperature-corrected venous blood pH, pCO2, pO2, and HCO3- did not differ among groups, although for the midazolam-sedated in-water group, pCO2 trended lower and pO2 varied most widely, and in the ketamine-dexmedetomidine anesthetized group there was one turtle considered clinically acidotic (temperature-corrected pH = 7.117). Venous blood lactate was greater for hatchlings recently emerged from the nest than for turtles sedated with midazolam in air, with the other two groups falling intermediate between but not differing significantly from the high and low lactate groups. All releases of hatchlings to the ocean were scored as good, except for one fair on one poor release out of 11 in the midazolam-sedated in-water group. Use of midazolam for sedating red-eared sliders (*Trachemys scripta elegans*) and snapping turtles (*Chelydra serpentaria*) has previously been described, but reports in sea turtles are lacking. Full anesthesia for in-water AEP measurements, as has been reported for larger juvenile green turtles, was not pursued for leatherback hatchlings because the small glottis and trachea posed physical limitations on protecting the airway adequately with an endotracheal tube while submerged. Sedation allowed the turtle to protect its airway voluntarily while limiting flipper movement. Midazolam or ketamine-dexmedetomidine (and reversal with atipamezole) would be useful for other procedures requiring minor or major restraint in leatherback sea turtle hatchlings and other sea turtles, although variable susceptibilities may require dosage adjustments.

VALIDATION OF ULTRASONOGRAPHY AS A NONINVASIVE DIAGNOSTIC TOOL TO MEASURE SUBCUTANEOUS FAT DEPTH IN LEATHERBACK TURTLES

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Leatherback turtles undergo substantial cyclical changes in body condition between foraging and nesting grounds caused by periods of intensive foraging followed by prolonged fasting during migration and reproduction. These anatomical changes are characterized by alterations in body mass and morphometric measurements, prominence of dorsal carapacial ridges, and thickness at the base of the head and appendages. Ultrasonography has been used to measure subcutaneous fat depth to quantify body condition in a variety of domestic and wild animal species, but has not been reported for use in any sea turtle species. To assess the efficacy of this technique for leatherback turtles, a total of 21 turtles were sampled, including foraging adults from central California (n = 4), Massachusetts (n = 1), and Nova Scotia (n = 5); nesting adult females from Florida (n = 8); and immature turtles from the Pacific Islands region (n = 3). Ultrasound images were obtained from four anatomical sites: dorsal shoulder, dorsal neck, lateral neck, and hind end. Ultrasound sites were chosen based upon previously identified regions of fat deposition, accessibility of the site for turtles on a nesting beach and on a capture boat, and ability of the ultrasound signal to penetrate the tissue. A SonositeVet 180 Plus portable ultrasound machine with curvilinear transducer was used to determine tissue boundaries of the epidermis, dermis, subcutaneous fat, and muscle. The thickness of each tissue layer was recorded with the machine's internal calipers. Rigid landmarks were used as reference points and multiple measurements were obtained from the same site to facilitate comparison within and between individuals. The dorsal shoulder region was identified as the best site for differentiation of tissues and appeared to be less affected by position or movement of the body as compared with the neck and hind end. Imaging through the carapace was not possible due to the tight matrix of dermal ossicles which reflected the ultrasound signal. Ultrasound measurements of subcutaneous fat depth were validated and confirmed histologically in a subset of turtles by directly measuring the fat layer at necropsy in dead turtles (n = 8) and with surgical fat biopsy of live turtles (n = 2). Potential issues causing variability with this method include operator-applied pressure of the transducer, position of the front flipper in flexion or extension, gelatinous consistency of the fat reducing accuracy of direct measurements, and degree of tissue autolysis and freeze-thaw artifact in dead animals. Ultrasound can be used to rapidly assess body condition during nesting and in-water capture operations without requiring manual restraint or disrupting normal nesting behavior. Quantitative assessment of body condition may provide valuable data that can be used in conjunction with other health parameters to facilitate global health comparisons between increasing and declining leatherback turtle populations, and may have applications for other sea turtle species.

SURGERY, REHABILITATION AND RELEASE OF A JUVENILE HAWKSBILL RESCUED FROM A LONGLINE IN THE BAHIA DE JALTEMBA, NAYARIT, MEXICO

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We report the treatment, surgery and satellite tracked release of a juvenile East Pacific hawksbill turtle (*Eretmochelys imbricata*) that was given to our research group after being cut from a longline by divers in the Bahia de Jaltemba, Nayarit, Mexico. The turtle was transported to the wildlife department of the CIIDIR-IPN in Sinaloa for treatment. Radiography was used to gather information on the position and size of the hook. The hook measuring 3cm was found lodged in the esophagus. The removal of the hook was complicated due to its relatively large size compared to that of the turtle (SCL: 40cm; SCW: 31cm; 5 kgs). The hook was successfully removed by making an 5mm incision through the tissue on the neck through which the point of the hook was cut allowing the subsequent removal of the shank through the mouth. After 38days to recuperate at the research center we returned the turtle named "Jaltemba" to the bay where she had been caught. Jaltemba is the first sea turtle to be satellite tracked in the state of Nayarit which resulted in the turtles release being attended by hundreds of people from the community, press (local and national) and government officials raising awareness of sea turtle bycatch and EP hawksbill turtles in the Mexican Pacific.

A PRELIMINARY SCREENING OF PERSISTENT ORGANIC POLLUTANT CONCENTRATIONS IN HAWAIIAN GREEN TURTLE PLASMA IN RELATION TO FIBROPAPILLOMATOSIS

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Fibropapillomatosis (FP) prevalence in green turtles (*Chelonia mydas*) has varied through time and space in Hawaii but appears to be declining island-wide for unknown reasons. Because of this variation and immunosuppressive qualities of contaminants, scientists have hypothesized that pollutants may contribute to this disease. To address this, in 2011, we screened 12 Hawaiian green turtle plasma samples for concentrations of 164 persistent organic pollutants (POPs). Four groups of turtles were examined: free-ranging turtles from Kiholo Bay (0% FP), Kailua Bay (low to moderate FP 0-10%), and Kapoho Bay (higher FP >10%) and severely tumored stranded turtles that required euthanasia. Samples were archived by the Biological and Environmental Monitoring and Archival of Sea Turtle Tissues (BEMAST) project at the National Institute of Standards and Technology Marine Environmental Specimen Bank. Three samples from each group were selected for POP screening. Only seven of 84 polychlorinated biphenyls (PCBs 99, 118, 138, 153+132, and 180+193), one of 19 organochlorine pesticides, one of 36 brominated flame retardants, three of 16 hydroxylated/methoxylated polychlorinated biphenyls (PCBs) or polybrominated diphenylethers (PBDEs), and two of nine halogenated phenols were detected with all other compounds below the limit of detection. Medians ($n = 12$) were 66.7 pg/g total PCBs, 2.63 pg/g 4,4'-DDE, 14.6 pg/g PBDE 99, 8.05 pg/g 4OH-PCB 187, 275 pg/g 6OH-PBDE 47, 127 pg/g 6OH-PBDE 99, 352 pg/g 2,4,6-tribromophenol, and 149 pg/g pentachlorophenol. For comparison, PCB levels in Hawaiian turtles are approximately one order of magnitude lower than green turtles examined elsewhere and two orders of magnitude lower than loggerhead turtles from the southeastern U.S. coast. The presence of hydroxylated and phenolic compounds is a novel discovery for sea turtles. These compounds originate from liver metabolism of parent pollutants (e.g., OH-PCBs) or are naturally synthesized by marine organisms like algae or sponges (e.g., OH-PBDEs and 2,4,6-tribromophenol). Their presence at concentrations higher than total PCBs leads to interesting questions about their origins and toxicity, particularly because hydroxylated PCBs/PBDEs can be more toxic than the parent contaminant. Significant differences were detected among the four groups for total PCBs ($p = 0.0102$; stranded>Kiholo>Kailua>Kapoho). Stranded turtles also had the highest concentrations of 4,4'-DDE and PBDE 99 probably because of weight loss resulting in a release of POPs from fat stores thus elevating the blood concentrations. Even though POPs probably did not play a role in the genesis of tumors, the higher circulating levels after weight loss could exacerbate their poor health status. Significant differences were also detected for 6OH-PBDE 99 ($p = 0.0037$), in which Kiholo, the FP-free site, was the only site with detectable concentrations. Kiholo turtles also had the highest concentrations of 6OH-PBDE 47, and Kailua turtles had the highest levels of 4OH-PCB 187, 2,4,6-tribromophenol, and pentachlorophenol. These findings provide some of the first baseline data for POP exposure in Hawaiian sea turtles and suggest that these 164 POPs are not contributors of FP. Future analysis of additional samples is expected to provide more statistical power to better answer this question.

IS POLYCYTHEMIA AN ADAPTATION TO HIGH CO^2 INCUBATION CONCENTRATIONS BY LOGGERHEAD SEA TURTLE EMBRYOS?

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Loggerhead sea turtles lay their eggs approximately 30-45 cm deep and clutch incubation is dependent on several intrinsic factors such as sand quality, temperature, moisture and compaction. Beach erosion has led to beach restoration projects that create anthropogenic shorelines that may or may not be conducive to egg incubation. Previous research has shown that nourished beaches with high sand compaction restrict the diffusion of oxygen and carbon dioxide gases between the egg clutch and beach surface. Depending on individual sand properties and nest location along the planform, high sand compaction can increase embryonic mortality. However, in some situations, embryonic development proceeds and hatchlings emerge successfully. This paradox leads to questioning if polycythemia could be an adaptation used by loggerhead embryos to survive higher carbon dioxide (and lower oxygen) concentrations during incubation. The experimental design consisted of two incubator conditions of high and low sand compaction. Each incubator had 40 randomized eggs and each treatment had four replicates, plus *in situ* control nests. Concentrations of carbon dioxide and oxygen were measured continuously throughout incubation. After emergence, hatchlings were weighed, measured (straight carapace length, straight carapace width, body depth), and a sample of 10 hatchlings/incubator had blood drawn from the dorsal cervical sinus. Blood was used to make smears that were stained with Wright's solution. Erythrocytes (rbc) were counted using a light microscope under oil immersion and averaged for each experimental treatment. Data show that clutches incubated in higher sand compaction had restricted gas diffusion rates and its embryos were exposed to higher concentrations of carbon dioxide and lower oxygen. Conversely, clutches in lower sand compaction had opposite gas concentrations and were similar to *in situ* nests. Hatchlings from high carbon dioxide nests had higher RBC counts when compared to those from the opposite incubation treatment. However, these values were not statistically significant so we cannot state that polycythemia is a survival adaption used by sea turtle embryos under similar incubation conditions. Another possible explanation for the high hatching success of some clutches exposed to high carbon dioxide and low oxygen is the effect that carbon dioxide can have on the oxygen affinity of hemoglobin. As the amount of blood carbon dioxide increases, more $H+$ are formed and blood pH decreases. This changes the percentage of oxygen saturation of hemoglobin (Bohr Effect), causing it to deliver more oxygen to tissues. It appears that loggerhead sea turtle embryos evolved different physiological adaptations to incubation conditions of high carbon dioxide and low oxygen concentrations, such as those created when beach sand compaction is very high. Whether through polycythemia, the Bohr Effect, or both, sea turtle embryos can develop under these compromised incubation conditions. However, physiological constraints exist which limit the ability to adapt to these incubation environments. Besides lowering the hatching success, high incubation concentrations of carbon dioxide also lower hatchling physical characteristics and vigor, which decrease survivorship. Therefore, we recommend that when designing a beach restoration project, that sand compaction be a key factor to determine the successful incubation of sea turtle clutches.

EMBRYONIC GONADAL DIFFERENTIATION OF PROGESTERONE RECEPTORS IN THE GREEN TURTLE, *CHELONIA MYDAS*, RAS AL-HADD, OMAN.

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Steroidogenesis and the expression of the progesterone receptor (PR) is not well established during the embryogenesis in the sea turtles. A total of 170 freshly laid green turtle (*Chelonia mydas*) eggs were collected at random during June 2010 at Ras Al-Hadd Reserve, from different nests immediately after oviposition. Shortly after, the eggs were placed in an incubator set at 30^{o}C to produce 100% females. Eight to ten eggs were dissected every 48h and the embryos were immediately frozen in liquid nitrogen. Prior to day 20, the gonads were undifferentiated but became differentiated between day 20-30 which is known as the thermosensitive period (TSP). The undifferentiated gonads gave rise to primary ovarian organ. To detect progesterone receptors, soluble proteins were extracted and the concentrations were determined using nanodrop. Then the proteins were separated by sodium dodecyl sulfate gel electrophoresis (SDS-PAGE) and were detected by commassie blue staining technique. Progesterone receptors were then specifically detected using western immunoblotting technique. Rabbit polyclonal to PR was used as a primary antibody and alkaline phosphatase conjugated mouse IgG was used as a secondary antibody. Progesterone receptors were present during the TSP which is an indicative of steroidogenesis. However, these receptors were not present prior to day 20. These progesterone receptors remained stable for the rest of the incubation period. The initiation of gonadal differentiation occurred almost 1/3 of the incubation period. Results from this study are in agreement with the immunohistological studies of progesterone receptor expression in both female and male embryos.

SCALING OF BITE PERFORMANCE WITH HEAD AND CARAPACE MORPHOMETRICS IN GREEN SEA TURTLES (*CHELONIA MYDAS*)

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Traditionally, adult green sea turtles (*Chelonia mydas*) are characterized as predominately herbivorous. However, data from the pacific demonstrates that green turtles consume a more varied and omnivorous diet comprised of sea grasses, algae, and animal matter. For example, green turtles off the Baja Coast of Mexico occasionally target red crabs. Also, there is evidence that green turtles in this region consume more animal matter in deeper water and more plant matter in shallower water. The ability to mix diets from a variety of habitats should be reflected in adaptations of the feeding apparatus. Recent data in loggerhead turtles

(*Caretta caretta*) demonstrate that bite force is correlated with head morphometrics and that the ontogeny of bite force has implications for foraging ecology. Therefore, the objective of this study was to correlate bite force data with head and carapace morphometrics from adult green sea turtles. We predicted that maximum bite force in green sea turtles would be less in magnitude than loggerheads, but still forceful enough to break vegetation, which is a tough material. In light of the omnivorous diet of some green turtles, a high bite force would also be advantageous for consuming animal matter. In addition, we predicted that bite force would be positively correlated with head width since an increase in the cross-sectional area of the adductor mandibulae (as reflected by head width) should increase bite force. Therefore, mass, straight carapace length, straight carapace with, greatest head width, height, and length, were collected along with bite force from free-ranging green sea turtles (N=73) from Punta Abreojos, Baja California Sur, Mexico and from several adult green sea turtles from Otsuchi, Japan. Subjects ranged from 13.6 to 147 kg, with a mean straight carapace length and width of 56.6 cm (S.D. ±12.5) and 45.2 ±7.6, respectively. A bite force apparatus that incorporated a piezoelectric force transducer, with bite plates customized for sea turtles, was used to collect bite force data at the rostral most tips of the jaws from subjects. The maximum bite force measured was 303 N. Mean HW, HH, and HL were 8.9 cm (± 1.8), 9.0 (± 2.0), and 11.2 (±2.7), respectively. A stepwise regression demonstrated that head width was the best predictor of bite force ($P < 0.01$; $R2 = 0.61$). Although the maximum bite force for green turtles was lower than that reported for loggerheads, bite forces were relatively forceful compared to other marine durophagous vertebrates. In addition, during bite force measurements, propalineal movement of the lower jaw was routinely observed. This suggests that the maximum bite force may be slightly underestimated. This movement also suggests that some degree of oral processing occurs during feeding events. The magnitude of bite force and propalineal motion of the lower jaw of green turtles is likely an adaptation for cropping tough plant and algal material, but bite forces generated are also in the range required to crush several crab and mollusk species at small size classes.

USE OF HYPERBARIC OXYGEN THERAPY TO TREAT OSTEOMYELITIS IN A LOGGERHEAD SEA TURTLE

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Hyperbaric Oxygen Therapy (HBOT) involves inhaling 100% oxygen while under increased atmospheric pressure. This fully saturates the hemoglobin in the red blood cell, and allows for hyperoxygenation of the blood by further dissolving oxygen into plasma. The first use of HBOT was in 1600s, when a British clergyman built a structure he called a domicilium and used hand bellows to pressurize the air inside. Its use today has multiple physiological effects which have proven beneficial for a remarkable variety of diseases. The objective of HBOT is hyperoxygenation, which is effective in the treatment of: decompression sickness, carbon monoxide toxicity, retinal artery occlusion, crush injury/compartment syndrome, compromised grafts, blood loss anemia, soft tissue infection, refractory osteomyelitis, and more. Some of the important benefits include: vasoconstriction, reduction of edema, promotion of angiogenesis, stimulation of fibroblasts, increase of collagen synthesis, increased oxidative killing by leukocytes, and clostridial toxin inhibition. Treatment involves placing the patient in a chamber and increasing pressure to 2-4 atmospheres depending on overall condition and reason for use. Pressure is increased with addition of 100% oxygen and maintained for approximately one hour. Treatment frequency can be daily for several months. In this case, HBOT was employed as treatment of refractory osteomyelitis. HBOT has many beneficial effects specific for osteomyelitis as it will reduce the presence of anerobic bacteria and make systemic antibiotics more effective. Furthermore, as oxygen tension in the infected bone is elevated above normal levels, oxygen dependent polymorphonuclear cell function will increase. Finally, HBOT promotes osteoclast function, as resorption of necrotic bone is also oxygen dependent. An adult female loggerhead was presented in the fall of 2010 with both front flippers partially amputated by apparent shark bite. There was a deep laceration on the ventral side of the right flipper which penetrated the carpal joint. The left front flipper was missing 60% of its distal tip. Over the subsequent year, wounds were cultured multiple times and treated with appropriate systemic antibiotics for extended courses (60-90 days). Wounds were also deeply debrided twice under anesthesia: once with silverlon drains placed to facilitate exudate leaving the wound, and a second time with antibiotic impregnated beads placed into the wound bed to elute antibiotic directly into the wound. Despite the variety of techniques and extended treatment intervals, when treatment was discontinued, within 6 weeks the patient would become inactive, anorexic, and show a marked increase in the WBC. Active osteomyelitis was visible radiographically as an increase in bone lysis in the affected areas. HBOT therapy was initiated as an alternative therapy. The treatment sessions involved 1 hour "dives" to 2.5 atmospheres of pressure for one hour 3 days a week for a total of 18 dives. Concurrent use of appropriate systemic antibiotic was also used for its synergistic effect. The turtle was held in captivity for 1 year after treatment and showed none of the clinical or radiographic changes previously seen. The turtle was tagged and released and her progress can be monitored by satellite tag.

ANATOMICAL STUDY OF HEART MORPHOGENESIS OF OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) ON THE COAST OF OAXACA*

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Sea turtles are endangered, which is why research on embryos of these species is limited; obtaining permission to collect samples is difficult. Because of this the study aimed to examine morphological changes of the heart in embryos during development until hatching. Embryos were studied from 240 eggs, which were collected from two olive ridley nests on the beach of Palmarito, in the municipality of Bajos de Chila, San Pedro Mixtepec, Oaxaca, Mexico, under permit number SGPA/DGVS/01731 / 08 dated April 1 2008. The collected eggs were incubated in the sand protected by a corral on the beach. The first specimen was taken on the 2nd day of incubation, and collection continued daily with sampling until day 45 of incubation. The samples were injected with 10% formol for fixation and were preserved in the same solution in plastic bags, labeled with the date and the day of incubation. Subsequently embryos were obtained by cutting the shell of the egg and baring the yolk, where the organisms were extracted and fixed in jars with 10% formol for 24 hours. After this fixing time, we proceeded to wash the embryos with tap water for 12 hours and continued the processing in toto using the "Green Light" technique. This begins with the embryos in the light green solution, then excess dye is removed by washing them in alcohol at 85°, followed by dehydration through changes of one hour at 96° alcohol, absolute alcohol followed and the mixture in absolute alcohol - salicylate, the transparentation was performed with salicylate - xilol mixture and finally the embryo is mounted with synthetic resin and observed under a microscope to obtain the results. It was noted that embryos on the 3rd day of incubation showed secondary encephalic vesicles, cephalic flexure, were developing eyes and the heart was forming by the heart straight tube having a series of expansions corresponding to arterial trunk, arterial bulb, primitive ventricle atrium and venous sinus, in addition 7 to 9 pairs of somites. As the incubation days advanced until the 12th day, the following changes were observed in the heart: the development of the cardiac loop corresponding to the first curvature called bulboventricular asa, then the curvature took the form of an "S"; that ensures that the atria that are still developing are positioned dorsal to the ventricle. We conclude that the morphological changes that occur until the 12th day include a heart with well-formed structures, and from then until 45 days, the heart only undergoes changes in its structural size (atria and ventricle) with the right atrium predominating in size with respect to the left atrium.

SEA TURTLE DERMAL SCUTE VARIATIONS FROM RESCUED INDIVIDUALS IN THE GULF OF VENEZUELA

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Species from the Cheloniidae family: *Chelonia mydas*, *Caretta caretta*, *Eretmochelys imbricata*, *Lepidochelys olivacea*, *Lepidochelys kempii* and *Natator depressus*, presents as a distinctive feature the presence of an osseous carapace covered with skin and scutes. In the Gulf of Venezuela (GV) four of the six species belonging to this family are present; this area is a well-known foraging location for Caribbean populations of marine reptiles. The number and arrangement of these scutes or scales are specific to each species, the presence of supernumerary dermal shields or scales could lead to confusion at the moment of correctly identify these species. This variation has been associated with altered dermal environmental conditions during embryonic development. Based on the review of sea turtles individuals rescued and included in the database of the Workgroup on Marine Turtles in the Gulf of Venezuela (GTTM-GV, by its Spanish Acronym) a total of 19 individuals with presence of supernumerary scales were analyzed; 89% of individuals belonged to the species *Chelonia mydas* and 11% of the species *Caretta caretta*. Several variations in dermal shields agreements of both species' carapace were observed, with a range from one to four "extra" scales or scutes. This phenomenon (called "Dovetail Syndrome") does not affect the survival of the individuals; it is known to be an anomaly related with either a genetic or embryogenesis condition and a poorly understood phenomenon. All records and photographs of sea turtle individuals may have different uses in sea turtle populations' management and conservation programs. In foraging areas, such as the Gulf of Venezuela, this data can complement the morphometric and meristic database with a standardized photo-identification of individuals; such identification might be used in areas of illegal consumption and trade of carapace and other products for a better control for these unlawful acts with endangered species.

PRELIMINARY EVALUATION OF MINIMALLY INVASIVE SEXING TECHNIQUES FOR IN-WATER STUDIES OF LEATHERBACK SEA TURTLES

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Sea turtles do not contain heteromorphic sex chromosomes, precluding the use of genetic methods to confirm sex of individuals. Common alternative techniques used to confirm sex include laparoscopy, gonad histology and ultrasound of the inguinal region to view the reproductive organs. These techniques are not practical for in-water studies of leatherback sea turtles that depend on humane and short handling protocols. For large sub-adult and adult leatherbacks, tail length is a secondary sexual characteristic that can accurately identify sex. However, unless phallus eversion occurs during handling or tag recapture data can link individuals to nesting beaches, sex cannot be confirmed with absolute certainty. We explored the use

of three techniques for identifying sex of leatherbacks live-captured off of Nova Scotia, Canada: ultrasound of the tail to view the phallus, digital palpation of the phallus through the cloacal opening, and blood sampling followed by testosterone radioimmunoassay (RIA) to analyze sex hormone levels. Digital palpation was performed on two live adult male turtles and tail ultrasounds were performed on three live adult turtles (two females and 1 male) and one stranded, dead adult turtle. For the latter, ultrasound was promising as the phallus was identifiable using a 7.4cm field depth, especially when the phallus was manipulated. Ultrasound on the live adult male turtle was inconclusive, possibly due to boat and animal movement. Digital palpation of the phallus through the cloacal opening was unsuccessful in the two live male turtles. Using 600pg/mL as the cutoff value between males and females, we found that testosterone levels of 22 of 26 turtles agreed with their sex assignment based on tail length. The sexes of 9 of the 22 individuals were confirmed based on tag recapture data or phallus eversion. Three of four turtles for which testosterone levels were discrepant with sex assignment based on tail length were visually determined to be males with testosterone levels more typical of females. This may have been resulted from stress-induced increases in cortisol, which can decrease testosterone levels.

FLOW CYTOMETRY OF MYCOBIOTA ISOLATED FROM NESTS, EGGS, AND STILLBIRTHS OF THE SEA TURTLE *ERETMOCHELYS IMBRICATA* (LINNAEUS, 1766)

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The hawksbill sea turtle, *Eretmochelys imbricata*, was a subject of trade due to the collection of its eggs, consumption of the female's meat, and fishing activities in coastal areas. Besides human impacts, pathogens have also led to high rates of mortality, especially fungi that can kill embryos and cause cutaneous mycosis. Flow cytometry, a highly robust and fast technique, has become widely used in the last couple of decades to estimate the genome size of living organisms, including fungi. This can be very useful for biosystematics purposes. This study used this technique to quantify the genome size of fungal species isolated from soil, stillbirths and hawksbill turtle eggs, and then to evaluate the usefulness of this character to complement previous morphological identification of fungal species. Nuclear suspensions were obtained after chopping the fungal tissue in 1 mL of lysis buffer, subsequent filtering of the solution through a 80 µM nylon filter and staining with propidium iodide. The stained samples were then analysed in the flow cytometer and data was acquired in the form of histograms. Using this method, the genome sizes of *Fusarium solani*, *Aspergillus terreus*, and *A. niger* were estimated as 1C=95 Mbp, 35 Mbp and 40 Mbp. Consistent estimates among different replicates aided in the complementary identification of the fungal species. Using this method, the genome size of *Fusarium solani*, *Aspergillus terreus* and *A. niger* was estimated as 1C = 95 Mbp, 35 Mbp and 40 Mbp. The detection of *Fusarium solani* is particularly important as this species is known to be the cause of mortality in embryos of some species of sea turtles. Further studies related to the size of the fungal genome, its possible variations, and other inferences on gene mutations in differentiation of species or subspecies are necessary to investigate their pathogenicity and strengthen studies on the ecology and conservation of sea turtles.

FLIPPER BEATING MODULATION OF GREEN TURTLES IN WATER AND ON LAND: IMPLICATIONS FOR AQUATIC ADAPTATION AND LOCOMOTOR TRADE-OFF

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Sea turtles spend most of their lives in marine habitats, but they require a terrestrial environment for oviposition. In both conditions, they use limbs for thrust production and modulating the stroke for efficiency or higher thrust is important in their biomechanical strategy. We attached animal-borne W1000L-3MPD3GT data loggers on green turtles during inter-nesting periods and recorded the surging acceleration and swimming speed. We report how green turtles modulate flipper beating during travel in the inter-nesting period and whether the stroke cycle is different between in-water and on-land. Firstly, we assessed the relationship between swimming speed, stroke frequency, and amplitude of surging acceleration representing stroke amplitude for varying swim speed. For varying speed, stroke frequency × amplitude of surging acceleration had more explanatory power than stroke frequency or amplitude of acceleration. Therefore, flipper-beating of sea turtle during continuous swimming is indicated to be modulated by both of stroke frequency and thrust per stroke that may enable sea turtles to adopt flexible swimming strategy depending on the situation. Assuming that the amplitude of acceleration is proportional to the stroke amplitude, the relationship observed in this study indicated that Strouhal number slightly but significantly decreases as swim speed increases. Secondly, stroke frequency was compared between during swimming in water and crawling on land. The results showed that stroke frequency during terrestrial crawling is significantly higher than that during swimming. It contrasts to previous studies of animals performing drag-based swimming. Because green turtles are thought to be lift-based swimmers that produce thrust mainly by dorsoventral excursion, anteroposterior excursion that is thought to be important for drag-based swimming and terrestrial crawling may be restricted. Small anteroposterior excursion resulting in short stride length may be complemented by higher stroke frequency during crawling. We thank the Symposium Travel Fund and donors for assistance.

PAIN MANAGEMENT STRATEGIES IN SEA TURTLES AND PHARMACOKINETICS OF TRAMADOL AND O-DESMETHYLTRAMADOL IN LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*)

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Trauma is the most common reason for sea turtles to be presented to the Georgia Sea Turtle Center for rehabilitation. Boat strike injuries account for over 20 percent of our caseload and these injuries are likely

to be extremely painful. During the past few years, our understanding of reptile pain and its reduction through analgesic (pain management) drugs has become clearer, although many of these drugs cause respiratory depression in reptiles as they do in mammals. Tramadol hydrochloride is a centrally-acting synthetic analgesic drug which is used for moderate to moderately-severe pain in a variety of species. Tramadol is a very weak μ-opioid (morphine-like drug) receptor agonist, induces serotonin release, and inhibits the reuptake of norepinephrine. Tramadol is converted to O-desmethyltramadol, a significantly more potent μ-opioid agonist. The opioid agonistic effect of tramadol and its major metabolite(s) is almost exclusively mediated by such μ-opioid receptors. This further distinguishes tramadol from opioids in general (including morphine), which do not possess tramadol's degree of receptor subtype selectivity and which are much stronger opiate-receptor agonists. A recent study in red eared sliders showed that orally administered tramadol provided analgesia in red-eared slider turtles, and the pain relieving effects appeared to last for 4-5 days following a single oral dose. In addition, tramadol caused minimal respiratory depression in the same turtles. The objective of this study was to determine the pharmacokinetics of two orally administered doses of tramadol (5 and 10 mg/kg) and its major metabolite (O-desmethyltramadol) in loggerhead sea turtles (*Caretta caretta*). After oral administration, the half-life of tramadol administered at 5 mg/kg and 10 mg/kg was 20.35 and 22.67 hours, whereas the half-life of M1 was 10.23 and 11.26 hours, respectively. The maximum concentration (Cmax) for tramadol after oral administration at 5 mg/kg and 10 mg/kg was 373 and 719 ng/mL, whereas that of M1 was 655 and 1376 ng/mL, respectively. We were able to determine that tramadol, administered orally to loggerhead sea turtles at both dosages provided measurable plasma concentrations of tramadol and O-desmethyltramadol for several days with no adverse effects. Plasma concentrations of tramadol and O-desmethyltramadol remained ≥ 100 ng/ml for at least 48 hours and perhaps as long as 96 hours when tramadol was administered at 10 mg/kg. Based on therapeutic levels that are achieved in humans, a dose of 10 mg/kg every 48 hrs should produce similar levels but further studies are needed to confirm this information including multi-dose and pharmacodynamic studies.

SEA TURTLE HEALTH, VETERINARY CARE, AND REHABILITATION WORKSHOP IN COSTA RICA

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Sea turtles are global citizens whose status is imperiled worldwide. As nations struggle to conserve this priceless natural resource by developing their own methods for conservation, it should be remembered that rehabilitation is a powerful tool. While the number of animals returned to the sea is often inconsequential, the number of people that can be influenced by the effort can be enormous.The positive effect of a successful rehabilitation and public release back to the wild can ripple thru the community and inspire people from many backgrounds.Sea turtles are effective ambassadors for ocean conservation worldwide. Education programs using animals undergoing rehabilitation can highlight local threats to sea turtles. When witnessed, this can develop an appreciation and even sympathy for the species which can have far reaching effects. Sea turtle rehabilitation allows for "saving turtles, one person at a time". Sea turtle rehabilitation in the United States attracts hundreds of thousands of visitors who are local and many more tourists from other regions and countries. Many countries already have veterinarians that are willing to help but simply lack the knowledge and the coordination with local biologists and wildlife rehabilitators to successfully hold animals in captivity during convalescence. Due to endangered species law it is not practical or legal to move animals across borders so it becomes vital that each nation have its own network for a successful

rehabilitation program. The purpose of the sea turtle medicine and surgery workshop is to provide the special training to these people. It is a 5 day intensive lecture and wet lab designed to expose veterinarians, veterinary students, biologists, and rehabilitation specialists to the unique aspects of sea turtle health care. It is taught by four veterinarians with extensive experience in facility development, husbandry, pathology, and wildlife medicine.

FACTORS AFFECTING SURVIVORSHIP IN REHABILITATING SEA TURTLES WITH FIBROPAPILLOMATOSIS

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Fibropapillomatosis (FP), a neoplastic disease of sea turtles with a likely primary herpesviral etiology, is characterized by cutaneous, conjunctival, and occasionally visceral growths. We characterized the occurrence, clinical presentation, case progression, and outcome of rehabilitating sea turtles with FP (n = 18) at the Georgia Sea Turtle Center, Jekyll Island, GA (GSTC). We also evaluated case data from a group of non-FP turtles in rehabilitation (control group, n = 18). During 2009-2012, FP was present in ~5% of rehabilitating sea turtles at the GSTC, including green (*Chelonia mydas*) and Kemp's ridley (*Lepidochelys kempii*) turtles. The majority of the FP+ turtles were juvenile (94.4%), female (87.5%), green (94.4%) sea turtles. Highest FP prevalence was in the 25–29.9 cm and 40–44.9 cm SCL size classes (22.2% each). Floating was significantly more likely to be observed in FP+ turtles than in non-FP turtles. Average time in rehabilitation was 251 days (± SE 18.94) for FP+ turtles, and 127 days (± SE 62.59) for non-FP turtles. Time to FP onset ranged from demonstration of FP lesions at the time of submission (0 weeks) to 40 weeks. Of the FP+ cases, 61.1% were released following rehabilitation; 22.2% were euthanized due to FP; 11.1% died in captivity; and 5.6% kept in permanent captivity. FP+ turtles had significantly greater odds of being euthanized than non-FP turtles. This study summarizes multifactorial aspects of FP cases in rehabilitation, suggests important parameters to evaluate in prospective FP cases, and provides potential predictors for possible case outcomes.

BIOACCUMULATION AND BIOMAGNIFICATION OF MERCURY AND SELENIUM IN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*): A CAUSE FOR CONCERN IN THIS SPECIES?*

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Leatherback sea turtles (*Dermochelys coriacea*) make long-distance migrations between foraging areas and breeding areas. Within foraging areas, leatherbacks consume vast amounts of prey that can expose them to high concentrations of environmental toxicants. Increased concentrations of contaminants may have detrimental impacts on health, reproduction and survival. Specifically, I chose to analyze mercury, a toxicant with no known biological function, and selenium, a necessary nutrient that is known to detoxify mercury, yet can be toxic at elevated concentrations. To quantify bioaccumulation and biomagnification of

mercury and selenium in the leatherback food chain, I collected and analyzed water and prey samples from areas where leatherbacks feed and liver samples from stranded leatherbacks of all life stage classes (hatchlings, juveniles, subadults, adults). Lastly, one food sample and multiple liver samples from post-mortem lab-reared leatherback post-hatchlings were collected. All samples were analyzed for total mercury and selenium compounds by spectrometric methods. I found that both of these trace elements tended to biomagnify up the food chain: water samples had the lowest concentrations of mercury and selenium, while liver samples from the adult life stage class had the highest concentrations of these elements. Analyses of captive-raised individuals, which fed on a manufactured diet that used tuna as a protein source, showed bioaccumulation of mercury. Individuals that were captive for longer had much higher concentrations of mercury in their livers than those individuals that died in quarantine (i.e., before feeding began) indicating biomagnification and bioaccumulation can start early in life and primarily occurs from food intake; however, absorption of the yolk sac may cause a slight increase in bodily mercury levels at this early life stage. Liver samples of stranded juvenile leatherbacks had significantly lower concentrations of both mercury and selenium in comparison to the adult life stage class. In leatherbacks, mercury and selenium concentrations in the liver of adult individuals were much lower than marine mammal species, but are often similar to or higher than fishes, birds, and other marine turtles. One interesting observation found is that concentrations of both mercury and selenium in the liver of the stranded leatherback adults were greater than or equal to levels known to affect health of some bird species and were above tolerance limits established for human food consumption set by a variety of environmental and public health agencies. This observation is important in areas where turtle meat is consumed by human populations. Such levels suggest that scavengers and predators upon leatherbacks are also at risk unless they have physiological mechanisms to detoxify ingested mercury. Anthropogenic deposition of trace elements and toxicants into the environment is of concern because bodily concentrations of both mercury and selenium increase as leatherbacks age. Because these organisms are long-lived, toxicant loads may increase to physiologically harmful levels in these imperiled species and to their consumers.

GREEN SEA TURTLES (*CHELONIA MYDAS*) RECEIVED AT CENTRO DE RECUPERAÇãO DE ANIMAIS MARINHOS (CRAM/FURG) IN 2011

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Although the Centro de Recuperacao de Animais Marinhos (CRAM-FURG) receives a number of green sea turtles exhibiting different types of injuries each year, numbers were unusually high during 2011, with 92 green turtles being admitted for treatment. These turtles ranged from 28.5 to 62.0 cm curved carapace length (CCL) (mean = 38.0 ± 4.96 cm CCL) and injuries were classified as: 1) heavy epibiont load, 2) debris ingestion, and 3) fishery interaction. The purpose of the current study was to assess potential relationships between injury type and stranding date. Of the total 92 green sea turtles received, 56 had debris in their gastrointestinal tract, 21 exhibited heavy epibiont loads, 9 displayed evidence of fishery interaction, and for the remaining 9 turtle's cause of stranding could not be determined. In addition, three of the individuals exhibited two types of injuries. Two ingress peaks were observed, one during April/May and the other in October/November. Turtles received during the first peak were cachectic and severely dehydrated, while those during the second peak displayed good body condition and only moderate dehydration. We propose that the first peak results from consumption of debris that accumulates in great quantities near the beaches of Rio Grande do Sul State, Brazil, from tourist use of the area during summer

months (December to March). Because early juvenile green turtles may not yet have fully transitioned to an herbivorous diet, if food resources are limited in these areas then the turtles might adopt a mixed, omnivorous feeding strategy that could lead to consumption of debris. Treatment for debris ingestion was intensive hydration, antibiotic therapy, and regular feeding; however only two (5%) of individuals displaying this type of injury had good response to the treatment and were released. Green turtles received during the second ingress peak appeared to represent those turtles that stayed in inshore waters during the winter (July to September) and possibly entered a lethargic, dormant state due to low water temperatures (~10° C) and food availability, which in turn allowed extensive epibiont colonization of the turtles' carapaces. This behavior may be comparable to the dormancy observed for Gulf of California green sea turtles, which have been observed to decrease activity and partially bury themselves in the substrate at temperatures below 15° C. Treatment for the second group first involved hydration as well as regular feeding and 14 (70%) of the individuals responded well, beginning to eat on their own, and were subsequently released. No ingress pattern was evident for the 9 turtles exhibiting signs of fishery interaction, as they were received throughout the year, and 5 of these turtles were rehabilitated and released.
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AGE AND GROWTH OF GREEN SEA TURTLES (*CHELONIA MYDAS*) IN SOUTHERN BRAZIL

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Sea turtles of the species *Chelonia mydas* use the Brazilian coast for development and reproduction, with the major nesting beaches located in Trinidade Island (ES State), Atol da Rocas (RN State) and Fernando de Noronha (PE State). The majority of studies on green turtles in Brazil involve adult females on nesting beaches and information about juveniles during their pelagic and neritic stages is fragmentary. In the current study, age was estimated for 55 green sea turtles through skeletochronoogical analysis of humerus bones. All turtles in the study stranded dead on Cassino Beach in Rio Grande do Sul state in southern Brazil and curved carapace lengths (CCL) ranged from 28.0 to 49.0 cm (mean = 38.3 cm ±4.98 SD). As annual growth mark deposition has been validated for green sea turtles, the number of lines of arrested growth (LAGs) was taken as the age estimated for those samples that retained the annulus (i.e. diffuse LAG denoting the end of the first year). For larger turtles whose humeri exhibited resorption, or destruction of early growth marks, a correction factor was applied to estimate the number of lost LAGs. This correction factor was based on two models, the first denoted "naïve" made no distinction between inter- and intra-individual variability and the second denoted "hierarchical", took this distinction into account. The hierarchical model fit the data set best, probably because these reptiles experience stochastic conditions throughout their lives, so that some individuals may grow more than others. Ages estimated for the sample ranged from 3 to 12 years. Schnute's growth model was fit to age-at-CCL data and was used because of its versatility in shape and lack of a requirement for data from the entire size range (i.e. hatchlings to adults near asymptotic size). As the sample only included juveniles and growth was generally linear, a linear model also fit the data quite well and both this and the Schnute model had similar DIC (Deviance

Information Criteria) values. The “Body Proportional Hypothesis” (BPH) was incorporated into the calculation of growth rates through conversion of sequential growth mark measures to estimates of CCL. Growth rates averaged 2.46 cm CCL ± 0.59 SD year-1 and ranged from 1.31 to 3.58 cm CCL year-1 and were similar to results from other skeletochronological analyses of Atlantic green turtles, but lower than those estimated through mark-recapture. Humeri from 43 of the green turtles retained an annulus, allowing back-calculation of size at age 1 and it averaged 22.97 cm CCL ± 5.3 SD and ranged from 11.92 to 34.97 cm CCL. It is likely that the turtles retaining the annulus were new recruits and, as a result, their ages should approximate pelagic stage duration. Ages for these turtles ranged from 1 to 7 years, similar to estimates from North Atlantic green turtle populations, as assessed through skeletochronological data and stable isotope analysis. The results of the current study provide the first age and growth data for juvenile green sea turtles in the south Atlantic. Acknowledgements: We acknowledge the following organizations for the travel grants, International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics and CLS America.

BACTERIAL FLORA IDENTIFIED FROM LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*) EGG SHELLS AND NEST SAND AT GRANDE RIVIERE BEACH, TRINIDAD.

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Grande Riviere beach, on the island of Trinidad, supports the country’s largest nesting population of leatherback turtles, *Dermochelys coriacea*. It is estimated that up to 5000 turtles come ashore to nest on the 970m stretch of beach annually. Throughout the nesting season which spans from March to August, nests are naturally disturbed by newly nesting females, resulting in egg breakage and loss of some egg viability. This environment provides ideal conditions for the growth and proliferation of microbes. Dramatic changes in the course of the Grande Riviere river also significantly affect this nesting site, by periodically washing away large areas of sand and the nests therein. Tidal activity quickly replenishes the void area with ‘new’ sand throughout the season, thus potentially altering microbial load in the affected zone. This study sought to identify the range of bacterial flora present in beach sand and egg shells on the nesting beach, with emphasis being placed on bacteria that may pose a threat to animal health, including turtle hatchling health, as well as those of public health significance. It further sought to determine the extent to which the bacterial load and bacterial species on the beach changed throughout the season. Three sample sets were taken during the 2011-2012 nesting season, representing the early, peak and late season. Each sample set consisted of 40 sand samples collected across the entire beach, in addition to swabs of any egg shells that were adjacent to the sand sample site. Samples were cultured on a variety of nutrient agars and selective media, standard biochemical tests were used to identify organisms to the genus level and heterotrophic plate counts were performed to quantify the bacterial load of each sample. Pseudomonads have been found to predominate. We discuss the pathogenic bacteria identified, the nesting areas with the highest bacterial load and the potential threats posed to visitors and hatchling health. Further studies will seek to document the fungal pathogens that may pose a threat on this heavily nested, highly traversed beach.

IMMUNOSUPPRESSION EVALUATION OF *CHELONIA MYDAS* (TESTUDINES, CHELONIIDAE) CAUGHT IN BRAZIL

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The green sea turtle (*Chelonia mydas*) feeds and nests along the Brazilian coast. Fibropapillomatosis (FP), a disease characterized by skin tumors, is a growing threat to this species, having a multifactorial and complex etiology (Chelonid Fibropapilloma-associated Herpesvirus, genetic and environmental factors including organochlorine compounds and heavy metals). This study assessed leukocyte activity (phagocytosis and oxidative burst) from non-affected turtles (control group) and affected turtles (FP group) by flow cytometry, and correlated these results with hematological data. The evaluation of leucocyte activity is extremely necessary because turtles affected by FP are immunosuppressed. Specimens of *C. mydas* were randomly caught or rescued on beaches in Ubatuba/SP and São Sebastião/SP (Brazil). After capture, debilitated green sea turtles remained at TAMAR-ICMBio Rehabilitation Center in Ubatuba/SP. Blood samples were taken and biometric data (curved carapace length, curved carapace width and body mass) were recorded from 58 juveniles specimens (23 without tumors and 35 with tumors) in accordance to protocols of TAMAR-ICMBio. Frequency and distribution of tumors by anatomical region were also recorded. Leucocytes were obtained using Percoll Amersham Biosciences® and the stimuli applied were Phorbol Miristate-Acetate for oxidative burst and Zymosan A (Saccharomyces cerevisiae Bio Particles®, Alexa Fluor® 594 conjugate) for phagocytosis. Tumor number per animal ranged from 1 to 59, with the anterior limbs being the most affected region. Animals with FP were larger in size (42.18 cm ± 8.42) than turtles without FP (39.26 cm ± 12.34). The values of hematological parameters (from 43 turtles) were similar ($p \geq 0.05$) for both affected (n=24) and non-affected (n=19) turtles. Additionally, hematological results were also compared with reference values from non-affected juvenile green sea turtles caught in Fernando de Noronha/PE, Brazil, revealing that the turtles from this study had lower values for Hematocrit, Hemoglobin, Mean Cell Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Eosinophils (Eos), but higher values for total Leucocytes, Heterophils (Het), Monocytes (Mon) and Lymphocytes (Lym). The results of flow cytometry included samples from 22 specimens (8 non-affected and 14 affected turtles). Three cell populations, isolated first by Percoll Amersham Biosciences®, were observed: Lym, Mon and Granulocytes (Gran). Phagocytosis and oxidative burst analyses (geometric mean of fluorescence intensity) included two populations (Mon and Gran). Phagocytosis and oxidative burst from turtles with and without tumors did not differ ($p \geq 0.05$). However, there was a significant difference ($p \leq 0.05$) between control group and stimulus group for Phagocytosis. The pathogenesis of FP is still unclear, so elucidating some parameters linked to diseases related to pollution are relevant in studying ecosystem imbalances and are important for new directions in sea turtle conservation issues. Acknowledgements: Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP): 2010/01781-8 and 2011/04565-7; Projeto TAMAR-ICMBio.

A PROPOSAL TO OBJECTIVELY CLASSIFY FIBROPAPILLOMATOSIS SEVERITY IN SEA TURTLES CONSIDERING NUMBER AND SIZE OF TUMORS

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Fibropapillomatosis (FP) is a disease that affects sea turtles, especially green turtles, *Chelonia mydas*. Researchers attribute complex etiology involving genetic and environmental factors, as well as the Chelonid Fibropapilloma-associated Herpesvirus. Specimens of *C. mydas* were caught in different feeding areas along the Brazilian coast: Ubatuba-SP (n=63), Vitória-ES (n=23) and Almofala-CE (n=4). Biometric data was collected in accordance to protocols of TAMAR-ICMBio-Brazil, and the number and distribution of the tumors per anatomic region (anterior and posterior flippers, including adjacent skin; cervical region; plastron; eyes; inguinal region and tail; carapace and horny scales of head) were recorded. Tumors were measured and classified for each individual according to their diameter based on Work & Balazs: A (<1 cm), B (1 cm $\leq$ tumor $\leq$ 4 cm), C (4 cm $<$ tumor $\leq$ 10 cm) and D ($>$ 10 cm). A total of 3,035 fibropapillomas were counted, ranging from 1 to 129 (34.49 ± 27.69) per turtle and were classified as: FPA (43.14% of tumors), FPB (50.55%), FPC (5.98%) and FPD (0.33%). Tumors were distributed in greater quantities on the anterior and posterior flippers (respectively 44.12% and 29.36%), cervical region (11.51%), plastron (4.97%), near the eyes (4.16%), inguinal region and tail (3.22%), carapace (1.79%) and head (0.88%). Based on this data, we developed a system to objectively classify the severity of fibropapillomatosis based on the quantity of the tumors in each size category. The number of tumors in each size category was then used to calculate a novel fibropapillomatosis index (FPI) for each individual: $FPI = (1\times FPA)+(2\times FPB)+(4\times FPC)+(8\times FPD)$, where FPx is the number of tumors of the x size category that were counted on that individual. The resulting fibropapillomatosis index may be used to classify the degree of this disease of that individual as “mild” ($FPI<50$), “moderate” ($50\leq FPI<100$) or “severe” ($FPI\geq 100$). Through this index, individuals with the same number of tumors may be classified very differently. For example, consider two hypothetical individuals with 40 tumors: individual A has 10 tumors smaller than 1 cm, 25 tumors from 1 to 4 cm, 4 tumors from 4 to 10 cm, and one tumor larger than 10 cm; individual B has 37 tumors smaller than 1 cm, 2 tumors from 1 to 4 cm, and one tumor from 4 to 10 cm. As a result, individual “A” will have a fibropapillomatosis index of 84 and will be classified as “moderate”, whereas individual “B” will have an index of 45 and will be classified as “mild”. This fibropapillomatosis index will be applied to green turtles caught along the Brazilian coast to correlate the severity of fibropapillomatosis with other health and environmental variables in order to develop a better understanding of the regional manifestations of the disease and its implications for the conservation of this species. Acknowledgements: Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP): 2009/53956-9, 2010/01781-8, 2011/04565-7; Projeto Tamar-ICMBio.

IMMUNOTOXIC EFFECTS OF SELECTED PCBS UPON IN VITRO EXPOSURE IN JUVENILE LOGGERHEAD SEA TURTLES, *CARETTA CARETTA*

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The loggerhead sea turtle, *Caretta caretta*, is considered endangered by the IUCN and is currently protected under the Endangered Species Act. Sea turtles face numerous environmental challenges including exposure to anthropogenic chemical pollutants such as polychlorinated biphenyls (PCBs). Although banned in the 1970s in the United States, they still persist in the environment and are documented to exert immunotoxicity in a wide range of species. This is of particular concern as modulation of the immune system may lead to an increase of disease's susceptibility. A battery of in vitro immune assays, previously optimized in loggerhead sea turtles, was used to quantify the direct effects of selected PCBs at increasing concentrations (0.5, 1, 2.5, 5, 10, 15 and 20 ppm) on peripheral blood leukocytes. The effects of PCB 105 and 138 on innate immunity were assessed (eosinophils phagocytosis and natural killer (NK) cell activity). The activity of NK cell after exposure to PCB 169 was also determined. Acquired immunity was tested by incubating lymphocytes with PCB 105, 153 or 180 for 96 h while phytohaemagglutinin (PHA)-induced T lymphocyte proliferation was measured. Blood samples from healthy juvenile captive loggerhead sea turtles were collected from the cervical sinus under the appropriate permits. The results show that: (1) peripheral blood mononuclear cell viability was > 90% after 96h of exposure of either coplanar PCBs (105, 123, 169) and non-coplanar congeners (138, 153, 180) at all tested concentrations; (2) PCB 105 and 138 significantly increase phagocytosis at 10 and 15 ppm ($p<0.002$, $n=4$, PCB 105) and 15 ppm ($p<0.04$, $n=4$, PCB 138) compared to unexposed eosinophils; (3) PCB 169 did not modulate NK cell activity, while PCBs 138 and 105 significantly decreased NK cell activity at 15 ppm ($p=0.007$, $n=3$) and 20 ppm ($p=0.008$, $n=3$), respectively, compared to unexposed control; and (4) PCB 180 significantly decreased T lymphocyte proliferation at 10, 15 and 20 ppm ($p<0.001$, $n=3$). None of the other PCBs tested (105 and 153) modulated T lymphocyte proliferation, however, data obtained with these two congeners had insufficient statistical power to determine significant differences if they existed. In conclusion, this is the first study reporting the toxic effects of two PCBs (105 and 138) on sea turtle innate immunity such as phagocytosis and NK cell activity. Any modulation of immune functions may increase the likelihood of infection, which may impact the survival of individuals. This research will help establish relationships between chemicals measured in loggerhead sea turtles and the integrity of defense mechanisms as indicators of disease susceptibility to pathogens and consequently guide veterinarians and wildlife rehabilitators in caring for and treating afflicted animals. Acknowledgements: The authors would like to thank the supporting personnel at the NOAA Fisheries Service Galveston Sea Turtle Facility. Funding and logistic support for this project was provided by the Rotary Foundation. I would like to thank the Sea Turtle Symposium for making trip to the 33th Sea Turtle Symposium possible through a student grant travel.

BODY CONDITION INDEX OF *CHELONIA MYDAS* (TESTUDINES, CHELONIIDAE) WITH AND WITHOUT FIBROPAPILLOMATOSIS ALONG THE COAST OF BRAZIL

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Fibropapillomatosis (FP) is an important conservation threat to green turtles, *Chelonia mydas*, due to its widespread and complex character. Its etiology is not yet entirely understood and its impacts on sea turtle populations is a priority for conservation efforts. The body condition index (BCI) can be used for routine green sea turtle health evaluations. This study used BCI to evaluate and compare the condition of *C. mydas* specimens with (n=94) and without fibropapillomas (n=127) in relation to capture location, gender and capture method in Brazilian waters. Biometric data (curved carapace length-CCL, curved carapace width-CCW and body mass-BM) were recorded. Straight carapace length (SCL) was extrapolated (SCL=(CCL-2.2464)/1.0363) and then Body Condition Index was calculated ($BCI=BM/SCL^3$). BCI had a normal distribution (KS=0.053 P=0.140), and a General Linear Model with Tukey's post-hoc test was used to compare BCI in relation to capture location (Ceará, Espírito Santo, Rio de Janeiro, Santa Catarina, São Paulo), gender (female, male, not determined), capture method (incidental netting, floating, stranded, others) and fibropapillomatosis (absent, present). Animals captured through incidental netting were further compared to the fishery type (fishing hooks, floating siege, corral, trawl nets, gillnets, driftnet, cast net, not determined). BCI was not significantly different among genders (F=1.83, P=0.163) or whether they had fibropapillomatosis or not (F=0.01, P=0.919). However this may result from the fact that there was great variation in the number and distribution of tumors, and therefore the impacts on body condition may vary largely among individuals with the disease. There was a significant difference in relation to capture location (F=2.89, P=0.023), however the Tukey post-hoc comparison failed to identify it (all P>0.05). BCI differed in relation to capture method (F=11.05, P<0.001): turtles captured though incidental netting (1.50 ± 0.19) had a higher BCI than those found floating (1.29 ± 0.33), stranded (1.30 ± 0.23) or captured by other methods (1.41 ± 0.26). Among the animals captured through incidental netting, BCI was different depending on the fishery type (F=3.22, P=0.002), with a higher BCI for animals captured by fishing hooks (1.86 ± 0.08; n=2) than in those captured by cast nets (1.42 ± 0.10; n=17). These groups did not differ from others, nor did any other groups differ from one another. Further studies are currently under development to correlate BCI with FP severity and tumor distribution, as well as with levels of persistent organic pollutants such as organochlorine pesticides and polychlorinated biphenyls in tissues samples of *C. mydas* caught along the Brazilian coast to clarify their role in the etiology of fibropapillomatosis. Acknowledgements: Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP): 2011/04565-7 and 2010/01781-8; Projeto TAMAR-ICMBio and the International Sea Turtle Symposium and sponsors.

PROLAPSE AND EXPULSION OF OVIDUCT IN OLIVE RIDLEY *LEPIDOCHELYS OLIVACEA*, DIFFERENT BEACH IN SINALOA, MEXICO.

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Four cases are reported and documented on prolapse and expulsion of oviduct in olive ridley (*Lepidochelys olivacea*) during nesting on beaches as Caimanero, Rosario, Sinaloa (1989), Stone Island, Mazatlan, Sinaloa (1997); Playa Brujas, Mazatlan, Sinaloa (2003) and Playa Ceuta, Elota, Sinaloa (2011), which according veterinarians consulted due to deficiencies in calcium, they also lay eggs before prolapsing shelled or shell very weak.

EVIDENCE FOR NUTRITIONAL PROMOTION OF SEA TURTLE TUMORS

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Around the Hawaiian Islands, green sea turtles are often afflicted with fibropapilloma, a potentially debilitating, tumor-forming disease associated with herpes virus. While the disease itself is not uncommon, the continuous expression of large tumors leading to animal mortality is cause for concern. Recent spatial analysis work has shown that disease rates are highest in watersheds where human land use impacts are greatest. The proposed mechanism for this correlation posits that nitrogen-rich runoff enters the neritic environment and is taken up by invasive algae, which are then eaten by foraging turtles. The algae store the excess nitrogen as arginine, which is an amino acid essential to herpes growth. Using stable isotope analysis, we are comparing the dietary composition of tumored and tumor-free turtles during their pre-recruitment and post-recruitment life stages. In tumored turtles, we expect to see evidence that they are eating algae that have been enriched with N15 post-recruitment. This would provide additional evidence for the mechanistic role of diet in promoting this disease.

PLASMA CONCENTRATION OF VITELLOGENIN IN THE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*): FROM THE NESTING BEACH TO IN WATER STUDIES

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The loggerhead sea turtle (*Caretta caretta*) is a keystone species found throughout the temperate waters of the world's oceans. Four of the 9 distinct population segments (DPS) are listed by the IUCN as endangered,

including the Northwest Atlantic Ocean DPS. This population is made up of mostly juveniles and immature adults but also includes many females that nest along the U.S. east coast. Research on the reproductive physiology of sea turtles has clarified the distinct seasonal cycles in hormone production during reproduction. Several physiological processes, such as vitellogenesis, are under hormonal control during the reproductive cycle in females. As a precursor protein for yolk production in oviparous vertebrates, liver production of vitellogenin (vtg) is induced by estrogen typically only in reproductively active females; however, both males and females carry the vtg gene. Both progesterone (P4) and testosterone (T) are inhibitors of vitellogenin production; therefore rising concentration of these hormones is thought to cease vitellogenesis at the end of the ovulatory phase. The multi-hormonal control of vitellogenesis and the biologically healthy concentration of vtg in sea turtles are not fully understood. To date, concentrations of vtg in wild populations of loggerhead sea turtles during reproductive and non-reproductive periods has not been described. This study describes the circulating concentration of vtg in nesting (n = 193) and non-nesting loggerhead females (n = 44) from the Northwest Atlantic Ocean DPS, and also reports concentrations of vtg in males (n = 111), juveniles and non reproductive females (n = 250) of the same DPS. Blood samples were collected from turtles caught off the coast of South Carolina in 2008 and 2009, and from nesting females in 2008 at Hutchinson Island, Florida. All samples were analyzed using Enzyme-linked Immunosorbent Assays specific for *Caretta caretta* vtg. The detection limit of the assay used to analyze the South Carolina samples was estimated at 3.5 µg/ml, and the detection limit of the assay used to analyze the Florida samples was estimated at 0.5 µg/ml. Vitellogenin concentration in turtles captured at South Carolina ranged from undetectable to 16 µg/ml, with a mean detection of 6.0 µg/ml ± 1.3 µg/ml. A single female yielded a vtg concentration of 146 µg/ml, and was not included in the mean. In nesting Florida turtles, vtg concentration fluctuated between 1.3 mg/ml and 96 mg/ml, with a mean of 18 mg/ml ± 1.6 mg/ml. There was a significant difference between vtg concentration in reproductive females versus males and non-reproductive females. Vtg concentration was correlated with month in both nesting turtles and turtles captured off shore. Vtg concentration was not correlated with size, or whether or not an emerged female oviposited. These results indicate that low concentrations of vtg can be detected in males and non-reproductive females, and that vitellogenesis is complete before the end of the nesting season in reproductive females. This assay is useful in determining variations in vitellogenin concentration during the reproductive cycle and can also be used to identify exposure to xenoestrogens at ecologically meaningful concentrations in juveniles, males, and non-reproductive females.

DETERMINATION OF HEMATOLOGICAL AND BIOCHEMICAL VALUES IN A WILD POPULATION OF GREEN TURTLE (*CHELONIA MYDAS*) IN NORTHERN PERU

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The green sea turtle (*Chelonia mydas*) is the most common sea turtle in Peru. The species is considered endangered by the IUCN as a result of anthropogenic threats including fisheries bycatch and threats at nesting beaches. Due to their migratory behavior, green turtles are an important bioindicator of the coastal marine environment, both locally and globally. In addition, variability in hematological and biochemical values may occur because of geographic area, diet, season, age, etc., which help define the variance in each population. In this study, we analyzed 32 clinically healthy individuals that were incidentally captured in artisanal fisheries from Sechura Bay, Peru. The average hematological and biochemical values found were: erythrocytes 0.52 ± 0.18 x 106/µL, hematocrit 33 ± 5 %, mean corpuscular volume 720.62 ± 288.76 fL, leukocytes 15.25 ± 5.73 x 10^3/µL, heterophils 9.66 ± 4.43 x 10^3/µL, lymphocytes 3.58 ± 1.61 x 10^3/µL, eosinophils 0.55 ± 1.41 x 10^3/µL, monocytes 1.47 ± 0.91 x 10^3/µL, normal thrombocytes, alkaline phosphatase 38.04 ± 14.85 UI/L, alanine aminotransferase 32.38 ± 42.89 UI/L, aspartate aminotransferase

191.17 ± 64.63 UI/L, urea 64.31 ± 37.84 mg/dL, creatinine 0.25 ± 0.28 mg/dL, glucose 148 ± 52 md/dL, total protein 4.2 ± 0.7 g/dL, albumin 2.2 ± 0.6 g/dL, globulin 2.1 ± 0.4 g/dL and A/G ratio 1.1 ± 0.6 g/dL. There was no correlation of body size with any of the blood parameters measured. The values of erythrocytes, hematocrit and mean corpuscular volume are within the reference values from other Pacific Ocean regions. While there are similarities with blood chemistry values reported here with those from other healthy green sea turtle populations, urea, total protein, albumin and globulin values are higher probably due to an omnivorous diet rich in proteins and carbohydrates. Post-capture stress may have affected glucose and heterophils values.

COMPARISON OF BEHAVIORAL RESPONSE TO COLD WATER BETWEEN GREEN AND LOGGERHEAD TURTLE JUVENILES

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Generally, loggerhead turtles nest at the temperate zones, but green turtles nest at the subtropical and tropical zones. Thus loggerhead turtle juveniles are assumed to have a tolerance for colder water, and they are triggered escape reaction at lower temperature than green turtle juveniles. Comparing the behavioral response to cold water between loggerhead and green turtle juveniles, may enable us to get a key of the difference in distribution among two species. We conducted a tank experiment to reveal the behavioral response of green and loggerhead turtle juveniles to water temperature. In this study, we used 8 green and 8 loggerhead turtle juveniles captured at Ishigaki island, Japan (24^{o}N, 124^{o}E) and then bred for about 1 month at Yaeyama station, Research Center for Subtropical Fisheries Seikai National Fisheries Research Institute, Fisheries Research Agency, Japan. In the first experiment, to compare the activity level in the different water temperature of loggerhead and green turtle juveniles, the juveniles were settled in the experimental tank which could change the water temperature voluntarily by a thermo-regulator. Then, we monitored the number of their stroking and their swimming performance for 30 minutes at different temperatures (15, 20, 25 and 28 ^{o}C). In the second experiment, to reveal their behavioral response to the water at different temperature, we flowed different waters in temperature from one side and another of the tank, then monitored which temperature they preferred. As a result of this study, both green and loggerhead turtle juveniles escaped from the waters at low temperature, but loggerhead turtle juveniles demonstrated a greater tolerance for lower temperature than green turtles. Our results indicate that loggerhead juveniles are able to disperse in wider range than green turtle juveniles.

ESTABLISHING A GLOBAL DNA BARCODE AND MOLECULAR PHYLOGENY FOR MARINE LEECHES (OZOBRANCHUS SPP.) FROM SEA TURTLES IN THE ATLANTIC AND PACIFIC OCEAN BASINS*

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The possible role of *Ozobranchus* spp. in sea turtle fibropapillomatosis (FP) disease etiology has not been fully explored, yet these ectoparasites have been shown to contain high concentrations of the fibropapilloma-associated turtle herpesvirus virus thought to cause FP. Only two *O.* spp. (*Ozobranchus branchiatus* and *Ozobranchus margoi*) are known to be associated with sea turtles. *O. branchiatus* has historically had a species-specific relationship with host *Chelonia mydas* yet host divergence has recently been recorded. Likewise, FP was first reported in *C. mydas* but has since been documented to a lesser degree on all other species of sea turtles. Assessment of their potential role in FP etiology requires accurate species identification. Morphological identification of *O.* spp. can be difficult or impossible due to their small size and various life stages including larval and cocoon. DNA barcoding using mitochondrial cytochrome c oxidase I (COI) gene was employed to identify both *O. branchiatus* and *O. margoi* at all stages of development that were collected from turtles in the Pacific and Atlantic ocean basins. Collection sites included Barbados (five O. spp. samples from *Eretmochelys imbricata*), Florida (43 from *Chelonia mydas* and 13 from *Caretta caretta*), Hawaii (34 from *C. mydas*), Hong Kong (two from *C. mydas*), Brazil (ten from *C. mydas*), and Mexico (two from *Lepidochelys olivacea*). *O. branchiatus* was found in both ocean basins, while *O. margoi* was only found in the Atlantic Ocean. All Pacific turtle hosts were green turtles (*C. mydas*) with the exception of olive ridley turtles (*L. olivacea*) from Western Mexico. The COI marker has proven successful at meeting all the requirements for a DNA barcode. Diagnostic sites at COI successfully identify not only the species of marine turtle leech but also determine from which ocean basin the specimen originated. Furthermore, pooled samples yielded identical genetic information as unpooled samples from the same locations. Although COI is conserved for *O. margoi* in the Atlantic, at least four COI haplotypes for *O. branchiatus* exist in each ocean basin. Phylogenetic analysis of *O.* spp. at other genes (18S rDNA, 28S rDNA, and histone H3) may establish whether Atlantic and Pacific Ocean turtles are infested with cryptic species of *O. branchiatus*. Preliminary data indicates 28S rDNA to be uninformative because it was conserved in all *O. branchiatus* samples from Florida and Hawaii. On the other hand, *O. branchiatus* specimens from Hawaii and Florida revealed two fixed sites for 18S rDNA. New primers were developed to sequence histone H3, revealing gene duplication for *O. branchiatus* and possibly three for *O. margoi*. Acknowledgments: Special thanks to the WSU WISGC for funding much of the research and to the International Sea Turtle Symposium for providing a travel award to attend the 33rd Annual Symposium on Sea Turtle Biology and Conservation. Support for the grant has been made available through generous donations by the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, and CLS America.

TWO NEW RECORDS OF MARINE LEECHES（HIRUDINIDA：OZOBRANCHIDAE）OF SEA TURTLES IN TAIWAN*

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Marine turtle leeches (*Ozobranchus* spp.) are ectoparasites of sea turtles. They can cause such symptoms as anemia, large-scale thinning of the dermal layer and general deterioration in the health of sea turtles. Only two species were identified on turtles examined from Taiwan: *Ozobranchus branchiatus*, only found on the green turtle (*Chelonia mydas*), with 7 external gills on each side of its abdomen and *Ozobranchus margoi*, found on the loggerhead turtle (*Caretta caretta*), with 5 external gills on each side of its abdomen. From July 2009 until July 2011 in eastern Taiwan's Don-Ou village, the infection rate of *O. branchiatus* and *O. margoi* were 8.5% (2/23) and 37.5% (3/8), respectively. We report the first records of both leech species in Taiwan. We observed an extreme case of infection, with approximately 400 *O. margoi* on a single loggerhead turtle taken as by-catch in the local pound net fishery on December 14, 2009. The infection caused cloacal swelling and localized carapace depression.

TAIL GROWTH IN HAWKSBILL TURTLES MATURING AT MONA AND MONITO ISLANDS, PUERTO RICO

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Mona and Monito Islands harbor a large aggregation of immature and adult hawksbill turtles that use a variety of habitats for foraging and breeding. Since 1992 we have performed annual in-water surveys of hawksbills along the nearshore waters of both islands, an effort that includes turtle capture for tagging, measurement and sampling. Here we report on 1,177 plastron to tail-tip measurements taken over a 21 yr period for 665 individual hawksbill turtles. Measured turtles ranged in size from 20.00 to 91.80 cm straight carapace length (SCL). Hawksbill tail lengths scale linearly with SCL for both sexes from 20.00 cm until a median 64.00 cm SCL, beyond which tail lengths bifurcate by gender and indicating the onset of maturity. Hawksbills can exhibit long tails (extending well beyond the carapace) and other secondary male characteristic from 50.10 cm SCL. Tail growth trajectories for nine maturing male turtles yielded mean peak tail growth rates of 3.50 cm/yr (range 1.60-4.80 cm/yr). Based on these tail growth rates, males can be expected to take on average 6.90 yr after reaching 64.00 cm SCL to become fully mature.

THE EVOLUTION OF LEATHERBACK (DERMOCHELYID) TURTLES

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Recent discoveries of relatively well-preserved fossil shells (in Egypt, Peru, California, Maryland, and especially South Carolina) have permitted reassessment of the evolutionary history of leatherback (Dermochelyid) turtles. A review of the entire fossil record of Dermochelyids allows the formulation of a phylogenetic hypothesis for this extremely divergent family of turtles. In the past, there has been a tendency to refer most Dermochelid fossils to one extinct genus, *Psephophorus*, the implication being that some form of *Psephophorus* eventually evolved during the Teriary into the living genus *Dermochelys*. However, cladistic analysis clearly indicates that Dermochelyid evolution has been considerably more complex. The earliest known fossil leatherbacks in the Cretaceous had a shell morphology rather similar to other types of contemporaneous marine turtles. Over time several distinct leatherback lineages evolved, all but one of which became extinct. As many as three different types of Dermochelyids coexisted at various times during the Tertiary. One of these is represented by forms having a smooth, unridged carapace, as well as, apparently, a fully ossified plastron. There are other leatherback lineages typified by varying numbers of anteroposterior carapacial ridges and distinctive ridge morphologies. It is now clear that most taxa previously referred to *Psephophorus* are not assignable to that genus, and *Psephophorus* is definitely not ancestral to *Dermochelys*. Features of Dermochelyid shell evolution include: 1) a progressive decrease in shell thickness; 2) a concomitant decrease in the size of individual ossicles (and therefore an overall increase in the number of ossicles forming the carapace); 3) wide variation in the number of anteroposterior ridges on the carapaces of different taxa (from zero to seven or more); 4) variation in the cross-sectional structure of the anteroposterior ridges; 5) the development of undulting crests along the length of the ridges; and 5) an increase in the number of ossicles between adjacent ridges.

Conservation, Management and Policy

QARAPARA - SEA TURTLE CONSERVATION IN CHILE

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Qarapara Sea Turtles Chile, Chile

The migration routes and foraging habitats of four of the five species of sea turtles that inhabit the Eastern South Pacific are found along the coast of Chile. These four species include *Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea* and *Lepidochelys olivacea*. Important research studies and conservation efforts in different parts of the country are conducted by universities and government institutions. However, even though some foraging sites have been identified and are monitored systematically, there is a gap in the integration of the information collected throughout the country. Qarapara Tortugas Marinas Chile was formed in 2012 by young professionals from different disciplines (veterinary medicine, marine biology, ecotourism, agriculture, etc.) with knowledge in various areas related to these species and the support of experts in the field of sea turtles. It's mission is to promote, coordinate and develop research that contributes to the knowledge and conservation of sea turtle populations and their habitats in Chile, and integrate the development of associated human communities and form networks throughout the country. The scope of the work incorporates advice on rescue and rehabilitation activities, environmental education and research. The first studies in Bahía Salado, a foraging site for the black turtle (*C. mydas agassizii*) located in the north of the country which is the southernmost congregation site of this species in the Eastern South Pacific, have just begun. Furthermore, in order to gain experience and build a cooperating network, we have conducted a series of outreach activities and participated in scientific workshops in Chile and abroad. Likewise, our NGO has the support of private organizations and experts in various fields concerned with the protection of marine ecosystems and their biodiversity.

NESTING BEACH AND BYCATCH MONITORING EFFORT IN SIERRA LEONE

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The Marine Turtle Program - Sierra Leone (MTCP-SL) began as a student research project in the late 1990s and has turned into a full sea turtle conservation program in Sierra Leone. The project actually started in 2001 after five of the world's seven species of sea turtles were identified in Sierra Leone. Threats imposed on the five marine turtle species and their nesting beaches were documented during a national survey that was funded by the USFWS in 2006. However, the species of sea turtles that nested in Sierra Leone still needed to be identified. In order to identify and protect the nesting sea turtles, MTCP-SL, with support from USFWS and in collaboration with the Conservation Society of Sierra Leone, the Wildlife Conservation Branch (WCB) of the Ministry of Agriculture, Forestry and Food Security (MAFFS) and the Ministry of Fisheries and Marine Resources (MFMR), set up taskforce groups along selected coastal communities based upon the result of the national survey. Responsibilities of the taskforce group included bycatch and beach monitoring, while MTCP and the collaborating organizations listed above embarked on education and sensitization campaigns. Results of these efforts include the release of captured turtles, burying of dead turtles and identification of marine turtle species that nest on beaches in most communities. So far, MTCP-SL has documented all five species nesting on beaches in Sierra Leone, and in over three years, has identified over 600 turtles and released over 15,000 hatchlings. With the presence of MTCP, the government has now afforded much protection for sea turtles in Sierra Leone. This is demonstrated by the inclusion of marine turtles into both wildlife and fisheries acts as protected species.

HALTING INDONESIAN SEA TURTLE DECLINES: EXPANDING AND IMPROVING EFFECTIVENESS OF PROTECTED AREAS FOR TURTLE NESTING SITES

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Sea turtle species in Indonesia are experiencing declining population trends. Direct catches for personal consumption or for sale at national and global markets, uncontrolled coastal development, pollution, disease and climate change are all contributing to turtle declines. A gap analysis, which is a method to identify important ecosystems and habitats while investigating the representation of ecosystems that have not been included in the system of conservation area networks, was conducted in order to analyze the status of sea turtle conservation. There have been at least 95 major nesting beaches documented in Indonesia, many of which are regionally significant. Of these, 95 nesting areas 53 (56%) lack protection status. Halting turtle declines will require two key actions: 1) establishing conservation areas that protect currently unprotected turtle nesting beaches, and 2) increasing the effectiveness of management efforts at existing protected beaches. To accomplish this requires investment in programs focusing on community empowerment, public awareness, enforcement, inter-governmental collaboration and scientific studies; these will all be important factors in ensuring the long-term survival of these species.

THE XUNLIAO GUANGDONG PROVINCE EXPERIENCE: RELEASING SEA TURTLES FOR RESTOCKING AND CONSERVATION AWARENESS IN CHINA

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There is widespread global and historic multi-cultural interest in releasing or returning sea turtles to the sea for restocking efforts, conservation awareness, government-sponsored activities, and even for religious purposes. Sources of these turtles have included hatchlings from artificial hatcheries, captive rearing projects, captive breeding, fishery by-catch, and turtle rehabilitation facilities. Often the turtles are released in considerable numbers with advance publicity attracting many adult and child spectators filled with excitement and interest. The mass release of sea turtles for restocking and conservation awareness in

Mainland China occurs periodically but not predictably as to date and location. Very little information in English has been reported outside of China about internal turtle release events. These activities usually include the release of other marine life such as fish, shrimp, and crabs obtained from aquaculture facilities. On June 6, 2012 the authors were honored to participate in the release of 134 turtles and an array of other marine life at Xunliao, Oceania Point Resort, in Guangdong Province, People's Republic of China. The event marked the government's seasonal closure prohibiting the use of certain fishing gear in the South China Sea, including Guangdong Province. Thirty-four of the turtles released were from fishery by-catch turned in to the authorities by fishermen. These turtles ranged up to 99 cm carapace length and included 33 green turtles and one loggerhead all obtained from the coastal waters of Guangdong Province, such as Daya Bay. In addition, 100 others were captive-reared green turtles estimated to be 45cm carapace length. All turtles appeared to be healthy, active, and in excellent body condition. This presentation explores and photographically illustrates some of the unique aspects of China's spectacular sea turtle release phenomenon, as witnessed at Xunliao. Ideas are set forth for the possibility of enhanced conservation study involving both cultural and biological science perspectives. The People's Republic of China has vigorous and growing sea turtle conservation and research programs that deserve praise and partnership to improve the status of regional stocks.

AN UPDATE ON THE STATUS OF SEA TURTLE CONSERVATION IN VIEQUES AND AN EXAMPLE IN CO-MANAGEMENT OF THE SPECIES BETWEEN GOVERNMENT AGENCIES AND COMMUNITY BASED ORGANIZATIONS

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There is an informational void on the status of sea turtles in Vieques and the role that this island plays in the overall conservation of these endangered species in Puerto Rico, to this date. Therefore we will be presenting information on the sea turtle monitoring program that has been taking place in Vieques (both on and off the Vieques National Wildlife Refuge) since the U.S. Navy left the island and transferred the property to the Municipality of Vieques, the Puerto Rico Conservation Trust and the Department of the Interior. This data and work will be contrasted with the previous sea turtle management work done by the U.S. Navy. The presentation will highlight the cooperation and co-management of sea turtle conservation between Government Agencies (the PR-DNER and the USFWS) and local community groups in Vieques (TICATOVE, Sea Grant at UPR in Humacao, the Vieques Historical and Conservation Trust). The programs continues to go through growing pains and improvements; yet we believe that it is proving itself to be successful and may be useful to other municipalities in Puerto Rico or even other regions that could benefit from this type of cooperative sea turtle conservation efforts between well trained community based conservation organizations and Government agencies.

COMMUNITY-BASED CONSERVATION OF MARINE TURTLES ON TETEPARE ISLAND, SOLOMON ISLANDS

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Tetepare Island, the largest uninhabited island in the South Pacific, is an icon of Solomon Islands biodiversity and conservation management. In response to destructive logging threats, displaced landowners formed the Tetepare Descendants' Association (TDA) with the core objective of conserving natural resources for the use of future generations. TDA's flagship conservation program is focused on monitoring and conserving marine turtles, particularly greens (*Chelonia mydas*), hawksbills (*Eretmochelys imbricata*), and leatherbacks (*Dermochelys coriacea*), in both their foraging and nesting environments. Through this monitoring, TDA seeks to gain a better understanding of the demographic characteristics, distribution, and population status of globally endangered sea turtles around Tetepare. By strengthening and expanding existing community-based monitoring programs, this project also seeks to empower local communities to manage their resources, laying the foundation for long-term marine turtle conservation. In addition, by linking this community-based effort to nearby islands, this project is able to catalyze partnerships that can cope with local economic and social challenges to sea turtle conservation. Results from this study will improve our overall understanding of sea turtles in the greater Pacific region, and contribute to the development of an effective management plan to protect sea turtles and their ecosystems around the island.

U.S. NAVY ENVIRONMENTAL COMPLIANCE AND CONSERVATION EFFORTS FOR SEA TURTLES IN THE ATLANTIC AND GULF OF MEXICO

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Environmental stewardship is an integral part of the Navy's mission. It protects and preserves the capabilities of training areas, ensures operational flexibility, and sustains the resources and public support needed to carry out the Navy's mission. The Navy is responsible for compliance with a suite of environmental and natural resources laws and regulations that apply to the marine environment, and in particular, to sea turtles. To comply with these mandates, the Navy works closely with regulatory agencies and must be able to properly evaluate the impacts of at-sea training activities on protected species. In order to institute efforts to minimize these impacts there must be: 1) the best available data on the density and distribution of the species in question; 2) the criteria necessary to assess impacts; and 3) the creation of the practical mitigation measures. To meet these objectives, the Navy developed the Navy Marine Species Density Database (NMSDD) which documents density estimates for all sea turtle populations where the Navy primarily trains in the Atlantic Ocean and Gulf of Mexico. The Navy also established an initial set of quantitative criteria for assessing acoustic impact to sea turtles from sonar and explosives. These data are utilized in regulatory compliance documents to support quantitative modeling and qualitative assessments of the potential impacts of a variety of Navy stressors on sea turtles and their habitats, including but not limited to the use of sonar, explosives, and military expended materials. Additionally, the Navy employs mitigation measures both at-sea and on Navy installations to minimize the impacts of Navy activities on sea turtles and to promote conservation of their populations. Some of these measures include monitoring sea turtle nests on Navy beaches during the nesting season, having trained lookouts to observe mitigation zones during at-sea training activities to minimize potential effects to sea turtles, and conducting or funding sea turtle research to reduce knowledge gaps. The Navy continues to be a leader in environmental stewardship and utilize the best technology and techniques to improve our compliance and conservation efforts with respect to sea turtle populations. However, deficiencies in the amount or quality of data available, as well as access to research, can significantly limit the Navy's ability to assess and mitigate impacts. As a result, the Navy plans to improve partnerships with international, federal, state, and local agencies; public and private organizations; and academic institutions by engaging stakeholders to maximize our effectiveness in addressing environmental issues.

NESTING OF LEATHERBACKS AT COSTA RICA NORTH CARIBBEAN COAST

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The project was developed in the north Caribbean coast of Costa Rica, particularly on Pacuare and Moín Beaches. The objective was the protection and monitoring of sea turtle nesting on these locations. These places have very strong and particular threats over the nests, nesting females and habitat. The poaching of eggs, the hunting specifically over green and hawksbill and the impact of ocean erosion, expressed as loss of sand, excess of organic matter deposited on beach and coastal floods were the most important impacts over the nesting critical habitats. Both places show a nesting over 2000 nests of leatherback, green and hawksbill turtles. Monitoring and conservation patrols, hatcheries, alternative livelihoods and environmental education were some of the activities developed to reduce the impacts and increase the number of hatchlings getting the water.

COMMUNITY BASED SEA TURTLE CONSERVANCY IN SOUTHEASTERN PUERTO RICO: PROYECTO ATMAR A STORY OF SUCCESS.

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Since 2001 and through the ATMAR Project, community volunteers in the coastal town of Maunabo southeast of the island of Puerto Rico have worked to assist in the conservation of sea turtles. This project is a story of success in community-based turtle conservation. Organized and run by community volunteers who are committed to stop the poaching of nests and turtles, ATMAR Project is the oldest of its kind in Puerto Rico and has become a model for other coastal communities on the island. It has worked continuously for 12 years and has helped other communities to get organized and to work for the same purpose. More than 65 volunteers have been involved with the project, and several thousand people have

been impacted. Volunteer work includes conducting nests surveys, night patrols, tagging turtles and hatchling work. All field data obtained through their work is part of the National Sea Turtle Project of Puerto Rico. Volunteers also serve as guides to those who are interested in learning about sea turtles. A very important part of their work is educational - visiting schools, churches, communities and universities to inform others about the project and its work. Volunteers also utilize newspaper, television, radio, and internet outlets (www.tortugasmaunabo.com) to publish information about the project and the importance of conservation. As a result of the project, nest poaching decreased significantly (6% in the early years). During the past three years the poaching of nests and turtles has been 0 %. In addition, leatherback nests have increased from 53 to 199 per season and hawksbill nests increased from 15 to 129 per season. Proyecto ATMAR thanks our sponsors: Puerto Rico Department of Natural and Environmental Resources, Regional Newspaper LA ESQUINA, Cooperativa Mauna-Coop and Sea Grant-University of Puerto Rico at Humacao Campus.

THE PROTECTION OF SEA TURTLE IN NEW CALEDONIA

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Here we present the history of sea turtle occurrence and protection in New Caledonia. The “Bwara Tortues Marines” association was created by Emmanuel Hernu and Dominique Lafage in July 2006 to protect "La Roche Percee" Beach, which is the first nesting beach for *Caretta caretta* in New Caledonia. There are numerous threats to nesting sea turtles, including stray dogs, fires and lights of the campers and residents, cars on the beach and egg poachers. Cages were constructed to protect the nests from dogs. Four-hour patrols were conducted every evening (8:30 pm) and morning (5:00 am) on the beaches of “ La Roche Percee” (1.8 kilometers) and “Baie des Tortues” (.3 km). We have education programs to raise awareness of the locals but behavior modification is difficult and we do not hesitate to lodge complaints to the authorities against the offenders. We also have a school program to educate young people about sea turtle conservation. We work with two South Pacific scientists, George Balasz of Hawaii and Colin Limpus of Australia, to create a database for turtles and their nests. We created a nursery for trees resistant to sea spray to reforest the coast. We also worked with the authorities to create current fisheries legislation. Harvesting and/or selling sea turtles and their eggs is now forbidden, as well as the disturbance of nesting sea turtles by humans or dogs. Melanesians have the right to harvest turtles for food only for important ceremonies and have to request permission from the authorities.

SEA TURTLE CONSERVATION IN UNITED ARAB EMIRATES: STATUS OF IMPLEMENTATION OF IOSEA MEMORANDUM OF UNDERSTANDING

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Two species of sea turtles, the hawksbill (*Eretmochelys imbricata*) and green (*Chelonia mydas*), predominantly occur in the waters of the Emirate of Abu Dhabi, United Arab Emirates (UAE). Both species extensively use UAE waters for foraging and one species, the hawksbill, nests on the sandy beaches of at least 18 offshore islands. UAE is a signatory to the UNEP-CMS Memorandum of Understanding (MoU) on the conservation and management of marine turtles and their habitats of the Indian Ocean and South-East Asia (IOSEA) since 2007. The “Conservation and Management Plan” (CMP) appended to the MoU lists 6 objectives and 24 programmes (actions) to be considered by signatory states for implementation. UAE has been undertaking at least 60% of the actions listed in the CMP. Investigation of causes of sea turtle mortality reveals that 46% of sea turtles die from drowning in illegal or abandoned fishing nets followed by 25% from vessel strike. Seasonal aerial surveys indicate that at least 67.4% of sea turtles (both green and hawksbill) occur within the MPAs during 2011compared to 62% in winter 2004 and 64.8% in winter 2009. This trend of gradual increase of foraging turtles within the protected areas may be the result of protection of foraging areas of green as well as hawksbill sea turtles within the MPAs. All nesting beaches in the UAE are protected by Federal Law no 23 (1999) and are being monitored continuously since 2000. Inter-annual nesting variability ranges from 155 to 242 nests in the emirate of Abu Dhabi and 142 to 261 nests in the emirate of Sharjah. Data on nesting processes and patterns are being collected and analysed. As part of the objective under rehabilitation of sea turtle habitats, UAE has regulations in place to rehabilitate sea turtle habitats impacted by human activities by implementing appropriate mitigation measures. As part of the study to understand sea turtle ecology of the region, UAE has been involved in a regional program of satellite tagging to study post nesting migration of the nesting species in order to review and revise conservation initiatives taken up by the Range States within the Gulf. Meetings with stakeholders, training to teachers, field tours for students, beach cleaning involving general public are part of the public awareness program that has yielded significant results as evidenced by reports of dead and stranded turtles by various stakeholders and increased number of requests by schools for teachers training and field trips for students. The paper presents the status of implementation of IOSEA MoU in the UAE and analyses the methods followed and results achieved.

MAKING CONNECTIONS: THE INTER-AMERICAN CONVENTION FOR THE PROTECTION AND CONSERVATION OF SEA TURTLES (IAC)

Belinda M. Dick and Veronica C. Chamorro

Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), Washington D.C., USA

Without a doubt, sea turtles connect us. As ambassadors of the oceans they bring people and countries together. The Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) is becoming a leader in this initiative by connecting decision makers, scientists and NGOs in order to make the best possible management decisions for the future of this species. In 2001, the IAC was established to encourage international cooperation to protect and conserve sea turtles in the Americas. The IAC is quite unique in being the only legally binding treaty for sea turtle conservation and protection in the Western Hemisphere. Its objective is to promote the protection, conservation and recovery of the populations of sea turtles and those habitats on which they depend by using the best available scientific information and taking into consideration the environmental, socioeconomic and cultural characteristics of the parties. Although the Conference of the Parties is the highest entity of the Convention, it has two subsidiary bodies, the Consultative Committee of Experts (CCE) and the Scientific Committee (SC), to which each country nominates a specialist in diverse topics relating to sea turtles. The CCE has an additional nine members, three from each of the following sectors: non-governmental organizations, private sector and scientific community. These committees, as well as the participation of official IAC observers, provide the IAC with a balanced, transparent approach to address current challenges facing sea turtles. In order to strengthen its ability to effect change, the IAC supports efforts to harmonize national legislation throughout the region by providing countries with guidelines to prepare national sea turtle action plans and thus provide a more effective management. The IAC promotes cooperation among its party countries and non-party countries through a series of agreements, resolutions and memorandums of understanding to help create policies and programs that safeguard sea turtles and their habitats. For example, under these agreements and resolutions, IAC Parties have taken actions such as the creation of protected areas specifically for sea turtles and prohibiting certain types of fisheries. In order for the IAC to follow-up on compliance with the mandates of the Convention, IAC Parties submit annual reports highlighting their activities in favor of sea turtle protection and conservation, especially regarding the leatherback and hawksbill turtles, their efforts to mitigate fisheries interactions with sea turtles and adaptation to climate change. Just a decade after its existence, it is important to recognize and applaud the efforts and achievements carried out by its current 15 member countries in implementing the objectives of the Convention. The IAC is a testament to the extraordinary regional efforts taken to preserve these ancient animals, and inspires all of us to continue this good work by addressing the many challenges that sea turtles still face.

CONSERVATION OF SEA TURTLES IN PUERTO RICO: FROM SCIENTIFIC RESEARCH TO COMMUNITY-BASED MANAGEMENT.

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During the early 1990s until the 2010s, sea turtle projects in Puerto Rico focused on basic research conducted by university and government agencies. These studies were related to status surveys, genetics, fibropapillomatosis assessments, migration patterns, sex ratios, population trends and dynamics, amongst other specialized studies such as diving behavior and diet selection. These studies contributed greatly in the elaboration of management and recovery plans for sea turtle species that occur in Puerto Rico (hawksbill turtles, green turtles and leatherbacks). However, many of the recommendations that these studies yielded were not implemented. During 2010, the Department of Natural and Environmental Resources of Puerto Rico (DNER) started to deputize management and conservation strategies through local community-based groups (most of them incorporated as “non-profit” organizations). A total of eight groups are authorized to conduct such tasks. These groups are: ATMAR (Maunabo-Yabucoa), Vida Marina (Isabela), Yo Amo El Tinglar (Hatillo, Arecibo, Barceloneta), ATIPUR (San Juan), *Chelonia* (Dorado and Culebra), TICATOVE (Vieques), Coalición del Corredor Ecológico del Noreste (Luquillo-Fajardo) and Playas pal Pueblo (Isla Verde). The groups are responsible for collecting statistical data (nests counts and hatchling production). Also, they are authorized to conduct management actions such as beach clean-ups, habitat restoration, stranding/rehabilitation of injured animals, assist hatchlings and adult females during disorientation events, preventive vigilance against poachers, control of exotic predators, outreach and proposed designations for protected areas. All these activities are in close coordination and collaboration with the DNER. The following presentation illustrates the significant contributions of combining both strategies (scientific research and community-based management).

INTERAGENCY COLLABORATIONS IN MARYLAND 1990-2012: NATIONAL PARK SERVICE AND MARYLAND DEPARTMENT OF NATURAL RESOURCES

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The Maryland Department of Natural Resources (MD DNR) formed the Sea Turtle Stranding Program in the Fall of 1990. MD DNR is responsible for all dead-stranded sea turtles in Maryland waters as well as nesting sea turtles. Our geographic response area includes 3,800 miles of Maryland coastline in the Chesapeake Bay and on the Atlantic Ocean. Assateague Island is a 37-mile (60 km) long barrier island located off the eastern coast of the Delmarva Peninsula. The northern two-thirds of the island is in Maryland while the southern third is in Virginia. The MD DNR has partnered with the National Park Service at Assateague Island National Seashore in an effort to document species occurrence, causes of strandings and nesting activities, as well as to promote sea turtle conservation. This presentation summarizes 22 years of collaborative conservation in Maryland. The majority of stranded sea turtles are found along the coast of the Atlantic Ocean and this presentation will focus on the species found along AINS shores. Four species of sea turtles have been found in Maryland: loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and Kemp's ridley (*Lepidochelys kempii*). The loggerhead is the most commonly stranded sea turtle. Loggerhead strandings increased in 1998, 2001 and 2002, and leatherbacks stranded in large numbers along the mid-Atlantic coast in 2004. Data collection parameters include date, species, location, carcass size, body decomposition index, evidence of human interaction, and gross necropsy findings. Little is published about sea turtles in Maryland, yet there is a need to provide this information when conservation measures are proposed. Two loggerhead nesting events have been fully documented in the 22 years of our partnership: one in 1999 and one in 2012. False crawls are rarely reported, but have been noted. A nesting protocol is currently being developed with other partners to help protect nesting beaches and document nesting attempts. We hope to gain a better understanding of threats to sea turtles in our state through a thorough examination of nesting in the mid-Atlantic with a comparison to stranding records. Acknowledgements: The authors wish to thank all past and current rangers and natural resource biologists in sea turtle conservation in MD, including federal and state staff the Assateague Island National Seashore.

INFLUENCE OF TIDAL CURRENTS ON OFFSHORE MIGRATION AND SURVIVAL OF SEA TURTLE HATCHLINGS RELEASED FROM THE GULF OF FONSECA, HONDURAS

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Punta Raton is the main olive ridley nesting beach on the Pacific coast of Honduras. As part of a conservation project established by the Honduran Government, more than 200,000 hatchlings have been released since 1975, yet until 2011, no studies had been performed on their fate, and there were no data available on survival or mortality rates. Because Punta Raton is located in the eastern end of the Gulf of

Fonseca, a shallow inlet of the Pacific Ocean, released hatchlings must swim more than 30 km towards the West before reaching the open sea. In 2011, we carried out a study on aquatic predation during hatchling offshore migration. Although no predation events were observed, we did observe tidal currents strongly affecting hatchling movement. From September to November 2012, we followed 14 hatchlings for up to 12 hours, releasing them at different times respective to high tide and tracking their movements until the next high tide. We released half of the hatchlings from the local hatchery and the other half from the main nesting beach in the area, 2 km South of the hatchery. We plotted our data in a GIS and observed that the hatchlings released from the hatchery moved Southwest during the outgoing tide but were pulled Northeast, in the opposite direction to the mouth of the Gulf, during incoming tidal movements. One hatchling was carried several miles up into one of the local estuaries. Hatchlings released from the nesting beach were also pulled back towards the coast during incoming tides, but their trajectories were more variable. To assess the influence of tidal currents in the absence of hatchling movement, we did two trials (one from each releasing point) with dead hatchlings. Their trajectories followed the same patterns as live hatchlings. These results suggest that hatchlings released from Punta Raton become entrapped in the tidal cycle, delaying their exit from the Gulf and extending their vulnerability to predation, entanglement in nets, and beach strandings. The possibility exists that these hatchlings are staying in the estuaries and using them as early juvenile feeding grounds, although this seems unlikely since there are currently no reports of neonates or juvenile Olive ridleys seen in the area. Further research is needed to assess if hatchlings from Punta Raton are eventually able to leave the Gulf, the temporal scale of this exodus, and what routes they may be utilizing. Conclusions from this and subsequent studies will also have important applications to assessing and enhancing the effectiveness of the sea turtle conservation efforts currently implemented by the Honduran Government. This research has been funded by ProTECTOR, the Boyd Lyon Sea Turtle Fund and a Sigma Xi grant from Loma Linda University. I appreciate the Travel Award granted by the International Sea Turtle Symposium to attend the 2013 meeting, supported by generous donations from the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America.

ON EFFECTIVE PARTNERSHIPS THROUGH SEA TURTLE CONSERVATION

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Across the world's oceans and coastlines, the territories of indigenous peoples often overlap with critical sea turtle habitats. Consequently, the fate of these ancient mariners lies heavily in the hands of indigenous or local communities, placing community-level partnerships at the heart of sea turtle conservation efforts. This idea is not new; conservation organizations have been partnering with communities for decades. However, with a focus on awareness and scientific monitoring activities, many of these partnerships have been unable to link community action to direct conservation efforts and have failed to engender a long-term commitment to sea turtle conservation. In order to be successful, these partnerships can no longer be consultative or passive, but need to accept the diverse perspectives of local communities and focus on enabling community decision-making capacity and fostering opportunities for community-level engagement in sea turtle conservation. Sea turtles represent an excellent opportunity to achieve this type of partnership due to their ability to attract international investment, focus capacity-building objectives, increase community-level engagement, and ultimately provide a platform for indigenous voices. Overall, this type of participatory engagement can improve the long-term conservation of sea turtles in changing social, political, and ecological contexts. To illustrate this point, I provide a case study that identifies the challenges and impacts of a partnership between the Tetepare Descendants' Association (TDA) from the Solomon Islands and the Center for Biodiversity and Conservation at the American Museum of Natural History. With increased investment, we are strengthening TDA's flagship conservation program focused on monitoring sea turtles, which provides us with a clear capacity building agenda and also empowers this communities' agency to steward their customary resources.

A DECISION FRAMEWORK FOR PRIORITIZING MULTIPLE MANAGEMENT ACTIONS

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Conservation funds are grossly inadequate to address the plight of marine turtles. Government and conservation organizations faced with the task of conserving marine turtles desperately need simple strategies for allocating limited resources. The whole array of management actions necessary to stop decline and support recovery of marine turtles is usually described in their recovery plans, which aim to maximize the long term survival. Although recovery plans often provide a planned and logistical framework for policy makers to coordinate their work, the majority do not provide any support to help prioritize resources across identified management actions, and when they do, there is no transparency of how these priorities were determined. However, where conservation targets and management actions are diverse, within a species or population, the frameworks that set these priorities are vital. Here we present a novel framework which explicitly prioritizes actions necessary to minimize the impacts of several threats across the geographic range of the flatback turtle population in the Gulf of Carpentaria and Torres Strait (GOC/TS). This framework includes a budget constraint and maximizes the expected improvement in species persistence, resulting from a set of selected management actions that accounts for the likelihood of the action being successfully applied and accepted by local communities. This structured approach can be applied to guide prioritization of other species in similar contexts.

DEVELOPMENT OF A SUSTAINABLE ECO-TOURISM SYSTEM AT BLUFF BEACH, BOCAS DEL TORO PROVINCE, PANAMA.

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Bluff Beach, located on Isla Colón, in Bocas del Toro Province, on the Caribbean coast of Panama, supports nesting populations of leatherback (*Dermochelys coriacea*) and hawksbill (*Eretmochelys imbricata*) sea turtles. Unfortunately, various anthropogenic threats have been identified in recent years, including the illegal take of nests and females, and degradation of the nesting habitat through sand extraction and inappropriate use of the beach during the filming of reality television programs. The local indigenous community acknowledged the potential negative impacts of such threats on these critically endangered species, and in 2010 established a grassroots conservation organization; the Bocas Hawksbill Association (Asociación Natural Bocas Carey - ANABOCA). Members of ANABOCA have been working with Sea Turtle Conservancy (STC) staff to conduct a regular monitoring and conservation program along 4.8 km of beach since 2010; results indicate that 250 – 300 leatherback, and 100 – 150 hawksbill nests are laid each season. Due to its proximity to Bocas Town, and relative ease of access, Bluff Beach is subject to considerable tourist activity, especially tours to observe nesting turtles at night. To date, however, such tours have been conducted in an ad hoc and uncontrolled manner, with no formalized training of guides, no regulation of the number of tourists permitted on the beach, and no established regulations or best practices. These problems arise primarily from the fact that while designated as a Municipal Reserve, Bluff Beach is not included in the official list of protected areas of the National Environmental Authority (Autoridad

Nacional del Ambiente – ANAM); thus there is no law enforcement or protection, no restriction of access, and no control on the use of the natural resources in the Reserve. During 2012, under its contract with the USAID Regional Program for the Management of Aquatic Resources and Economic Alternatives, STC has collaborated with ANABOCA and other regional stakeholder groups to form an Advisory Group for Bluff Beach Municipal Reserve, with the goals of: a) establishing a turtle tourism program for the Reserve that ensures economic benefit for the local community while simultaneously minimizing the impacts of tourism on turtles and the nesting habitat; b) working with the municipality to encourage them to establish the Reserve as an ANAM protected area, and thus ensure its adequate protection; and c) establishing a management plan for the Reserve, which will ultimately subsume the turtle tourism administrative program and ensure its long-term viability. The Advisory Group has also assisted ANABOCA in obtaining legal incorporation and developing a business structure, and has provided scientifically-informed training for guides and beach monitors. Results from a series of meetings and workshops conducted throughout 2012 will be presented, to demonstrate the development of the Advisory Group and the steps taken to establish a sustainable turtle tourism program at Bluff Beach. Conclusions and recommendations will be provided, as will an analysis of some problems encountered to date, and the solutions devised to address them. There will also be a summary of the proposed next phase in this ongoing process.

HABITAT-USE OF BREEDING GREEN TURTLES, *CHELONIA MYDAS*, TAGGED IN DRY TORTUGAS NATIONAL PARK, USA: MAKING USE OF LOCAL AND REGIONAL MPAS

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Use of existing marine protected areas (MPAs) by far-ranging marine turtles can be determined using satellite telemetry. Because of a lack of information on MPA use by marine turtles in the Gulf of Mexico, we used satellite transmitters in 2010 and 2011 to track movements of 11 adult female breeding green turtles (*Chelonia mydas*) tagged in Dry Tortugas National Park (DRTO), in the Gulf of Mexico, south Florida, USA. Turtles nested every 9 to 18 days and consistently used a common core-area within the DRTO boundary, determined using individual 50% kernel-density estimates (KDEs). We mapped the area in DRTO where individual turtle 50% KDEs overlapped using the USGS Along-Track Reef-Imaging System, and determined the diversity and distribution of various benthic-cover types within the mapped area. We also tracked turtles post-nesting as they transited to foraging sites 5 to 282 km away from tagging beaches; these sites were located both within DRTO and in the surrounding area of the Florida Keys and Florida Keys National Marine Sanctuary (FKNMS), a regional MPA. Year-round residency of 9/11 individuals (82%) both within DRTO and in the FKNMS represents novel non-migratory behavior which offers an opportunity for conservation of this imperiled species at both local and regional scales. These data comprise the first satellite-tracking results on adult nesting green turtles at this remote study site. Additional tracking could reveal whether the distinct inter-nesting and foraging sites delineated here will be repeatedly used in the future by these and other breeding green turtles.

CURRENT STATUS OF SEA TURTLE CONSERVATION IN SRI LANKA

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Five species of sea turtles nest in Sri Lanka: green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*) and hawksbill (*Eretmochelys imbricata*) turtles. Coastal communities of Sri Lanka depend on surrounding natural resources for their survival. In addition, development activities are taking place in many coastal areas of the island. As a result, very important coastal habitats (i.e. coral reefs, sea grass beds, mangroves) and coastal fauna (i.e. marine turtles) are under serious threat of extinction. After the eradication of terrorism from the island, the government now plans to extend development to the northeastern coast, which includes large scale tourism projects. Domestic travel and tourism have increased after the war, resulting in coastal habitat degradation such as damage to the coral reefs on the Pigeon Islands and Bar Reef of the Kalpitiya Peninsula. Large mangrove areas have been cleared in Kalpitiya area to construct luxury hotels, disturbing the Puttlam lagoon system where sea turtles and dolphins are found. Sea turtle hatcheries are still illegally operated in Sri Lanka and the Department of Wildlife Conservation has failed to regulate these hatcheries. There is a great political influence to keep the illegal turtle hatcheries in operation. Although the nesting turtles are protected in National Parks (NP) such as Yala NP, Kumana NP and Wilpattu NP, natural predators account for nearly 100% egg predation in these areas. Sea turtle by-catch seems to be the biggest threat for survival in their marine habitat. Thousands of turtles become entangled in fishing nets and drown each year. TCP has recorded several fishhook entanglements associated with long-line fisheries but further research is needed to fully understand this problem. The new harbor which is being constructed in Hambanthota is posing a serious threat to sea turtles in the Ussangoda-Godawaya and Rekawa sea turtle sanctuaries. Additionally, there is a proposal to remove beach sand from the Ussangoda-Godawaya Sanctuary. The planting of introduced beach pines (*Casuarina*) along the beaches of Ussangoda-Godawaya sanctuary disturbs the sand dune formation process and shows negative impacts on nesting activities of critically endangered leatherback turtles. Sea turtles that nest in Kosgoda beach forage in Hikkaduwa Marine Sanctuary and these turtles are being used as tourist attractions as children ride them and locals feed them. Although there is a wildlife office located in Hikkaduwa Marine Sanctuary, they fail to prevent these illegal activities. Also, both Kosgoda and Rekawa beaches are currently becoming narrower each year, limiting suitable nesting habitat for sea turtles.

BYCATCH AND CUMULATIVE IMPACTS IN U.S. FISHERIES: WHERE ARE THEY NOW?

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Fishing-related injury and mortality is one of the primary threats impeding the recovery of threatened and endangered sea turtle populations in U.S. waters. Studies have estimated that up to 346,500 sea turtle interactions occurred in U.S. fisheries each year throughout the 1990s, with over twenty percent of those likely causing mortality. Many measures have since been implemented to minimize these harmful impacts, but are they helping? We assess U.S. fisheries identified as having high levels of turtle bycatch over the last two decades and provide an update on progress in three areas: accounting for cumulative impacts, reducing bycatch, and refining bycatch estimates through improved observer coverage. This evaluation reveals the cumulative number of takes authorized in U.S. fisheries and shows that even where improvements have

been made, many gaps still exist in comprehensively minimizing the harmful impacts of fisheries. No improvements have been made by the National Marine Fisheries Service to account for cumulative incidental takes across fisheries that operate in the same region and interact with the same populations of turtles. Accounting for these significant cumulative impacts when authorizing additional incidental takes of loggerheads and other sea turtle species is required under the Endangered Species Act and should be a future priority. Although estimated bycatch has declined in a number of fisheries, we question the validity of these estimates based on poor compliance with conservation measures, particularly in southeast Atlantic shrimp trawls. Likewise, observer coverage has improved in only a few of the fisheries, with coverage actually declining since the early 2000s in several cases, leaving insufficient data to accurately estimate bycatch. Oceana combats these shortcomings by promoting measures that will ensure adequate management, monitoring, and enforcement. In the coming years, it will be important for the National Marine Fisheries Service to develop a cost-effective system to effectively document cumulative impacts, elucidate the sub-lethal impacts of fisheries interactions, and enforce existing conservation regulations. This analysis highlights the importance of advocacy and litigation in ensuring that fishing activities are not threatening the recovery or future existence of sea turtle populations within U.S. waters.

MANAGEMENT TOOLS TO PROTECT THE CALIFORNIA CURRENT LARGE MARINE ECOSYSTEM: ARE THEY ENOUGH TO SAVE LEATHERBACK AND LOGGERHEAD SEA TURTLES?

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As highly migratory species, sea turtles depend on safe passage through open oceans to successfully feed and reproduce. Recent tagging data of Pacific leatherback and loggerhead sea turtles and other large marine vertebrates has shed light on ocean migrations and the importance of the California Current large marine ecosystem in attracting and retaining these animals. These data prompt the question of how to protect the open water habitat of loggerhead and leatherback sea turtles. We compared and contrasted the recent scientific papers on sea turtle concentrations and environmental parameters used to predict these concentrations with available U.S. management measures. To protect and recover endangered leatherback and loggerhead populations in the North Pacific Ocean, the U.S. National Marine Fisheries Service (“Fisheries Service”) must designate critical habitat, defined by the Endangered Species Act as specific geographic areas essential for conservation and that may require special management and protection. In January 2012, the Fisheries Service identified leatherback critical habitat based on the density of prey items, specifically gelatinous zooplankton, but declined to recognize migratory pathways as part of the critical habitat. The Fisheries Service uplisted North Pacific Ocean loggerhead sea turtles from threatened to endangered in September 2011, triggering their statutory requirement to designate critical habitat no later than a year after designation. Critical habitat protection provides a greater chance of recovery of endangered species. Species with critical habitat protected under the Endangered Species Act are twice as likely to be recovering as those without. In the case of Pacific leatherback, the current implementation of critical habitat protection is inadequate. Since designation of Pacific leatherback critical habitat, a scientific study suggested that the time leatherback sea turtles spend searching for food may be hindering population recovery, which underscores the need to protect sea turtle prey. Therefore the designation of prey density as the primary element of critical habitat is a positive step. The Fisheries Service identified activities that may affect leatherback critical habitat, but these are largely coastal threats, including coastal water pollution, oil spill response, power plants, desalination plants, and tidal and wave energy projects. This suggests we need to explore more ways to protect open water habitat within the 200-mile U.S. exclusive economic zone. The Fisheries Service must designate North Pacific Ocean loggerhead critical habitat in the near future. This provides a second chance to examine what parameters compose habitat for highly migratory species in the California Current large marine ecosystem and how to define this habitat to ensure conservation and recovery of sea turtles.

ENHANCEMENT OF THE MARINE TURTLES LAND HABITAT QUALITY – GUADELOUPE ARCHIPELAGO INSHORE PLANNING

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Three different species of marine turtles (*Eretmochelys imbricata*, *Chelonia mydas*, *Dermochelys coriacea*) lay eggs on the Guadeloupe archipelago beaches from April to November and are protected by a National Recovery Plan. Those same beaches are often the scenes of many human activities which may lead to serious damages on marine turtles land habitat and on reproduction: large vegetation deterioration (quantity and quality), sand compression made by vehicles, inappropriate lighting of the beaches, which can put the turtles under pressure during the egg-laying season. The French Forest Service (ONF), The Fish and Wildlife Service (ONCFS) and the Coastal Region Institute (CDL) in Guadeloupe, together with the Marine Turtle Protection Network, are setting up an inshore management plan which is both taking into account the human presence on the beaches and the protection of marine turtle laying sites. Inshore management recommendations come from the following study : "The terrestrial habitat of sea turtles. Study on its relation to coastal development and ecological recovery in the French West Indies", made by the ONF and the Marine Turtle Protection Network in 2006.The main actions (that can be already done, currently tested or planned) are : - the setting of regeneration enclosures, to reconstitute the natural coastal plant cover - the creation of wooden fences, to avoid turtle road crossing. - Traffic control, car park or artificial lighting management are also being analyzed. - Members of the Marine Turtle Protection Network continue to actively watch the beaches to prevent any threat. - During the next 2 years, a thorough artificial light disturbance analyze will be planned. - Vehicles traffic on beaches or cutting down of coastal vegetation are illegal actions that will be more often controlled and prosecuted by the police. In addition to that, a communication campaign was launched in 2011 to celebrate the 20th anniversary of the legalization of turtle protection. A communication and technical guide was offered to local governments, to inshore managers and to all the coastal operators in Guadeloupe throughout meetings and seminars. This methodology guide fits more to territorial and practical needs and sums up the study recommendations. Moreover, an ombudsman will be hired to help local governments. Information signs are placed on beaches and communication actions are organized by the Marine Turtle Protection Network. The first results are very positive: the plant cover is growing on supervised beaches and technical progress is made. From now on, nesting sites are included in national and regional land management plans and political programs.

WWF'S MARINE TURTLE CONSERVATION PROGRAMME

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WWF has been working on marine turtle conservation for over 50 years, since its inception in 1961. As threats to these fascinating and unique species increase, the next 10 years of conservation work will be critical to ensure they continue to inhabit our seas and visit our beaches. Marine turtles are arguably the most “global” of WWF’s species priorities, present in almost all the marine and coastal priority places listed in the GPF, and in all of the world’s oceans. They cross thousands of kilometres of ocean and rely on a wide range of very different coastal and marine ecosystems at different times during their life cycle. As a consequence, marine turtle conservation requires a comprehensive approach to protection of many important marine habitats, and to mitigation of key threats within those habitats. Marine turtles are thus a symbol of key global threats to coastal and marine biodiversity and the importance of a marine conservation agenda in most parts of the world. Therefore WWF has launched the Global Marine Turtle Strategy (2012-2020). This strategy outlines WWF’s priorities for marine turtle conservation, taking into account their conservation status and needs, and WWF’s role and niche. This strategy includes site-based interventions, both on nesting beaches and in-water habitats (such as inter-nesting areas, foraging grounds and migratory routes), as well as broader regional and international policy interventions. It focuses specifically on five of the seven marine turtle species, but broad international, intergovernmental policy interventions intended for these five species will most likely also benefit the other two species (Kemp’s ridley and flatback turtles). The breadth and variety of WWF marine turtle projects reflect an evolving conservation scenario – emerging from an initial focus on interventions on nesting beaches aimed at protecting female turtles and their eggs. While these programmes remain an essential part of the overall strategy, WWF’s efforts have expanded to: reduce bycatch in fisheries; support and advocate international and intergovernmental policies to provide meaningful protection; generate community participation in conservation; and address climate change. Research and management, capacity building, public education and outreach have been key components of this work. Partnerships are vital to WWF’s conservation practice, and we value our relationships with governments, industry and other non-governmental organizations (NGOs). The purpose of this presentation is to give an overview of what WWF, in collaboration with many external partners, has determined are key intervention points where we will be focusing in the coming years. We would like to share some examples to receive feedback and determine synergies with the global marine turtle conservation community, because we need to build on each other’s efforts to have the biggest impact where it’s most needed. We’re running out of time and we need to do this together. Help us help you help turtles.

CONSERVATION EFFORTS TO PROTECT SEA TURTLE POPULATIONS IN THE MALDIVES

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Five of the seven species of sea turtles can be found in the Maldives, the hawksbill (*Eretmochelys imbricata*) and green (*Chelonia mydas*) turtles being the most common. Sea turtles face many threats in the Indian Ocean: entanglement in ghost fishing nets and long lines, ingestion of marine debris and direct capture for their shells, meat and eggs. In 1995, the Maldives Ministry of Fisheries and Agriculture banned the hunting and killing of sea turtles, as well as the importation and sale of turtles and turtle products. Even though these actions have been implemented, sea turtle populations are still struggling to recover. The Maldivian Sea Turtle Conservation Program was initiated by Seamarc Pvt. Ltd marine biologists to protect sea turtles through conservation and research. Since 2011 we have been visiting local islands and hosting school children to raise awareness of the importance of protecting turtles and their nests. As a result, we have created a network of islanders that assist us in safeguarding turtle nests from poaching. To date, we have protected nine nests and released more than 500 hatchlings. Nest location, depth, width and number of undeveloped eggs are also recorded. Since hatchling survival rate in the wild is very low, we have established a Head Start Program at Kuda Huraa Marine Centre. A few hatchlings from each protected nest are brought to the rearing facilities, where they stay until they reach 30cm straight carapace length (approximately 18 months) before being released. At this stage, their size protects them from the majority of predators, increasing their chances of survival to maturity. Body weight, straight carapace length and width and ID pictures are regularly recorded for each individual throughout their stay. Prior to their release, a few individuals will be equipped with satellite trackers that record position, water temperature and dive time. This information is of great scientific value since there is a significant lack of data regarding migration patterns and preferred foraging grounds of juvenile sea turtles in Maldives and greater Indian Ocean. Other important conservation projects include a rehabilitation program which was initiated in March 2010 at Landaa Giraavaru Marine Centre. The Centre rescues ill and injured individuals and nurses them back to health. To date, we have released 15 turtles back into the wild. We are also trying to estimate the wild Maldivian sea turtle population. Since 2010, we have been conducting a photo identification monitoring survey with marine biologists across the Maldives as part of a first national inventory. We now have a database of more than 200 individuals. The date, location, size and sex are also recorded. We aim to develop a nation-wide protection network with both local and resort islands in order to maintain a healthy population of sea turtles in the Maldives through such research and conservation efforts.

IDENTIFYING IMPACTS OF MONGOOSE PREDATION ON GREEN AND HAWKSBILL SEA TURTLES AND PROTECTING NESTS AT SANDY POINT NATIONAL WILDLIFE REFUGE, ST. CROIX, USVI

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Sandy Point National Wildlife Refuge (SPNWR) provides critical nesting habitat for three species of sea turtle. Although widely known for the long-term saturation tagging and nest management activities conducted on leatherbacks, SPNWR also supports large numbers of nesting greens and hawksbills which have been monitored primarily through daytime track surveys. The introduced small Asian mongoose *(Herpestes javanicus)* is a known predator of sea turtle nests. In an effort to curtail predation, intermittent trapping and removal of mongoose has occurred at SPNWR since 1995. Trapping efforts were minimally successful because of staffing and funding limitations. During the 2011 season, a more concerted effort was made to document mongoose predation. Nests were monitored throughout incubation for signs of depredation. Thirty five known hawksbill nests and 56 green nests were depredated. This constitutes 52% of all confirmed hawksbill nests or 29% of all potential nests, and 35% of all confirmed green nests or 24% of all potential nests. Mongoose predation on SPNWR was found to be a significant threat to green and hawksbill sea turtles. Consequently, predator control was determined to be the most important management activity for the 2012 season. Conibear® traps were deployed along the vegetation line of a section of the nesting beach with high nesting densities. Trapping efforts effectively controlled mongoose and decreased nest predation rates.

THE CONSERVATION AND MANAGEMENT STRATEGY FOR SEA TURTLES IN KENYA: CHALLENGES AND OPPORTUNITIES

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The Government of Kenya has shown its commitment to sea turtle conservation through adapting legislations such as the Wildlife Conservation and Management Act, the Fisheries Act, and the Environment Management and Coordination Act, among others. Internationally, Kenya is a signatory to the Convention on Migratory Species as well as the Indian Ocean South East Asia Memorandum of Understanding on the conservation of sea turtles and their habitats. However, while marine turtle conservation is provided for within these laws, the legislation is inadequate in scope, strength and penalties. Effective management and recovery of Kenya's sea turtle populations can therefore only be achieved through implementation of a national strategy that links into regional and international initiatives to protect nesting beaches and critical foraging habitats from degradation, eliminate illegal harvesting and trade in sea turtles and their products, mitigate fisheries impacts, and enhance collaborative participation of local communities and other stakeholders in conservation. The Kenya Wildlife Service through its Biodiversity Research and Monitoring division's team convened a meeting in November 2007 for representatives of all key stakeholders in Sea Turtle conservation. The Kenya National Sea Turtle Taskforce was formed and later endorsed by the Kenya Wildlife Service Board of Trustees. This taskforce was given the responsibility

to develop a national sea turtle conservation and management strategy which would provide a coordinated framework for the conservation of sea turtles in Kenya. The national sea turtle conservation and management strategy went through several developmental stages and was finally endorsed at another Stakeholders' Workshop held in 2009. Subsequently, the Kenya Sea Turtle Conservation Trust led awareness activities on this policy before its formal launch in 2010. The strategy is consistent with programmes including the formation of the Kenya Sea Turtle Conservation and Management Trust (KESCOM) and is guided by FAO-ecosystems based management and similar instruments. It is aligned with regional initiatives such as the Indian Ocean South East Asia Turtle MOU, the Marine Turtle Conservation Strategy and Action Plan for the WIO, Marine Turtle Task Force (MTTF), IOSEA/Nairobi Convention partnership, The Marine Turtle Specialist Group (MTSG), South Western Indian Ocean Fisheries Commission and the National Oceans and Fisheries Policy. Thus, it contributes towards the realization of Kenya's Vision 2030 and the new constitution, which both emphasize stakeholder participation in conservation. The main tools utilized include advocacy, communication, education, public awareness, targeted research and monitoring and threat mitigation. Ultimately, the wider participation of the local communities and other stakeholders, including scientists, government and non-governmental institutions, is to be realized. It builds on ongoing efforts and initiates changes that will add value to sea turtle conservation efforts. The strategy's overall goal is to reduce and mitigate threats, reverse declining sea turtle populations and enhance ecological, social and cultural benefits. This presentation highlights the framework for sea turtle conservation in Kenya as guided by this management strategy, while outlining the challenges and successes in its implementation.

PROJETO TAMAR: MATCHING THREATS AND CONSERVATION PRIORITIES FOR SEA TURTLES IN BRAZIL

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Marine turtles are circumglobally distributed, inhabit nearly all oceans, occupy unique ecological niches and are subject to different risks and threats. Therefore, several studies have acknowledged and identified global sea turtle research and conservation priorities to address essential actions for their protection. Considering the nearly continental dimensions of the Brazilian coast (8000 km) and the distribution of the sea turtle species throughout its length, it is essential to assess and orient conservation actions. Given that conservation resources are limited and conservation targets are diverse, it is important to concentrate efforts and prioritize actions for the recovery of the populations of the five species of sea turtles that occur in Brazil. Over 30 years of data collected by TAMAR/ICMBio through regular monitoring and research has made it possible to identify threats to each species of sea turtle and highlight important gaps in available information. A series of workshops were held with TAMAR's technical team and experienced researchers were invited. We categorized known threats to sea turtles and prioritized recovery actions. Threats were identified and classified for each of the different life stages and ecosystems inhabited by the sea turtles. We considered six life stages to facilitate the construction of the matrix: egg, hatchling, juvenile neritic, juvenile oceanic, adult neritic and adult oceanic. As threats varied depending on the ecosystem inhabited by the turtles, we incorporated beach and "in water" environments into the matrix. We assigned magnitudes to threats (e.g. low, medium and high impact) based on the best available information (e.g. published data, TAMAR database) and expert opinion to establish relative parameters. This work represents an experimental exercise to assist us in our current actions and to address future issues.

SEA TURTLE SEX RATIO ESTIMATOR

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The conservation status of most marine species, including sea turtles, is difficult to assess. Nonetheless, there is an international consensus on the need to protect sea turtles, since all seven species are threatened to a certain degree and all are included on the International Union for Conservation of Nature's (IUCN) red list. Incidental capture, alteration and loss of habitat, direct take, and marine pollution are, among others, the main threats these animals face. Climate change may also represent new cause for concern. In the case of animals with temperature-dependent sex determination (TSD), including sea turtles, small changes in the incubation conditions can be sufficient in provoking important changes in the sex ratio of hatchlings. Air temperature has been increasing globally for the past few decades and the Intergovernmental Panel on Climate Change estimates an average world increase of about 3ºC before the end of the century. As global temperature is on the rise, the number of females produced in natural nests is expected to increase, leading to a female-skewed population of adult sea turtles, or possibly a complete feminization of the species in the future. In general, females are expected to breed less frequently than males, which allows an adult sex ratio higher than 50% female to be sufficient to produce an operative ratio of 1:1 during the breeding season. However, the dynamics of future adult populations can be threatened as the percentage of female hatchlings rises, increasing their vulnerability to extinction. The Sea Turtle Sex Ratio Estimator (STSRE) is a new tool that allows users to easily estimate hatchling sea turtle sex ratios (Primary Sex Ratio, SR) produced in nests from various beaches. Based on sand or incubation temperatures, this tool calculates the average temperature of the nest during the middle third of the incubation period (thermosensitive period) and estimates SR taking into account 3 sex determination variables: pivotal temperature, transitional range of temperatures and embryonic thermal tolerance. STSRE will allow users from all over the world to easily calculate SR values for specific work (Individual Use), and also help to build (and continuously complete and update) a global database of theoretical sea turtle SRs (Global Use). Ultimately, this will help scientists evaluate the vulnerabilities and tendencies found in sea turtle populations. Thus, the main objective of the STSRE is to help prioritize conservation areas with relation to climate change impacts, particularly global warming. I would like to thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics, CLS America and the International Sea Turtle Symposium for the Travel Grant that have helped fund my travel costs for the 33rd ISTS in Baltimore, USA.

EVALUATING THE EFFECTIVENESS OF SEA TURTLE LIGHTING LEGISLATION IN FLORIDA

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Artificial lighting negatively impacts sea turtle populations. It discourages females from nesting and interferes with the ocean-finding abilities of hatchlings. This is a particularly salient issue in Florida, which hosts 90% of the sea turtle nesting in the United States and is projected to have nearly 15 million people living in its coastal counties by 2050. To reduce the impact of artificial light on sea turtles and their nesting habitats, 84 local governments in Florida have passed beach lighting ordinances, most of them based on the Department of Environmental Protection (DEP) model lighting ordinance for sea turtle protection (FL Admin Code Rule 62B-55). This study employs a content analysis methodology to evaluate both biological relevance, and strength of law for the State's model lighting ordinance (62B-55), newly promulgated draft best management practices, and the local government lighting ordinances currently in place. This study also uses GIS technology to understand how the strength of law relates to the nesting densities throughout the state.

CHALLENGES AND PROSPECTS OF SEA TURTLE CONSERVATION IN NIGERIA

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Sea turtles are part of Nigeria's cultural and natural heritage, as five species have been documented feeding offshore and nesting on beaches. According to historical information, they have been a part of the fisheries for centuries. Although they are non-target species, their incidental capture in fisheries has aided their exploitation for ages. However, nesting females and their eggs have been the targets of coastal dwellers for centuries. Within the last three decades, fishermen began to value the incidentally captured sea turtles due to the decline in fisheries and the need to keep body and soul together. Surveys conducted in coastal communities since 2008 revealed that green (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*) turtles are the most commonly captured turtles. A single nesting green turtle has been reported to Nigerian Institute for Oceanography and Marine Research (NIOMR). Investigations into the prospects and challenges of sea turtle conservation in Nigeria indicate that educating coastal communities about the status of the sea turtles is necessary for sea turtle conservation. The establishment of conservation programs, not just for sea turtles alone but for marine species and habitats at large, is of paramount importance. There are many challenges to sea turtle conservation, including poverty, low indigenous conservation in coastal communities, coastal development, lack of marine conservation programs for coastal communities, non-enforcement of existing fisheries laws, inadequate scientific and historical data and lack of marine reserves. There are many opportunities for sea turtle conservation in Nigeria provided that coastal dwellers are educated and trained for a conservation program guided by accurate scientific data and information. These efforts will aid sea turtle research and conservation in Nigeria.

BOHOL RESCUE UNIT FOR MARINE WILDLIFE: A VITAL COMPONENT OF SEA TURTLE CONSERVATION IN BOHOL, PHILIPPINES

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The Province of Bohol, part of the Sulu-Sulawesi Marine Ecoregion in the Central Visayan region of the Philippines, provides ideal sea turtle habitats across all life history stages. There are four species of sea turtles found in the surrounding waters of Bohol Island: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), and leatherback (*Dermochelys coriacea*). These species are listed by the IUCN as Endangered, Critically Endangered, Vulnerable, and Critically Endangered, respectively. Despite existing laws, sea turtles are still caught for local consumption of meat and eggs are still poached. Other threats include solid waste pollution, habitat destruction from unregulated tourism

development, fishery interactions and the exponential growth of the local human population. The existence of threats to all sea turtle life stages highlights the urgency of conservation efforts. Unfortunately, no data are available about sea turtles in the region. This report attempts to start filling these gaps by presenting stranding data as an indicator of the presence and distribution of sea turtles in Bohol. The local stranding network, named the Bohol Rescue Unit for Marine Wildlife (BRUMW) and the non-profit organization Physalus responded to and recorded sea turtle strandings in the province. From June 2011 to September 2012, fifteen sea turtle strandings were documented. Hawksbill turtles were the most commonly stranded species (8), followed by green (5), leatherback (1), and olive ridley (1). The leatherback turtle stranding in May 2012 was only the second record of the species from the area and the olive ridley turtle currently in rehabilitation represents the first record of this species in Bohol. Of the fifteen stranded turtles, nine were of unknown sex (mostly juveniles). Six of the eleven live strandings were immediately released. Three turtles were rehabilitated and successfully released back to the sea and one arrived in critical condition and did not survive the first twelve hours of therapy. In addition, beach patrols and targeted interviews have identified and protected more than fifteen nests in the municipality of Anda, where a 20-year old illegal headstarting facility has been demolished and all the hatchlings released. Starting in 2010, an intensive information, education, and communication (IEC) campaign led by Physalus comprehensively trained municipal response units, provincial BRUMW members and local veterinarians to respond to strandings. This complimented Physalus' IEC program which presented lectures about turtles and marine ecosystems to more than 10,000 students from schools along the south coast of Bohol. This is just a small first step toward the protection and conservation of sea turtles in the province. IEC is a key tool for conservation and will be supported by more rigorous data collection on the distribution of these species. The stranding data will be used to identify, quantify and manage threats that are bringing these species to the brink of extinction.

δ13C AND δ15N BULK TISSUE STABLE ISOTOPE PATTERNS OF OLIVE RIDLEY SEA TURTLES (*LEPIDOCHELYS OLIVACEA*) IN THE EASTERN PACIFIC OCEAN

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Olive ridley sea turtles (*Lepidochelys olivacea*) come to shore annually to nest in the eastern Pacific Ocean, but otherwise spend all of their time in the open ocean. Individuals have the ability to travel great distances, however actual habitual movement patterns (niche width, distinct foraging regions, etc.) are largely unknown. To advance our understanding of open ocean sea turtle foraging ecology, we analyzed the δ13C and δ15N stable isotope values of bulk epidermis samples from 200 olive ridley sea turtles (*Lepidochelys olivacea*) that were hand-captured in 2006 in three eastern tropical Pacific Ocean sub-regions: (1) Gulf of California (GOA; n=29); (2) North Equatorial Current (NEC; n=33); and (3) Eastern Pacific Warm Pool (n=138). We compared our findings to results from the analysis of 45 samples collected in 2003 from the same region by Hess *et al*. in 2007. We found no significant difference in δ13C and δ15N between size classes for all samples. We observed a significant difference in δ13C values between the GOC and the two more southern sub-regions, but not between the two southern sub-regions themselves. We found δ15N to enrich as latitude increased, with a significant difference between the values in the GOC and the two southern sub-regions, but not between the two southern sub-regions themselves. Here, we spatially contextualize observed isotopic patterns in olive ridleys oceanographically across the eastern Pacific Ocean, which is a dynamic region that supports diverse ecosystems and foodwebs. We have identified potential reasons for observed nitrogen isotopic patterns related to spatial variation in nutrient supply across the region due to changes in thermocline depth, iron deficiency, and/or oxygen depletion. The most interesting difference between our investigation and the prior study is that we found that both δ13C and δ15N values decreased as distance from shore increased in the NEC region. Since δ13C values reflect the carbon source for photosynthesis, this is an expected result because cell boundaries of plants in pelagic regions are thicker,

which results in resistance to diffusion and subsequent assimilation of 13C, as diffusion is a rate-limiting step in photosynthesis. This analysis is part of a larger research study aiming to develop a biochemical roadmap to open ocean sea turtle foraging on the seascape scale intended to provide useful open ocean foraging ecology information to marine resource managers.

VANUA-TAI TURTLE MONITORS A STORY OF SUCCESSFUL TURTLE CONSERVATION IN VANUATU

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The Republic of Vanuatu is a chain of 83 islands in the South Pacific lying between 13°S-20°S Latitude and 170°E- 166°E Longitude. Vanuatu is home to three of the six marine turtle species in the Indo-Pacific region, namely the green turtle, the hawksbill turtle and the critically endangered leatherback turtle. Turtle meat and eggs are a delicacy to the indigenous people of Vanuatu similar to the situation in other Pacific Islands. Recent archeological evidence suggests a three thousand year history of consumption of marine turtles. Currently on some former nesting grounds there is no longer nesting probably due to a long history of turtle egg harvesting. Sea turtle conservation in Vanuatu was first introduced to local communities in 1995 when a local non-government organization, Wan Smolbag Theatre (WSB) implemented a sea turtle awareness campaign using a play on the plight of marine turtles that was performed in local villages on the main Island of Efate. After the performance a discussion was held with villagers searching for solutions, out of this came the suggestion for the village to nominate a knowledgeable fisherman as a turtle monitor. This was the beginning of WSB’s sea turtle conservation and monitoring program with the establishment of village turtle monitors and a network, the Vanua-Tai Resource Monitors Network who now number over 500 and are spread throughout Vanuatu. The monitors initially focused on conservation and sustainable use of marine turtles but have proved invaluable documenting marine turtle occurrence and nesting beaches, tagging turtles and carrying out research. A 2005 survey suggested that the Vanua-Tai network in only 5 villages had conserved over 1200 marine turtles, extrapolated over the whole of Vanuatu this would amount to over 10,000 turtles conserved. The network has subsequently expanded to involvement in broader marine resource issues including coral reef monitoring and other marine resource conservation. Some of the significant achievements have been the identification and subsequent monitoring of important leatherback, green and hawksbill nesting beaches, the negotiation with tribal elders to reduce the take of large adult turtles for a traditional ceremony from 300 to 50 turtles, the development of turtle related ecotourism activities including sponsoring by tourists and cruise ship visitors of tagged and released turtles, and a village based turtle nesting beach watching activity.

ASSESSING A POTENTIAL LIGHTING PROBLEM FOR LOGGERHEAD HATCHLINGS NEAR THE BRIGHTEST LIGHTHOUSE IN THE WORLD: ARENA ASSAYS AT HILLSBORO BEACH, FLORIDA, USA

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Florida’s East Coast is home to 90 percent of all loggerhead sea turtle (*Caretta caretta*) nests in the U.S. It is also home to most of the 19 million people in Florida. This concentrated human population affects the turtles in many ways. The impacts of artificial lighting are major concerns, well known to both nesting beach managers as well as coastal residents. Consequently, many Florida municipalities and counties have adopted lighting ordinances. These are especially important in urbanized portions of southeastern Florida where some nesting beaches are exposed to many sources of artificial lighting. An advocacy group known as Sea Turtle Oversite Protection, Inc. (STOP) operates in one such urbanized setting (Broward County, Florida). Volunteers patrol beaches and document locations where lighting problems are severe. This is especially the case in the southern portions of the county where, in 2011, between 24-48% of the hatchlings emerging from nests in those locations were disoriented. STOP volunteers rescued 36,398 hatchlings from those sites and released them on dark beaches where they could successfully locate the sea. However, the northern portion of Broward County (Hillsboro Beach) is relatively dark and backed by private residences. Nesting densities are the highest in the County and only 6% of the hatchlings are disoriented. There is an inlet at the south end of the beach which is marked by a tall (41 m high) lighthouse maintained by the U.S. Coast Guard (USCG). Its 1000 w light is sufficiently bright to be visible 54 km out to sea. Its beam rotates rapidly above the beach, once every 20 s. STOP claimed that this light threatened marine turtles by repelling females from the nesting beach, and by attracting hatchlings toward the light and away from the ocean. They pressured the USCG to modify the light or to turn it off. The USCG sought opinions from experts at the National Marine Fisheries Service (which has authority over coastal waters). The NMFS concluded that nesting activity was unaffected. The USCG also sought opinions from the U. S. Fish and Wildlife Service (which has authority over the nesting beach). The USFWS concluded that there was not sufficient data to determine whether hatchlings were attracted to the lighthouse. That conclusion was unsatisfactory both to STOP and to the USCG. To resolve the problem, we did experiments to measure how loggerhead hatchlings oriented after simulated nest emergences. Hatchlings scheduled to emerge that evening were collected in the afternoon from nearby nests, and released that night in the center of a 4 m diameter circle (arena) drawn in the sand at Hillsboro Beach. Their orientation angle as they exited the circle was measured at three locations (100 m, 330 m, and 915 m north of the lighthouse) under each of two conditions (lighthouse light on; lighthouse light off). All of the hatchlings crawled with great accuracy toward the ocean. These data provided the evidence required to resolve the issue and allow the parties to concentrate on other ways to promote sea turtle recovery.

THE CASE OF THE GREEN TURTLE: AN UNCENSORED HISTORY OF A CONSERVATION ICON

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When the first generation of conservation scientists determined that the green sea turtle was threatened with extinction, they helped transform this heavily hunted species from a food source into a conservation icon. With its impressive migrations and homing abilities, the green turtle, like the giant panda, became a symbol of humanity’s commitment to preserve life on Earth, especially the relics of the original order. But the ‘founding fathers’ of sea turtle biology disagreed on how best to preserve the object of their studies. Would farming the green turtle as livestock help to feed human populations or trigger a new era of unsustainable demand for a fashionable luxury food? As a question of values and human behavior, biology had no answer, and so it fell to the courts to decide. Now, as the green turtle recovers from centuries of overexploitation, a new generation of turtle biologists grapples with the ‘sustainable use’ conundrum, reprising the debate that so bedeviled their intellectual forebearers.

THE SEA TURTLE NEST LOCATOR PROGRAM: USING ADVANCED GIS & GPS TECHNOLOGY TO BALANCE BEACH MANAGEMENT DEMANDS WITH ECOCONSERVATION EFFORTS

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Many cities face the challenge of balancing the need to protect a tourist economy with the need to protect endangered ecosystems. Innovations in GIS have allowed for the integration of advanced technology and ecoconservation. In the past 4 years, the City of Fort Lauderdale, in partnership with Broward County, has developed a program model focused on balancing the efficacy of mechanical beach cleaning with the objective to protect sea turtle nests. The Sea Turtle Nest Locator Program utilizes a Trimble GeoExplorer sub-meter GPS, ArcGIS Mobile, and ArcGIS Desktop to collect and analyze data used to identify and re-establish sea turtle nests in the event of natural or man-made disturbance. The program has resulted in improved efficiency in mechanical beach cleaning and increased ecopreservation of sea turtle nests. Due to its success, the program model has been adopted by other beach cleaning services within Broward County and is being implemented in several municipalities. This presentation will explain the program model, give examples of how the model has been put into use on Fort Lauderdale Beach and describe the use of ArcGIS Mobile and ArcGIS Desktop as tools in providing GIS services within beach management programs.

ARE HAWAIIAN GREEN SEA TURTLES IMPERILED OR RECOVERED?

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The United States is conducting a status review of green sea turtles to determine whether they should still be protected under the Endangered Species Act. The prospect of removing protections comes in response to a petition to remove the Hawaiian population of green sea turtles from the list of threatened and endangered species, and the move is highly controversial. This presentation will discuss the recovery criteria and examine the present classification of the green sea turtle. It will also identify the ongoing threats to the survival of Hawaii’s green sea turtles, including sea level rise, climate change, plastic pollution, disease, and fisheries bycatch. Legal protections have been instrumental in bringing green sea turtles back from the brink of extinction, and this demonstrates the success of the Endangered Species Act. The goal of the law is to recover imperiled species so that the protections of the law are no longer necessary. While population increases for the Hawaiian population of green sea turtles are encouraging, there are many factors and management challenges that weigh against removing protections.

CONSERVATION AND MANAGEMENT OF OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) AT INTENSIVE SPORADIC NESTING HABITATS OF ANDHRA PRADESH COAST, BAY OF BENGAL, INDIA

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The Andhra Pradesh coast is situated on East Coast of India between 11°24”- 19°54” N latitudes and 80° 02”- 86°46” E longitudes. This part of coastline abutting Bay of Bengal has diversified shore environments of main land beaches, salt water lagoons, backwater swamps and sand spits of Krishna and Godavari River mouths,. The breeding population of olive ridleys (*Lepidochelys olivacea*) is migrating during winter months (December to March) from Indian Ocean to the Orissa mass nesting sites (Gahirmatha & Rushikulya) they utilize the beaches of Andhra Coast for their sporadic nesting on remote main land beaches and riverine sandy spits & sand bars. Intensity of sporadic nesting activity and nesting density of the olive ridley were found to be varied from river mouth sand spits (>30 nests /km) to the main land beaches (<4 nests /km. Predation of eggs and hatchlings was very high at river mouth beaches due to jackals (*Vulpes vulpes*), foxes (*Vulpes bengalensis*), mongoose (*Herpestes edwardsi*) and shore crabs (*Ocypoda* sp.). As part of conservation and management of olive ridley sea turtle a total of 3000 Olive ridley nests were relocated at sand spits of Krishna, Godavari and Vamsadhara river mouths and protected naturally (in situ) until hatching of eggs. The newly emerged hatchlings (2000 nos) were reared in captive conditions up to six days old and released them in to marine waters. Besides, sea turtle awareness programs were organized at major fishing harbors for implementation of Turtle Excluder Devices (TEDs) to reduce the incidental catches of breeding population due to shrimp trawl nets. The vulnerable nesting sites of olive ridleys were regularly monitored to protect freshly laid nests, eggs and hatchlings from natural predation and beach erosion along the sporadic nesting sites of Andhra Pradesh coast, Bay of Bengal, India.

ASSESSING THE INFLUENCE OF NEST RELOCATION ON SEA TURTLES IN NORTH CAROLINA, SOUTH CAROLINA AND GEORGIA

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Nest relocation is generally considered a successful tool in sea turtle conservation. It is commonly used by many sea turtle projects in many countries, and often high hatching success in relocated nests has been interpreted as being beneficial for populations overall. However, there has been debate about potential negative effects of nest relocation, such as the possibility that relocated eggs may experience unnatural nest incubation conditions. It has also been suggested that nest relocation may artificially select for poor nesting behavior and possibly result in reduced overall fitness of sea turtle populations. As a way to test for the artificial selection hypothesis, we investigated nest relocation data of >11,000 loggerhead sea turtle nests laid in Georgia, South Carolina and North Carolina during the 2010 and 2011 nesting seasons. Nearly all

known nests laid (>95%) were linked to individual females, through a DNA fingerprinting project. As a result, we were able to assess if relocation of nests was randomly distributed across nests of individual turtles, or if nests of some females were relocated more often than others. This study is the first of its kind, with a large sample size distributed across a wide region. The results from our research will be informative in the ongoing discussion about the possible impacts of nest relocation on sea turtle populations.

WINNING SEA TURTLE PROTECTION THROUGH LEGISLATION IN CALIFORNIA AND BEYOND

Teri Shore and Todd Steiner

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Passing several state bills and resolutions supporting sea turtle conservation through the California state legislature and key marine management agencies over the past five years has proven an effective tool for increasing protections for endangered Pacific leatherbacks and raising the profile of the marine species among public officials, policymakers and the public. Turtle Island Restoration Network (TIRN) will explain the history, legislative language and campaign that resulted in successful passage of such bills, including a 2012 bill signed into law that designates the Pacific leatherback as an official state symbol of California. TIRN will also show how we've leveraged legislation and resolutions in other policy arenas - including the ISTS - and how such an approach can be modeled by others to enhance protections for and build constituencies for support of sea turtle conservation in the U.S. and internationally.

A COMPREHENSIVE REVIEW OF BEST PRACTICES IN PROTECTED SPECIES ADVISORY GROUPS, AS THEY PERTAIN TO NORTH CAROLINA'S SEA TURTLE ADVISORY COMMITTEE

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In accordance with a 2010 Settlement Agreement between NC Division of Marine Fisheries, NC Marine Fisheries Council and the Karen Beasley Sea Turtle Rescue and Rehabilitation Center, the NC Sea Turtle Advisory Committee (STAC) was formalized. The committee consists of 12 members appointed by the MFC Chairman and the Karen Beasley Sea Turtle Rescue and Rehabilitation Center. The role of the STAC includes: the review of monthly observer reports and fishing effort data, the review of weekly stranding reports, assisting with fishermen education on sea turtle biology, and advising on take-reduction measures such as gear modification or seasonal restrictions. The STAC also reviews and provides comment on all Incidental Take Permit provisions and take calculations prior to formal application to NMFS. After several years in their current capacity, members of the STAC expressed interest in expanding their work from NC gill net fisheries, which were the target of the Settlement Agreement, to advising on other state-managed fisheries that impact sea turtles. In an effort to maximize the STAC's effectiveness and clarify goals, other protected species advisory groups and marine mammal take reduction teams were examined, to determine best management practices and effective strategies. The size and composition of each advisory committee was examined, as well as the committee's mission, goals, and funding, if applicable. A close look is also

taken at each group's major initiatives and any documents produced in their advising capacity. Based on informal interviews and anecdotes, best practices are compiled and presented. Many thanks to the ISTS, Nicholas School of the Environment and Duke Environmental Law and Policy Clinic for their generous support of this project and presentation.

STATUS OF SEA TURTLE POPULATIONS IN PALOH, WEST KALIMANTAN, INDONESIA, WITH SPECIAL NOTES ON THE EFFECTIVENESS OF LOCAL PARTICIPATION IN PROTECTING TURTLE NESTS

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Paloh beach, which is located within the District of Sambas in the Province of West Kalimantan, Indonesia, is one of the major nesting beaches for sea turtles in Indonesia. Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles have been documented nesting on this 63 km long beach. For decades, sea turtle eggs in this region were exploited either by the local government who sold them through auctions to private entities, or by local people who took all of the eggs. In early 2009, WWF Indonesia initiated a campaign to obtain local support to promote effective law enforcement. Ex-egg poachers were transformed into monitoring and surveillance workers which resulted in a significant reduction in egg poaching activities. A total of 8,540 turtle nests were documented between June 2009 – August 2012. Based on the track width of the nesting females or on egg diameter and weight, it was estimated that the nests were composed of 98.33% green turtle nests and 1.70% hawksbill turtle nests. Regardless of species, overall proportion of poached nests during 2009, 2010, 2011, 2012 were found to be 99.62%, 95.01%, 25.64% and 21.42%, respectively. Significant reduction in poaching during the period of 2011 and 2012 compared to 2009 and 2010 indicates the necessity and effectiveness of involving local community in conducting monitoring and surveillance of nesting turtles in this particular area. Monitoring results indicated that peak nesting in Paloh occurs from June-August. Nesting abundance seemed to be concentrated on a segment of beach named Sebubus (89.41%) compared to the neighboring beach segment called Temajuk (10.59%). Considering the limitation of the resources, these results can be used as guidelines to focus the temporal and spatial scope of work during the peak periods.

THE USE OF RECREATIONAL DIVERS FOR IN-WATER SEA TURTLE MONITORING IN MOZAMBIQUE

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Five sea turtle species, all of which are globally threatened, are found within southern Mozambican waters. Illegal capture of foraging turtles by spear-fishers, nest raiding and coastal habitat modification are known to affect local sea turtle populations. Such is the case in many developing countries, where conservation initiatives have been hampered by the lack of capacity, lack of data and resource constraints for monitoring activities. Low monitoring capacity is a common issue, particularly within developing countries, and a potential solution is to enlist the help of the recreational diving community. Between 2008 and 2011 there

have been at least two projects in which recreational divers collected data on turtles and other marine megafauna in Mozambique. This study assessed the suitability of using volunteer divers to collect baseline data of sea turtle populations. The two datasets were consecutively collected for 37 months: one was a routine logbook of all marine megafauna sightings and the second was a dedicated turtle survey. A total of 317 sightings of loggerhead (*Caretta caretta*), green (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) were reported over 918 dives. Our analysis found that a large proportion of the sightings reported by the volunteer participants could not be conclusively assigned to species, and while estimates of turtle sizes were recorded, 13% exceeded biological limits and were clearly erroneous. While the dedicated survey protocol allowed for more detailed behavioural data collection, the independent logbook record was more useful for analysis of sighting trends because we could also get absence data (i.e. dives with no turtle sightings). Overall, useful data on foraging sea turtle species composition, size and distribution were obtained, which was a first for Mozambique. In addition, we used the data to develop a more robust protocol for a specialist in-water citizen science program. We advocate for the development of clear questions or objectives around which the monitoring program is developed, collection of effort data, and refinement of methodology, particularly through the incorporation of photographic verification of species identification. These changes can improve the ability of 'citizen scientist' programmes for in-water sea turtle monitoring to be a cost-effective and practical means to gather baseline data and to enhance the long-term sustainability of monitoring programmes.

SEA LEVEL RISE, SPECIES SURVIVAL, AND PRESERVATION OF UPLAND HABITAT

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Florida's coastal ecosystems and species face rising sea levels and increasing storm surge. It is critical to proactively map, protect, and manage upland habitats to enable adaptive habitat shifts by coastal species. The U.S. Endangered Species Act can help accomplish these objectives by protecting upland habitat for species to ensure they are able to move inland as their habitats are inundated. Mean global sea level is projected to rise by 1 to 2 meters this century, and intensifying storms and storm surge will exacerbate the effects of sea level rise. The Florida coast faces a significant threat of inundation, and many coastal species will likely suffer extensive habitat loss. Sandy beaches that are narrow, lack extensive dune systems, or are backed by armoring are vulnerable to disappearing entirely. Coastal species may be limited in their ability to move landward as coastal habitat has already been lost and degraded due to development and dense human populations along the coast. In Florida, population density in coastal counties is three times greater than in inland counties – thus coastal species are at risk of being trapped between rising sea levels and human development. Moreover, undeveloped areas that might be suitable for species' landward migration are likely to be claimed by development as human populations also retreat landward. Our nation's foremost biodiversity protection law, the Endangered Species Act, provides a powerful but under-utilized tool for proactively protecting habitat in response to climate change through the designation of "critical habitat." Under the Act, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, must designate areas essential to the survival and recovery of a species as "critical habitat." These areas receive protection from all federal agency actions that are likely to "destroy or adversely modify" them and critical habitat designation provides safeguards against development and other potentially destructive activities. In a climate change context, the Act allows the Services to designate critical habitat outside of a species' current range if those areas are needed for its conservation. The loggerhead sea turtle is widely distributed within its range, and makes some of the longest journeys of any sea turtle species. Originally listed as threatened range-wide, the Services recently divided the species into nine District Population Segments, and are now required to designate critical habitat. Loggerhead sea turtles nest on beaches from Texas to Virginia, and face significant loss of nesting habitat due to sea level rise. However, about 90% of U.S. loggerhead nesting occurs in Florida counties, mainly in Brevard, Indian River, St. Lucie, Martin, Palm

Beach, Broward, and Sarasota counties. A critical habitat designation for the Northwest Atlantic Distinct Population Segment that includes upland habitat that will become necessary for sea turtles will help ensure their survival and recovery under rising sea levels.

Education, Outreach and Advocacy

GTTM-GV: 15 YEARS OF EFFORT TOWARDS SEA TURTLE CONSERVATION IN VENEZUELA

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Management plans of endangered species worldwide have centered their guidelines based on the inter-institutional cooperation between countries and ecoregions. All proposed initiatives for sea turtle (ST) conservation have developed their work proposals based on networks that allow a fluent exchange of information and an effective extent to the protagonists of the conservation projects, which are the inhabitants of the coastal communities near sea turtle's habitats. This has been the key for the integration of fishing and indigenous (Wayuu) communities and the members of the "Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela" (GTTM-GV) during the last 15 years. The Gulf of Venezuela constitutes an important zone where conservation efforts for endangered species such as sea turtles need to be developed due to the combination of the complex sociocultural and environmental issues. It is a frontier zone between Colombia and Venezuela, with problems such as illegal drug and oil trade, critical economic situations and illegal immigrants. However, it also contains important ecological elements such as the presence of the five sea turtle species that inhabit the southern Caribbean, and ideal ecosystems for the development of sea turtles. This complex reality was one of the greatest challenges for the creation and growth of GTTM-GV as an NGO. After 15 years, many projects have been developed successfully under the three basic worklines: Intercultural Bilingual Environmental Education (Spanish-Wayuunaikii), Investigation-Action, and Networking (interinstitutional efforts). The GTTM-GV is recognized as a regional and national example of environmental efforts for community based conservation, achieving the integration of Wayuu and Añu indigenous communities. Additionally, there is an increasing number of volunteers and professional members in several academical areas (Biology, Social Communication, Education, Public Relations, Veterinary Medicine, Graphic Design and Engineering), as well as the development of workshops and courses directed towards students, fishermen, children and housewives, and finally the creation of a Biological Station in Zapara Island. For 15 years, the GTTM-GV has been successful in leading academic and community projects in the regions, training students in international internships, actively participating in workshops with governmental entities, and is constantly assuming new commitments promoting the conservation of sea turtles and their habitats in Venezuela.

COMMUNITY INITIATIVE OF NON-CONSUMPTIVE USE OF SEA TURTLES AS A RESULT OF LONG TERM CONSERVATION PROGRAM IN BRAZIL

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Since 1990 TAMAR develops scientific research, environmental education and social inclusion activities to protect sea turtles in Ubatuba, north shore of São Paulo state, Brazil. As a result, more than 10,000 juvenile sea turtles, which were caught incidentally at artisanal fishing, were released to the ocean with the fishermen volunteering partnership. Among them, 643 sea turtles (636 *Chelonia mydas* and 7 *Eretmochelys imbricata*) were captured by artisanal fishermen from Almada Beach. Since 1992, besides continuous development of research and educational activities in Almada, TAMAR has supported local events, helped in the implantation of mussel cultivation and promoted annual meetings with the fishermen to present the results of the sea turtle conservation program, also to clarify questions and issues about environmental legislation. In 2011/2012, a research about the touristic potential of Almada Beach, with the goal to plan and structure the activity in the area was conducted by AICÁS. This NGO, constituted of local people, develops educational activities with the community and tourists to protect the historical and environmental patrimony. In the AICÁS research, from a list of seventeen options of traditional touristic activities, the residents pointed out the observation of sea turtles as the second most significant one, only behind hiking in the rainforest. The proposal is to take groups of five people in small boats to watch turtles in 4 defined locations according to local fishermen knowledge, where turtles usually gather to feed. TAMAR Project was invited by the community to take part of a workshop to teach the local residents about the biology and conservation of sea turtles, relating it to their own performance as tourist guides. In this commitment, TAMAR also promoted dialogues about the ordering of the activity, the supporting capacity, the quality of the services offered and safety. This was also an opportunity to recommend how to live peacefully with the sea turtles, with the lowest impact possible for the turtles and its environment. Eight residents were trained and 4 boats' owners became interested in this activity. Just a few participants of this initiative are older than thirty five years and most of them are young people who have been involved in the TAMAR activities, since their adolescence. These people were raised in an environment where protecting turtles is important and where tourists' interest and affection for its observation represents a great business opportunity. This report suggests that the long term continuity developing education and inclusion actions in the community is the basis to build values and environmental consciousness, in a context where new initiatives and behavior can come from new generations.

SEA TURTLE CONSERVATION: TRANSFORMATION INTO K-12 EDUCATION: HYBRID POGIL™ METHODOLOGY IN A PLACE-BASED GEOSCIENCE PROGRAM

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The St. Catherines Island Sea Turtle Program (SCISTP) was founded in 1990 and has been funded continuously for 22 years through a consortium of partners led by Georgia's Improving Teacher Quality Program (GaITQ). The SCISTP combines "Conservation, Research, and Education" into an integrated, interdisciplinary, holistic program, featuring a total-immersion, procedure-optimized, process-oriented, guided inquiry learning (POGIL) educational component. The layered procedures of sea turtle conservation provide an excellent mechanism for modeling introduction of a hybrid POGIL methodology into K-12 curricula. The conservation procedures have been summarized and integrated onto a new map of the beaches of St. Catherines Island, gridded to GaDNR standards, to guide the layered learning in a field environment. A formal POGIL exercise piloted in 2012 rapidly taught new knowledge and new pedagogy to 16 K-12 teacher-interns. Over the years we have taught place-based sea turtle conservation, aspects of geology, ecology, oceanography, biology, archaeology, hydrology, history, and pedagogy, to 307 interns. Two hundred seventy three of these have been K-12 teachers from Georgia who, because of the compounding effect of multiple cohorts of students in their classrooms, have impacted approximately 373,858 K-12 students. During this process we have conserved 2,796 sea turtle nests that put 165,974 sea turtle hatchlings into the Atlantic Ocean, and have shared our science and experiences through numerous talks, publications, and websites. The SCISTP provides a robust model of how observational science and conservation can be transformed to maximize their impact in the public arena, especially in K-12 education, leading, we believe, to enhanced environmental stewardship and an enhanced appreciation for science. We intend to continue this project with shared operating support and exportation of our robust model to enhance science and science education around the world. This will be done through our website (www.scistp.org), through formal association with the POGIL Project (http://pogil.org/), and publication of a new book "Two Thousand Sunrises; Ten Thousand Surprises" (Draft II, ~ 425 p., single-spaced with illustrations), extending place-based POGIL learning through life-long learning processes in science and science education using the nesting ecology of charismatic sea turtles as a science education and wildlife conservation vehicle.

SEA TURTLE REHABILITATION AND MEDICINE COURSE: A UNIQUE HANDS ON CLINICAL EDUCATION FOR VETERINARY STUDENTS

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The North Carolina State University College of Veterinary Medicine (NCSU-CVM) was established in 1979 and has a reputation for its dedication to teaching, research, community outreach, and providing unique student learning opportunities. This is exemplified by the Sea Turtle Rehabilitation and Medicine

Course that was created in 2005. A relationship between the NCSU-CVM and Jean Beasley, the founder of the Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSTRRC), was formed in the late 1990's as the demand increased for consistent specialized care for injured sea turtles along coastal North Carolina. Faculty members from NCSU-CVM have been the primary veterinary caregivers for sea turtles at the KBSTRRC since its opening in 1997. Combining the mission of the NCSU-CVM to provide excellence in educating and training veterinarians and a mission of the KBSTRRC to provide an experiential learning site for students, the sea turtle rehabilitation and medicine course was born. The course is attended by fourth year veterinary students for two weeks, spending the majority of their time at the KBSTRRC in Topsail Beach, NC. The students engage in extensive hands-on practical and clinical experience with threatened and endangered sea turtles. Skills acquired during this time include sea turtle husbandry and rehabilitation techniques, diagnostic sample collection and interpretation, physical examination and safe animal handling, medication delivery, wound treatment, and necropsy protocols. Another aspect of this course is the social experience provided by interacting with people from all walks of life including volunteers, natural resource managers and biologists, working together for the conservation of these high profile species. Forty-seven students have completed the course since its inception. A number of these former students are pursuing zoological medicine careers in both public and private practice involving protected species, rehabilitation, wildlife, aquatic, zoo and exotic companion animals. While participating in the course, students have also been directly involved with sample collection and processing for research that has resulted in publications contributing to sea turtle health management. This distinctive course provides valuable experience applicable to many veterinary career paths, with a particular appreciation of the challenges and rewards of working with flagship protected species like sea turtles.

INTERGRATING SEA TURTLE RESEARCH INTO INFORMAL EDUCATION

Karen P. Burns, Rachel Reisbeck, Katie Vaughan, Alexis Rabon, and Elisabeth Boys

Virginia Aquarium & Marine Science Center, Virginia Beach, VA, USA

Virginia Aquarium & Marine Science Center educators worked with aquarium research staff to develop educator curriculum materials on sea turtle research and conservation. Sea Turtle Science & Stewardship workshops are being conducted for educators representing approximately 40 informal science centers in Virginia and Maryland. The workshops will provide informal educators with instructional kits, highlight programs and activities appropriate for family audiences, and explore how our facilities can best engage the public in sea turtle conservation issues and foster sea turtle stewardship. These workshops are designed to assist informal educators in developing programs for their institutions regarding sea turtles in general and research, threats and conservation efforts in Chesapeake Bay and other waters of Virginia and Maryland. Sea Turtle Action Kits have been developed for distribution to schools, scout troops, 4-H Clubs, and other youth organizations in Virginia and Maryland. These kits will provide props, materials, and activities that demonstrate the danger marine debris poses to sea turtles and contain the basics needed to create a display on the subject, such as directions for constructing a "Trash Talking Turtle" and posters about biodegradation of debris and how to properly dispose of balloons and trash. The kits will promote stewardship by encouraging youth groups to create action plans for setting up displays at school fairs, Earth Day events, and local parks that educate the public on how individuals can make a difference. Workshops and trainings are facilitated by both education staff and research staff for a greater impact on the participants. Through the Sea Turtle Science & Stewardship workshops, aquariums and informal science centers will have the resources to strengthen their programming about sea turtles. Workshop attendees are asked to track the number of sea turtle programs and program participants and to collect evaluation information. Through the Sea Turtle Action Kits, youth groups will have the resources to help increase awareness about the impact of marine debris on sea turtles and to share ideas for reducing the threat. Groups that receive the kits will report on their activities and provide estimates of the number of people they reach. The goal of all of these educational outreach components is to empower residents of Virginia and Maryland to take actions that reduce human impact on loggerheads and other sea turtle species that

visit our waters. All materials will be continually updated to incorporate new research as we generate results.

BAHARI KARUNA - CONNECTING PEOPLE THROUGH SEA TURTLE CONSERVATION IN WEST AFRICA.

Neil Davis, John Flynn, Juliana Baker, and Kostas Papafitsoros

Wildseas, Bahari Karuna, Eikwe, Ghana

A small team of WILDSEAS staff began working closely with existing turtle groups and fishermen in remote areas of Western Ghana in 2011/2012. The goal was to establish the first volunteer project of its kind in the region. After meeting in January 2012 we secured the support of many local communities and received land for a marine conservation and education centre in the village of Eikwe. After many setbacks, the project BAHARI KARUNA (meaning ocean compassion) was founded in October, 2012. The project works closely with local fishermen to ensure that sea turtles that have been accidentally captured are safely released, and also to facilitate data collection on any shark landings. Additionally, we also run a successful school education program. Approximately 10 local people are employed full time and many fishing boats have agreed to join us in this pilot project. The results are presented along with future goals.

EXPERIENCING SCIENCE TO CULTIVATE THE DESIRE FOR CONSERVATION AT HOME AND ABROAD

Tera C. Dornfeld[1], Gabriela S. Blanco[2], Julianne Koval[3], Pamela T. Plotkin[4], Richard D. Reina[5], Vincent S. Saba[6], Bibi Santidrián Tomillo[1], Lesley Stokes[7], Jen Swiggs[3], Bryan P. Wallace[8], James R. Spotila[2], and Frank V. Paladino[3]

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For the past 24 years, our research team has conducted studies on the population dynamics, behavior, and physiology of the leatherback turtles nesting at Playa Grande, Playa Ventanas, and Playa Langosta on the Pacific Coast of Costa Rica. Our research was an instrumental component of the effort to turn these beaches into the Las Baulas National Marine Park. Furthermore, these 24 years of meticulous data collection have allowed us to amass one of the most detailed sea turtle databases in existence. This comprehensive database owes its existence to the tremendous volunteer force that accompanies us to the beach each night. During the leatherback turtle nesting season, which runs October – March, we are assisted by 50+ Earthwatch volunteers as well as school groups from around the world. Volunteers walk with biologists on the beach each morning and night helping to tag and identify turtles, record nest locations, measure turtles, count turtle eggs as they are laid to understand fecundity, take internal nest temperatures to predict hatchling sex ratios, and excavate nests to calculate hatching success. Volunteers

also help with maintenance and protection of our beach hatchery, a safe place to relocate nests laid in perilous locations. We receive new volunteers every 10 days, however, we receive more than just able-bodied workers. By providing an opportunity for volunteers to experience sea turtles and a research team that is dedicated to conservation we are able to pass on knowledge about sea turtles, the threats they face, and conservation strategies. When volunteers who are already passionate about turtles have the opportunity to experience sea turtles and conservation in action their resolve to protect turtles strengthens. This resolve extends beyond their time at the project to when they return home. In this way we are providing not just field training but spreading the message of conservation around the world. At the time of writing this abstract we are midway through the nesting season. We have had the privilege of working with many volunteers so far and are looking forward to many more in 2013. To date we have encountered 22 different leatherback turtle females. Encouragingly, our first turtle of the season was first tagged in 1994-95, fitted with a satellite tag in 2007, and has been seen nesting during five previous seasons. With the help of our volunteers we look forward to protecting more nesting females and their clutches during the 2012-13 nesting season. We wish to thank the generous contribution of The International Sea Turtle Symposium, The International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, and CLS America for funding the travel grant that made possible the participation in this year's symposium. We also wish to thank the Earthwatch Neville Shulman Award for helping fund our participation in this symposium.

A MULTI-DIMENSIONAL APPROACH TO EDUCATION AT A SEA TURTLE NESTING BEACH IN PLAYA GRANDE, COSTA RICA

Tera C. Dornfeld[1], Kristin M. Reed[1], and Frank V. Paladino[2]

[1] The Leatherback Trust, San Jose, Costa Rica
[2] Indiana University-Purdue University, Fort Wayne, Indiana, USA

The Leatherback Trust began helping to collect biological data and protect nesting beaches for leatherback sea turtles at Playa Grande, Costa Rica in the late 1980s. We witnessed a dramatic decline and now the population could be stabilized, albeit at lower numbers. We believe the way forward is to pair research and protection of the remaining sea turtles and their habitat with community involvement. By providing residents with information about sea turtles and the anthropogenic threats facing them, as well as conservation strategies, we can mitigate one of the main threats to sea turtles: the negative effects of coastal development. These negative effects include an increase in plastic pollution, invasive species, and beachfront lighting, as well as a loss of beachfront vegetation. Without conservation information and strategies, we face two key problems: 1) residents are underutilized as partners in conservation and 2) some residents are, actively or unknowingly, working against conservation. To begin to partner with residents we first developed a survey to gauge their receptivity to educational programming as well as their perceived value of sea turtles. Of the 97 residents surveyed, 41/42 respondents strongly agreed or agreed with the statement 'I would like to learn about sea turtles' and 88% (37/42) answered that they would volunteer their time to help protect sea turtles. Many (88%; 37/42 respondents) strongly agreed or agreed with the statement 'Educating people in Playa Grande about sea turtles will benefit sea turtles'. Finally, 64% (27/42 respondents) believed they benefited from having sea turtles in Playa Grande. We are now organizing many different types of activities to learn which best facilitate community participation as well as education focused on the conservation of sea turtles and their habitat. Each month we aim to focus activities on a central theme; each theme is one of the main threats to sea turtles and how we can work together to mitigate that threat. With these themed activities we strive to engage different cohorts within the local population. We have hosted events including family hikes, a Kid's Club, beach clean-ups, and lectures. By capitalizing on the desire of local people to get involved in conservation we believe this program is beneficial, as it will provide eager residents with the information, opportunities, and strategies to connect with and conserve sea turtles. We wish to thank the generous contribution of The International Sea Turtle

Symposium, The International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America for funding the travel grant that made possible the participation in this year's symposium. We also wish to thank the Earthwatch Neville Shulman Grant for providing funding to facilitate our participation in this symposium.

CONNECTING JAQUÉ, PANAMÁ TO THE WORLD OF CONSERVATION

Mary Duncan[1], Ana Maria V. Leon[1], Richard Boren[2], Iver Valencia[1], and Jose A. Cordoba[1]

[1] Grupo Protector de la Tortuga Marina de Jaque, Darien, Panama
[2] Grupo Protector de la Tortuga Marina de Jaque, Tucson, AZ, USA

Ana Maria Vasquez Leon, Artist and Educator, left Colombia in 1998 due to the violence in the region. When she arrived in Jaque, Panama, she realized that sea turtle nests were being poached. She created a hatchery in Jaque which was modelled after a hatchery in Choco, Colombia that she had previously visited. The hatchery only had room for 20 nests, but at least some nests would not be poached. Soon Iver Valencia and other villagers joined this effort and were able to enlarge the hatchery after receiving funding through the Colegio de la Tierra, private donors and the sale of local sea turtle crafts. This group became the Grupo Protector de la Tortuga Marina de Jaque, coordinated by Iver Valencia. Soon the group was educating and involving students who helped collect nests and release hatchlings, recruit local volunteers and create an Annual Sea Turtle Festival. Biologists also visited the project throughout the season. Almost all nesting turtles here are solitary *Lepidochelys olivacea* nesters, however, we do see an occasional *Chelonia mydas* and in 2000, a *Dermochelys coriacea*. There have been a few stranded turtles that the group has helped, including a few *Eretmochelys imbricata* which do not nest in Jaque. This group has seen great improvements this year! By the end of this season there were 179 nests in the hatchery. These nests were collected by our volunteers and locals that receive $0.07 per egg to encourage conservation rather than consumption or sale of the turtle eggs. This is a very remote village in the Darien Gap and the locals eat all animals that they can find, so it is really exciting that we are now getting the community to connect with the turtles and conservation. This is not a tourist area so conservation has to be encouraged for conservation itself. Less than 50 nests were poached this year. Even the police are involved as they made their own turtle conservation banner and t-shirts for volunteers that say Grupo Protector de la Tortuga Marina de Jaqué. A group of community artists created a sea turtle mural in the airport and there are sea turtle posters all around town. This year we also had a biologist, Mary Duncan, who worked on the project to standardize and enforce procedures on the beach and in the hatchery, make the hatchery more efficient, create better data collection methods and to spread information and excitement for conservation. There are very few resources in Jaqué (2000 dollars per season or less) and we are trying to continue our conservation efforts and would love to have better connections with all of you! Acknowledgements: Thank you to the International Sea Turtle Symposium, International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America for all your help in getting our group to the Symposium!

TOUR DE TURTLES – USING RESEARCH TO INCREASE AWARENESS ABOUT SEA TURTLES ONLINE

Daniel R. Evans, Rocio Johnson, and David Godfrey

Sea Turtle Conservancy, Gainesville, Florida, USA

The Tour de Turtles Migration Marathon is a popular educational program that is increasing public awareness and support for the conservation of sea turtles and their habitats. Started in 2008, Tour de Turtles is a fun, educational journey through the science, research and geography of sea turtle migration using satellite telemetry. Created by the Sea Turtle Conservancy, this 3-month-long online program follows the migration of sea turtles from their nesting beaches to unknown foraging grounds. Tour de Turtles utilizes satellite telemetry data from migration studies in Florida, conducted in partnership with the University of Central Florida, and from STC's research programs in Central America and the Caribbean. After departing from some of the most important nesting sites in the Western Hemisphere, individual sea turtles are tracked and their locations and distances traveled are uploaded to interactive maps on the Tour de Turtles website, www.tourdeturtles.org. The turtles are competing with the goal of being the first to swim the furthest distance during the marathon. Tour de Turtles also includes a secondary competition, the Causes Challenge, to raise awareness about threats to sea turtle survival. Audiences, particularly educators and students, are invited to learn more about each turtle competitor and their Cause with the goal of promoting positive actions on behalf of sea turtles. Each year Tour de Turtles generates considerable public interest in sea turtles and, during just a three month period, inspires more than 30,000 visitors to log onto the Tour de Turtles website. In addition to reaching the general public and media outlets, the program provides educational resources to teachers across the United States, with hundreds of new educators signing up each year. Tour de Turtles includes a full suite of activities focusing on the biology and habitats of sea turtles. Teachers have free access to educational materials, quizzes and lesson plans that easily incorporate environmental education into classroom activities and lessons. The ultimate goal of Tour de Turtles is to raise awareness about the different species of sea turtles and the various threats to their survival. With an estimated one out of 1,000 hatchlings reaching adulthood, conservation must focus on combating human-caused threats. Using information gained through Tour de Turtles, the public will be better equipped to take action and reduce threats to the sea turtles.

COMMUNITY AWARENESS & CAPACITY BUILDING IN SEA TURTLE CONSERVATION IN SRI LANKA

Thushan Kapurusinghe

Turtle Conservation Project, Madakumbura, Panadura, Sri Lanka

Five species of sea turtles nest in Sri Lanka. They include the green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*) and the hawksbill turtle (*Eretmochelys imbricata*). Coastal communities of Sri Lanka depend on surrounding natural resources for their survival. In addition, development activities are taking place in many coastal areas of the island. As a result, very important coastal habitats and coastal fauna such as the coral reefs, sea grass beds, mangroves, marine turtles and other coastal vegetation are under serious threat of extinction. Creating awareness could play a vital role in conservation and management of sea turtles. The Turtle Conservation Project's (TCP) community awareness and capacity development programmes included conducting training workshop, field training, vocational training, school lectures, exhibitions, film

shows etc. TCP's community capacity development programme has turned the turtle egg poachers into nest protectors. Thirty-two former egg poachers have been employed as nest protectors in Kosgoda and Rekawa villages. With the assistance of Sri Lanka Tourist Board (SLTB) TCP trained local villagers and licensed them as eco tour guides. In addition, TCP has formed small community groups or Community Based Organizations (CBOs) such as the Community Batik Group, Community Sewing Group, Community Ornamental Fish Breeding Group, Community Coir Group and Turtle Nest Protector Groups in Kosgoda and Rekawa villages in order to implement various community livelihood development projects. By developing the capacities of CBOs it facilitated the TCP to implement various community projects. Through the education and awareness projects in these villages, TCP was able to change some of the negative attitudes of the local fishermen on marine and coastal resources that led them to over exploit the resources. In addition, TCP has also implemented community skills development programs such as primary school programs, computer classes, free English language classes, sewing training and disaster preparedness training etc. Children's clubs were established in order to involve children in the coastal eco-system conservation and management process, providing them with necessary awareness through various educational programs. The target groups of TCP's awareness and capacity development programs included local fishermen, school children, general public, wildlife officers, NAVY and Police officers, tour operators and academics etc.

THE SUCCESSFUL STORY OF LOS CALIFORNIOS VERDES

Luciana Klinge[1] and Cristian Jimenez[2]

[1] Ecology Project International
[2] Club de Ecología Los Californios Verdes, Mexico

"Los Californios Verdes" is a youth Ecology Club initiated by students from different high schools in La Paz, Mexico and Ecology Project International (EPI). Their general goal is to be agents of positive change and to generate opportunities to have contact with projects pro nature within the community of La Paz, Baja California Sur, Mexico. The passion for nature conservation of five young paseños was the seed of this now 30 member Ecology Club with more than 490 volunteers in La Paz in just 8 months. Los Californios Verdes co-lead two projects under the mentorship of an EPI staff person. The first project is a sea turtle conservation project, in collaboration with ASUPMATOMA and ProFaunaBaja. This project is their most popular. They study olive ridley sea turtles during a two-night beach patrol program that includes nest patrols, egg relocation and hatchery studies. The second project is the beach water quality monitoring project in collaboration with The La Paz Waterkeepers organization. Also, in September of 2012 they launched their Beach Cleaning project "Limpia Baja California Sur!" which is the first project they fundraised for and have organized by themselves. With this project they won the Amigos por el Mundo fellowship from Disney, which is a huge step for the young community of La Paz. This presentation is intended to show the history of the journey of los Californios Verdes, their challenges and accomplishments, and how a small group of young students with a big passion and enthusiasm has stolen the hearts of the people of Baja California Sur and how this is helping sow seeds of environmental stewardship in the minds of kids, teenagers and adults.

SEA TURTLES AND TRASH: AN UNFORTUNATE BUT PREVENTABLE RELATIONSHIP

Nicholas J. Mallos and Allison Schutes

Ocean Conservancy, Washington, DC, USA

Marine debris is a ubiquitous threat to marine organisms and ocean ecosystems, and has been documented to affect more than 267 marine species. However, plastic debris is consistently noted as the entangling or ingested debris. Sea turtles demonstrate an affinity for plastic debris in the marine environment, likely confusing it for natural prey items. Debris is also an impediment for sea turtles on beaches, where hatchlings can become severely entangled in fishing gear or entrapped in food containers. With all 7 species of sea turtles listed on the International Union for Conservation of Nature (IUCN), minimizing the threat of marine debris to sea turtle survival is imperative. This threat is not new however, and Ocean Conservancy has been engaged in the issue for more than a quarter century through the International Coastal Cleanup. Since 1986, citizen scientists around the world have come out on a single day to rid beaches, waterways, and the ocean of trash. Over the past 26 years, more than nine million (9,361,453) volunteers have removed almost 154 million (153,790,918) pounds of debris from 312,000 miles of coastline in 153 countries and locations. Volunteers record items of debris they collect on a standardized data form and document entangled animals such as sea turtles—more than 4,400 entangled animals have been encountered. These debris data have been cited in seminal publications and have lead to increased awareness by stakeholders including product manufacturers, consumers and government officials. Data were also critical in informing marine debris legislation. The simplicity of marine debris monitoring protocols lends them well to be incorporated into the thousands of existing volunteer conservation projects carried out on beaches around the world. Of these projects, volunteer sea turtle monitoring programs are some of the most extensive globally, and are conducive for simultaneous marine debris monitoring. Sea turtle volunteers perform an array of data collection services that directly aid sea turtle conservation, including beach patrols to check for signs of nesting activity, marking new nests, and calculating hatch success rate. Volunteers who engage in these activities typically monitor the same strand of beach or coastline for three to four months, from first crawl to final hatch. Incorporating cleanup and data collection protocols into these transects will generate a robust data set that can be used to evaluate potential interactions between nesting mothers and sea turtle hatchlings and marine debris. Furthermore, these data will enrich the existing open-access data set of the International Coastal Cleanup, expanding our understanding of debris proliferation worldwide. Sea turtle volunteers are highly motivated and committed and believe strongly in the conservation work they perform; and many volunteers already remove trash while monitoring beaches for sea turtle activity. In a climate where resources for marine conservation are limited, integrating standardized debris monitoring protocols into volunteer sea turtle programs seems a logical and necessary action for sea turtle conservation and overall ocean health.

UTILIZING NATIONAL SERVICE PROGRAMS IN CONSERVATION

Jeannie M. Martin

Georgia Sea Turtle Center, Jekyll Island, Georgia, USA

Looking for a unique way to engage students and community members in conservation? Need additional support for conservation programs but have limited funding? Combining National Service with Conservation may be the answer. The Georgia Sea Turtle Center (GSTC) is a hospital for ill and injured sea turtles located on Jekyll Island, Georgia. The center is open to the general public with an interactive Exhibit

Gallery and Rehabilitation Pavilion with viewable turtle patients. The center also focuses on environmental education and research in the fields of ecology and wildlife health. The AmeriCorps GSTC program is a nationally recognized national service program currently in its fourth year. During the first year of Service, it was recognized as one of the 52 Most Innovative AmeriCorps programs in the country and has continued to gain recognition since. During the first three years, the AmeriCorps GSTC program has trained 46 young professionals with 11 current participants and 6 additional members starting in the spring for the 2013 turtle nesting season. These members have donated more than 93,000 hours to sea turtle conservation efforts. This poster highlights the collaboration between the GSTC and the AmeriCorps program, and includes the AmeriCorps history, how the program began at the GSTC, and how this innovative collaboration promotes national service, member development, and conservation initiatives. Techniques for program development and how to apply for funding are also covered.

CROSSING SPACE AND TIME WITH SEA TURTLES: AN EDUCATIONAL PRODUCT TO RAISE AWARENESS FOR THE CONSERVATION OF SEA TURTLES AND ECOSYSTEM BASED-MANAGEMENT

Gustavo Martinez-Souza

Karumbé, Montevideo, Uruguay, Projeto Caminho Marinho and Oceanografia Biológica, Universidade Federal do Rio Grande, Rio Grande, RS, Brasil

“Crossing Space and Time with Sea Turtles” is an educational project based on the concept of emotional diversity, designed in the form of a board game. Up to four teams (4-30 children) can explore the ocean while learning about the historic and current states of sea turtles. All aspects are incorporated into a fun and exciting educational activity, including the turtle's environment, connections to local ecology, economics and culture. Teams choose game pieces from two category options: (1) sea turtle species (green, loggerhead, hawksbill, leatherback or olive ridley turtles), or (2) great travelers (Cabeza de Vaca, Sacawgawea, Charles Darwin or Jacques Cousteau). Cabeza de Vaca was selected to represent a traveller game piece because he was the first governor of River Plate Province after living in North America as an exile from Europe; Sacawgawea travelled across America to the Pacific Ocean; Charles Darwin travelled across the oceans, assessing biodiversity and exploring the connectedness of organisms, and Jacques Cousteau was vital to oceanic exploration and the documentation of marine life, as the inventor of the SCUBA aqualung. All historical figures chosen as game pieces represent a major societal connection to their work with nature. At each space in the game, the player or team can choose 3 cards, referring to 3 light wavelengths (ultraviolet, infrared, and visible light), each with a unique movement dynamic for the game pieces. In ultraviolet light, different real life situations are presented (narrative style) in which players either advance or retreat based on the information given, referring to more than 30 different papers. In infrared light, the players answer questions about geography, history, general biology, sea turtle biology, or environmental education (citizenship ecology, methods of improving sustainability and minimizing carbon footprints). Based on the accuracy of their response, players either advance or retreat. In the case of the pilot, questions reference concepts referred to during previous festivals (and the continued environmental education program of Karumbé in La Coronilla, Uruguay) as a method to assess the amount of information successfully assimilated by children. In visible light, movement forward or backward is determined by the outcome of the players participation in short games, incorporating different learning styles and methods. The different dynamics applied in the visible light dimension were discussed and tested in the last four sea turtle festivals. The distinctive characteristic of this game is that the applied concept of travel across oceans is rooted in the historic and contemporary information, consolidated from more than 30 publications. It also enhances participants’ awareness of being Citizens of the Oceans, while creating a focused, local and potentially low-cost global educational product.

NEW STRATEGIES OF ENVIRONMENTAL EDUCATION AND AWARENESS FOR A GOOD CONSERVATION OF THE SEA TURTLES ALONG THE COASTLINE OF MUADA, DEMOCRATIC REPUBLIC OF CONGO

Samuel Mbungu

ACODES, Muanda, Democratic Republic of Congo

Sea turtle conservation along the Muanda coastline began during the nesting season of 2006-2007. To date, several objectives have been initiated, including identifying nesting sites and seasonality, training guards to assure surveillance of the nesting beaches, conducting night patrols and track surveys, identifying and keeping under surveillance the artisanal fishing ports, and raising awareness in coastal communities through meetings and other media events. During the 2011-2012 nesting season, we adopted a new methodological approach. Environmental education activities preceded night patrols and port and market surveys. We have integrated the authorities along the coastline of Muanda in order to increase their level of implication in sea turtles conservation efforts. An ambitious awareness and education campaign was led along with the monitoring. We reached a large number of local people, belonging to very diverse groups: 120 community leaders, 6,405 students, 116 teachers from 10 schools located along the coast of Muanda and 124 militaries and policemen from the Banana naval base and the Company of NSIAMFUMU. We also have distributed 500 leaflets and 60 posters to raise local awareness, and local radio and television stations generously offered us one TV and two radio broadcastings per month. Sensitizing is an essential component of the efforts required to ensure the effectiveness of sea turtle conservation in Muanda. Our financial resources did not allow us to do more, but we were very motivated by the desire to communicate and educate the local communities on the sea turtle threats and the importance of protection.

SEA TURTLE FORENSIC FIELD INVESTIGATION WORKSHOP

Nancy Mettee[1], David Gulko[2], Patrica Rameriz[3], Angelique Brantwaith[3], and Karen Eckert[1]

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Regardless of region, most coastal sea turtle habitats around the world are under various levels of impact from illegal fishing, vessel groundings, destructive fishing, physical damage, coastal pollution and runoff, overfishing, illegal international trade, overlapping (and often conflicting) use by various user groups, bleaching, chemical effects and endocrine disruption, alien species-associated phase shifts, and nutrient-associated phase shifts. Few areas have trained field investigators and well-developed natural resource programs to properly assess and handle the wide variety of anthropogenic events occurring; in most cases, such short term human impact events often overwhelm the capabilities of resource managers to maximize prosecution, mitigation, negotiation, mediation, or litigation success. This takes on even greater significance relative to the illegal take of sea turtles and illegal trafficking in sea turtle products. While investigation systems and resource management strategies vary from country to country and island to island, successful field forensic strategies related to sea turtle anthropogenic events are relatively limited and, until now, unstandardized at the most basic levels. Recently, groups of recognized experts within the United States (The Coral Disease and Health Consortium's Forensics Workshop Committee) and the international community (the International Coral Reef Initiative (ICRI) Committee on Coral Reef Enforcement and Natural Resource Investigation) have proposed initiating projects to create such standards for coral reef

investigations. The Coral Reef CSI Field Training Program has in turn adapted these standards towards investigations of sea turtle take and habitat damage. This project makes use of investigative and rapid ecological assessment techniques, marine evidence collection methods and handling, in-water enforcement techniques, and education of both the public and decision-makers, and will enhance both resource protection and management capabilities. Examples of this approach for coral reefs are available from the successful pilot Coral Reef CSI workshop held in Cozumel in late 2006 and the fourteen previously funded workshops held in the Dominican Republic, Jamaica, Malaysia, Indonesia, Trinidad & Tobago, Belize, South Africa, Barbados, the Maldives, French Polynesia, Guam, Honduras, Thailand (Field Marine Enforcement Investigation), Guadaloupe (Field Contaminant Assays) and the recent pilot workshop on Sea Turtle Field Forenics held in Merida, Mexico. To date, the Coral Reef CSI Field Training Program remains the only internationally recognized course which trains natural resource managers and marine enforcement officers in standardized techniques and protocols to investigate and collect underwater evidence associated with human-induced injuries and crimes to protected marine natural resources. The pilot workshop on Sea Turtle Field Forensics was a successful 60 hour course taught in 2012. This program is available for use in other countries with budget and specifics of deliverables available upon request.

INCREASING CAPACITY FOR SEA TURTLE RESEARCH AND MANAGEMENT IN THE IOSEA REGION

Andrea D. Phillott and Ruvani N. Nagoda-Gamage

Asian University for Women, Chittagong, Bangladesh

Access to scientific literature is often a challenge for researchers in developing countries due to the high cost of Western scientific journals, low bandwidth connections, and frequent publication solely in English. To identify ways of overcoming these limitations, we conducted an on-line survey for readers of the Indian Ocean Turtle Newsletter in the IOSEA region. Responses indicated that access to literature problems were improved by the Sea Turtles of India and IOSEA Marine Turtle on-line bibliographies and libraries. However, the majority of free, on-line scientific papers are written in English, which can potentially restrict knowledge and understanding about standard research methods, and global research and conservation priorities. Our survey results indicated that translation of papers from English to first languages would be the second-best strategy to improve access to relevant scientific literature. To increase the regional awareness and understanding of important publications on sea turtle biology and conservation in the IOSEA region, we translated publications addressing global priorities, topics of regional interest and standard research methods into Bangla, Burmese, Cambodian, Hindi, Malayalam, Sinhala, Tamil, Urdu and Vietnamese. Papers were printed in each language, and hard copies and pdf's can be obtained from the senior author.

ENDANGERED PACIFIC LEATHERBACKS DOCUMENTED THROUGH COLLABORATIVE CITIZEN SCIENCE – THE LEATHERBACK WATCH PROGRAM

Christopher A. Pincetich and Kari K. Gehrke

Sea Turtle Restoration Project, Forest Knolls, California, USA

Endangered Pacific leatherback sea turtles (*Dermochelys coriacea*) migrate across the Pacific to forage on abundant jellyfish in and around 41,914 square miles of federally protected critical habitat offshore of

California, Oregon and Washington (USA). The Leatherback Watch Program is a collaborative citizen science project sponsored by the Sea Turtle Restoration Project that works to record and communicate sightings of leatherback sea turtles off the west coast of North America. The information obtained is then used for education, research, and conservation purposes. The objective is to build a database of opportunistic sighting with date, time, name of observer, exact GPS coordinates, a photograph or video as evidence of the sighting, weather and behavior details from each sighting included. The Leatherback Watch Program was organized and launched during the summer of 2010 and recorded one sighting in the Monterey Bay National Marine Sanctuary from a marine biologist, who also shared a spectacular collection of photographs from the sighting. During 2011 the program compiled 23 sightings from California to British Columbia, Canada through outreach to approximately 150 program participants that receive our monthly emails, phone calls and connect through the program Facebook page. The first sighting in 2011 was recorded June 29 offshore of Point Sur; sightings peaked offshore of Moss Landing in August, and the frequency of opportunistic sightings increased with increased program participants. A grading system was established to rank sightings; “A” grade contained photos, GPS coordinates, date, time, and came from an experienced observer while “D” grade was an observation reported without photos or GPS coordinates by an inexperienced observer. The first reported sighting of a leatherback in 2012 occurred offshore of Central California June 7, but due to a lack of photos, GPS coordinates, and the report coming from recreational sailors and not experienced marine naturalists, it was given a low grade. From July 9 to Jul 28, 2012 a total of 17 sightings were reported by experienced observers and accompanied by photographs and GPS coordinates. The current total of opportunistic sightings in 2012 is at 26 as of October 1. The Leatherback Watch Program contact list has served as a useful outreach tool for on-water researchers and for advocacy to gain support from businesses for AB 1776, the bill sponsored by the Sea Turtle Restoration Project bill that successfully established the Pacific Leatherback sea turtle as the official marine reptile of California and October 15 as Pacific Leatherback Conservation Day. The 2011-2012 observations represent a significant contribution to the limited information currently available describing the habitat use and behavior of the critically endangered Western Pacific population of leatherbacks. Sea Turtle Restoration Project's outreach and education programs have found many Californians are not aware that leatherbacks exist in the state’s coastal waters and rely on critical feeding habitat offshore of the state. The photos and videos obtained from leatherback sightings are invaluable components of the growing public awareness of this amazing sea turtle.

MARINE DEBRIS ACTION TEAMS WORKING TO CREATE PLASTIC-FREE SEA TURTLE HABITAT

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Marine Debris Action Teams are volunteer groups that conduct scientific assessments of marine debris density on shorelines, remove the debris, and spread awareness of the harmful impacts of plastic pollution to sea turtles. Endangered sea turtles are jeopardized by marine debris in both marine and beach habitats when they become entangled or ingest it. During the past three years of work building collaborative partnerships with volunteers, scientists, and students, the Marine Debris Action Team's work has increased its focus on developing a model project that can be implemented at sea turtle nesting beach conservation projects around the world. The current Marine Debris Action Team's effort working to create plastic-free sea turtle habitat in Costa Rica builds on a successful pilot project partnering with the local conservation group PRETOMA and the Science Exchange Sea Turtle Internship Program based in San Diego, CA, USA. Student interns work on nesting beach patrols during the evenings and early mornings as a top priority, then spend the remainder of the working day collecting debris density data, performing beach cleanups, and working to engage the local community and online followers in the importance of this work to sea turtle and ocean health. One intern performed over 240 debris density surveys in three months at Playa Caletas, Costa Rica, cataloged over 6,000 debris items, found a significant pattern of high debris density in nesting and hatchling emergence habitat, and published the results in Marine Turtle Newsletter. During the summer of 2012, interns collected debris density data at beaches on both Pacific and Caribbean coast nesting beaches in Costa Rica and found a significantly greater density of debris along the Caribbean. Collaborative efforts with Sea Turtles Forever at nesting beaches near Lagartillo Reef, Guanacaste, Costa Rica resulted in the recording and removal of over 14,000 debris items in 2010-2011 and increased to over 17,000 debris items during 2012. Marine Debris Action Teams efforts on beaches inshore from Pacific leatherback sea turtle critical habitat in Oregon and Washington have resulted in partnerships between federal, state, and local organizations. Macro and micro-debris density surveys performed in Oregon by Sea Turtles Forever use college student volunteers and receive support from local city government officials. Debris density assessments led by Sea Turtle Restoration Project in California have cataloged and removed over 10,000 debris items from 10 sites monitored over 20 months. Marine Debris Action Teams in California have led scientific trainings for members of the Surfrider Foundation, 5 Gyres, YMCA and collaborate with NOAA teams preparing for debris from the 2011 Japan tsunami. Plans in 2013 include the release of a Project Manual to transform any sea turtle field station into an action and awareness center for community education and action to create plastic-free sea turtle habitat, establishing permanent signage to educate the public of the harmful effects of plastic pollution to sea turtles at PRETOMA field stations, and increasing project partners around the world.

OUTREACH AND EDUCATION PROGRAM TO LOCAL COMMUNITIES: AN ESSENTIAL TOOL FOR SEA TURTLE CONSERVATION

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Empirical knowledge in local communities that interact with sea turtles is a fundamental element in their customs, and also represents a valuable resource for research and studies conducted by the Sea Turtle Workgroup of the Gulf of Venezuela (GTTM–GV). This cultural information, linked with scientific data obtained throughout 15 years of sea turtle conservation, has allowed us to better understand the current status of sea turtles that feed in the Gulf of Venezuela (GV). This information stimulates our passion for conservation, opening our senses to the mosaic of life-threatening impacts to these animals in our country (i.e. by-catch, illegal trade of products and by-products, ship collisions, plastic and water contaminants and ghost nets, among others). Thus, the GTTM-GV under its conservation objectives (research, education and extension) will study and mitigate these impacts and create awareness among urban and rural communities inhabiting GV coasts. We conducted educational and training activities through an outreach program in three different target communities: (1) Indigenous inhabitants and fishermen, (2) university students and faculty, and (3) urban citizens, granting social and ecological awareness and promoting a possible change in their current lifestyles which might decrease negative consequences to sea turtle populations in the region. The tools used for each target community were determined by evaluating surveys, tests, graphic design strategies, and the degree of literacy in each locality. Coastal communities (rural) in the GV are comprised mostly of illiterate indigenous people, primarily artisanal fishermen. Therefore, informal workshops in these communities during a sea turtle's rescue and/or release, and semi-structured interviews supported by images and other graphic materials, have resulted in the integration and empowerment of at least one community leader from each locality to sea turtle conservation activities executed by the NGO. Within the university community, photography exhibitions, forums and documentary films faciltated the

integration of young researchers with the NGO, presenting conservation and research opportunities with these reptiles or their habitats. Finally, at the third community level (urban), we implemented a series of structured talks and school tours for small groups to observe sea turtles in rehabilitation centers, and we displayed thematic bazaars and itinerant photographic exhibitions at several cultural facilities such as hotels, shopping centers and museums, among others, to educate larger groups. Our outreach efforts are fundamental to the development and implementation of the sea turtle conservation program. Each year a greater number of fishermen and Indigenous people are trained and committed to sea turtle conservation. New research opportunities along with financial support are growing. This helps us work towards one simple goal: to make a difference in the world and connect all of those involved: fishing communities, researchers, students and the general public.

THE GEORGIA SEA TURTLE CENTER MARINE DEBRIS CITIZEN SCIENCE AND EDUCATION PROGRAM

Caitlin Sampson and Jeannie M. Martin

Georgia Sea Turtle Center, Jekyll Island, Georgia, USA

The Georgia Sea Turtle Center (GSTC), located on Jekyll Island, Georgia, rehabilitates ill and injured sea turtles along with other native wildlife. The Center is open to the general public with an interactive Exhibit Gallery and Rehabilitation Pavilion with viewable turtle patients. The Center also focuses on environmental education and research in the fields of ecology and wildlife health. The GSTC has developed a grant funded program to address the issue of Marine Debris on Jekyll Island and the Georgia Coast in collaboration with the Southeast Atlantic Marine Debris Initiative (SEA-MDI). The GSTC’s Marine Debris Initiative consists of citizen science and educational components. The Garbage in the Water program is presented to 3rd grade classrooms in Glynn County, GA, in the hopes of educating the next generation about the fight against marine debris while encouraging them to make decisions that benefit our environment. The second component of the grant involved the creation of a citizen science program using the National Oceanic and Atmospheric Administration(NOAA)/SEA-MDI Marine Debris Tracker App. A Marine Debris Docent volunteer position was created to give active and episodic volunteers at the GSTC an app-based citizen science opportunity. Using the NOAA/SEA-MDI Marine Debris Tracker App, the GSTC volunteers perform beach cleanups and plot the locations and types of marine debris found in and around the coast. In addition to the benefit of having less marine debris, involving community members allows them to take greater pride in their coastal environment, gain experience with science and technology and show the importance of keeping our beaches clean. Previously there were no formal opportunities for one-time or short term volunteers at the GSTC, thus the Marine Debris Docent position is allowing more people to become involved in our Center and to work with us towards our goals of research, rehabilitation and education. To date, we have discovered that debris is concentrated in multiple kilometers of our beach and is comprised of over 80% plastic. Each of the remaining categories (cloth, fishing gear, glass, lumber, metal, rubber and other) individually constitutes 3% or less of our total plotted marine debris. The plastic category can be further broken down to reveal that 48% of the total plastics is cigarettes while 25% is plastic fragments. This data is being used to develop varied beach clean-up focus areas, to improve the Garbage in the Water educational program, and the interpretation of the marine debris exhibits within our Educational Gallery.

EIGHT YEARS OF OUTREACH IN COASTAL GABON: FEELING THE SEA TURTLE LOVE

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Gabon hosts the largest leatherback population in the world, and the highest nesting density in Africa of this critically endangered species. However, Gabon's leatherbacks and other sea turtle species (green, hawksbill and olive ridley turtles) face threats, including commercial fisheries, poaching of adults and eggs, and habitat disturbance and degradation (i.e. pollution, development, erosion, lighting, debris and logs on the beaches). The Gabon Sea Turtle Partnership has been conducting community outreach and education in Gabon since 2005. We have organized a national campaign to raise awareness of sea turtle conservation, focusing on our coastal field sites and on Libreville, Gabon's capital. We will present an overview of the last eight years of our efforts as an example of a successful and dynamic outreach program in Coastal Equatorial Africa, with the hope that it will inspire similar efforts worldwide. Our goal is to raise awareness among people of all demographics, including those that live near the national parks and those that live in cities, where one doesn't have many opportunities to discover the rich biodiversity of Gabon. If the conservation of sea turtles is to succeed in Gabon, it is essential for the Gabonese people to have a sense of stewardship toward their natural heritage and of responsibility toward its preservation for future generations. Each year, we run a large number of seminars, presentations, and informal discussions with members of coastal communities and school children. We produce and distribute educational materials. We have been working extensively with children using role-playing techniques, enacting scenes and threats from the life history of sea turtles in the schools and villages near sea turtle habitats. We also hold costume-making workshops to teach local educators how to create durable, low-cost costumes for use in dramatic role-play. Our activities and initiatives have frequently been presented in the national media through interviews, documentaries, TV programs and newspaper articles. Sea turtle publicity videos are frequently shown on giant flat-panel screens overlooking Libreville's busiest road, and a series of turtle murals publicize conservation in the smaller towns. We have also produced a website and number of Partnership films in order to broadcast our activities as widely as possible. The Partnership's flagship outreach event is Turtle Day, which is celebrated each year at the end of the nesting season in April and May. From its humble roots at a single elementary school in Mayumba, a small town in southern Gabon, Turtle Day has grown into a national event with over 2,000 participants at ten coastal sites, with large Gabonese corporations seeking to sponsor our festivals. The fact that sponsorships such as these are being offered attests to the success of our efforts. Even more encouraging is that after eight years, former elementary school students who participated in the first Turtle Day are volunteering at the events, and are seeking jobs in conservation and ecotourism as they begin to enter the workforce.

CITSCI.ORG: CYBERINFRASTRUCTURE SUPPORT FOR GRASSROOTS CONSERVATION, CITIZEN SCIENCE, AND COMMUNITY-BASED TERRESTRIAL, FRESHWATER, AND MARINE TURTLE MONITORING

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Citizen science and community-based turtle monitoring conservation programs are increasing in number and breadth, generating volumes of scientific data. Many programs are ill-equipped to effectively manage these data. We built a free, open-source, cyberinfrastructure support system for citizen science programs (www.citsci.org) to support the full spectrum of program management and data management needs. The system affords program coordinators the opportunity to create their own projects, manage project members, build their own data entry sheets, streamline data entry, visualize data on maps, automate custom analyses, and receive feedback. The majority of programs are grassroots efforts with conservation biology-oriented goals and objectives. Thus far, CitSci.org has engaged 34 programs resulting in some 7,000+ natural resource observations, and is perfectly suited to accommodate Testudine species project data. Here, we discuss the unique opportunities afforded by CitSci.org to support the needs of community-based terrestrial, freshwater, and marine turtle monitoring.

THE BELIZE TURTLE WATCH PROGRAM – IS CLIMATE CHANGE IMPACTING OUR SEA TURTLES?

Linda Searle and Melanie Day

ECOMAR, Belize City, Belize

The Belize Turtle Watch Program was launched in 2011 to determine if climate change is impacting sea turtles. In order to measure these impacts, the Annual Sea Turtle Census was launched which aimed to collect baseline data on the number of sea turtles nesting on our beaches, foraging in our waters, and the number of sea turtles that are stranded along our coast. At the end of each year data and reports are summarized so that changes, and impacts, over time can be measured. Diverse stakeholder groups living along the coast including biologists working with marine protected area managers, coastal property owners, marine guides, and the general public are invited to participate in the Belize Turtle Watch Program. Biologists participated in a 3 day training workshop and took part in the first Annual In-water Sea Turtle Survey. Biologists also learned new protocol prepared by SandWatch which measures changes in the beach profile within their MPAs that can be useful to monitor impacts of climate change. Other stakeholder groups were reached through the production and distribution of educational materials including a mini-documentary informing volunteers about the program, posters, stickers, calendars, and radio announcements. Questionnaires were also used to measure stakeholder participation. Other programs launched in conjunction with the Belize Turtle Watch Program include the Adopt A Beach and Adopt A Reef programs which encouraged stakeholders to become actively involved in monitoring for sea turtle activity. Results from the first Annual Sea Turtle Census indicate that hawksbill sea turtles are the most abundant in Belize. New reports on sea turtle nesting locations were received and an increase in the reporting of stranded sea turtles was also recorded. Preliminary results indicate that in some locations sea turtles in Belize are already impacted by climate change. Acknowledgments: There are numerous persons and organizations that must be acknowledged including partners of the Belize Turtle Watch Program: the

Belize Fisheries Department, World Wildlife Fund, Protected Areas Conservation Trust, Gulf & Caribbean Fisheries Institute, Caribbean Protected Areas Managers, United Nations Environment Program, Caribbean Environment Program, the Wider Caribbean Sea Turtle Conservation Network, and other members of the Belize Sea Turtle Conservation Network including the Belize Audubon Society, Oceanic Society, Southern Environmental Association, Toledo Institute for Development and the Environment, University of Belize Environmental Research Institute and Wildlife Conservation Society. The primary author is grateful for the travel grant awarded through generous donations by the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America. Special recognition of the stakeholders in Belize that monitor sea turtle activity must also be made and includes the biologists that spend hours in the field and share the results of their surveys; the coastal residents for volunteering with the Belize Turtle Watch Program by monitoring their beaches and coastal waters for sea turtles; and the general public for their interest in learning more about the great ocean migrators, the extraordinarily humble sea turtle.

COMMUNITY PARTICIPATION AND SEA TURTLE CONSERVATION ACTIVITIES IN COASTAL GUJARAT, INDIA

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Gujarat is one of the fastest developing states in India, comprising 6% of the total geographic area and 5% of the country's population. Gujarat has the longest shoreline of any Indian state (1,600 km), and therefore the highest interface with the marine environment. Olive ridley, green and leatherback sea turtles are found in Gujarat amongst various other marine fauna, and green and olive ridley sea turtles also nest on sandy beaches along the coast. Due to rapid industrialization, many natural sea turtle habitats are vanishing and require special attention for their conservation. There has been an effort by NGOs and local activists to conserve sea turtles, which has had positive results in Gujarat. Here we highlight how the IEC (Information, Education and Communication) activities have impacted the conservation efforts by local communities. The primary methods of the IEC include: (1) AV (Audio-video) communications, (2) publications and (3) mass addresses to women and children. There are more than 10 voluntary organizations involved in IEC activities for the conservation of sea turtles and other marine fauna. Additional coordinated efforts are required by the conservation practitioners and communities to improve the preservation of natural habitats and sea turtles in Gujarat. Acknowledgements: We acknowledge the support of International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service (NOAA), Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics, CLS America and our parent organisation Prakruti Nature Club (INDIA).

RAISING SEA TURTLE AND DUGONG CONSERVATION AWARENESS IN WESTERN PROVINCES, PAPUA NEW GUINEA

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Sea turtles and dugongs worldwide are close to extinction due to an array of human impacts such as over-fishing, coastal development, marine debris and unsustainable hunting. People living in thirteen Western Province communities of Papua New Guinea have recognised that current take levels are unsustainable. Sea Turtle Foundation, in partnership with several organisations (listed below) and at the request of the communities themselves, created a Sea Turtle and Dugong Awareness program that complements other work taking place in the Torres Strait, around Cape York and in other countries in the region. The first phase of the program entailed a workshop with elders of each of the participating communities; this gave everyone a chance to have a voice in the direction and scope of the program and ensured that traditional knowledge was included in the written resources and helped form the foundation of the program delivered in the communities. The final program content explored sea turtle and dugong biology, historical knowledge, environmental values, and sustainable practices. Resource packs distributed as part of the program included community participant workbooks, leader manuals, posters, stickers, hats, t-shirts, etc., as well as waterproof cards with rules that can be taken on boats. Resources were developed in consultation with community leaders including elders and teachers. The program was delivered to thirteen communities by a local, well-known conservation leader and STF staff, mainly by boat, and included twenty schools as well as general community visits. In addition, digital cameras were given to each community to record what was important in their community, with the understanding that the memory cards would be returned to STF (the cameras and new memory cards were left in the communities). The response to the awareness program has been very positive. Community members reported learning new information, particularly about sea turtle biology and life history characteristics, and are applying this new knowledge in their interactions with turtles and dugongs (i.e., taking smaller turtles rather than the largest ones). The photos returned from the villages are extremely good, and were used to create a calendar, the proceeds of which will go back into the awareness program. A gallery show of the photos is also planned, to increase awareness of the Western Provinces and the linkages between our turtle populations and the collective efforts to protect them in our region. This program is a joint effort between Sea Turtle Foundation, Marine and Tropical Sciences Research Facility, Department of Foreign Affairs and Trade, Torres Strait Regional Authority, Department of Environment and Conservation PNG, and James Cook University.

HAWKSBILL CUP: ADDING NON-ECONOMIC VALUES TO SAVE A SPECIES IN EL SALVADOR AND NICARAGUA

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Sea turtle eggs in low-income regions are often viewed by local residents as an economic resource, and conservation initiatives must offer a higher economic incentive for protection than would be received from other uses. This is particularly true for hawksbill eggs in El Salvador and Nicaragua, as conservation legislation formed by top-down, non-participatory measures has failed to protect hawksbill nests in both countries. However, the purchase of hawksbill nests for protection is financially unsustainable and does little to promote a local conservation ethic. To add non-economic value to hawksbill eggs, we initiated the Hawksbill Regional Cup in 2012, a friendly competition which emulated the Soccer World Cup such that the hawksbill nesting season represented the “final match” between the two most important nesting sites (i.e., El Salvador and Nicaragua) in the eastern Pacific Ocean. The goals were to determine which “team” could score more “hawksbill conservation goals” (e.g., most nests protected, most hatchlings released) and to examine how the Hawksbill Regional Cup has affected the values that local participants place on hawksbills and associated conservation actions at both sites. We analyzed the results of a standardized survey that was conducted with a total of 30 local participants in each country to better understand the motives that determine their level of participation in hawksbill conservation. We discuss how the Hawksbill Regional Cup has enhanced stakeholder interest and participation in nest protection activities, facilitated information-exchange and experience-sharing among egg collectors, and shifted local discourse on hawksbill conservation from purely economic terms.

Fisheries and Threats

HOW MUCH IS IT? ASSESSMENT OF SEA TURTLE SUB PRODUCTS ILLEGAL TRADE ON THE PACIFIC COAST OF NICARAGUA

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Nicaragua hosts important habitats for five sea turtle species. Two of the most important threats to these species have been poaching of eggs and hunting to extract hawksbill shells. Direct take of turtles and eggs are especially driven by financial incentives to coastal communities provided by urban populations where these products are demanded. For more than forty years Governmental and nongovernmental organizations have been developing actions to protect sea turtles. These efforts have been strengthened during the last 10 years. Today the trade of sea turtle eggs and hawksbill shell are banned and violation to this regulation face penalties of two to four years of prison. Even though the existence of these efforts and legislation, illegal trade of sea turtle sub products is widely widespread and still occurs openly in the cities of Nicaragua. The objective of this study was to quantify the volume of sea turtle sub products being sold in cities of the pacific coast of Nicaragua as well as understand the drivers for sellers and consumers. We analyze the results of 2,224 semi structured surveys performed in eight cities of the Pacific coast of Nicaragua. We conclude that major efforts must be implemented in cities in order to reduce the demand and therefore the extraction of sea turtle sub products, providing key elements to be considered on the development of a strategy to pursue this goal.

OVERCOMING THE LOGISTICAL CHALLENGES OF IMPLEMENTING OBSERVER PROGRAMS IN SMALL-SCALE FISHERIES

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Onboard observers are identified as the most accurate way to assess bycatch and mortality in fisheries operations. However, the implementation of onboard observer programs in small-scale fishing fleets, which are thought to have high levels of sea turtle bycatch, is very challenging. This is due mostly to logistical factors, such as small vessel size, which limits the space available for an extra person (the observer). We

tested the use of a SPOT Satellite GPS Messenger in parallel with an onboard observer program aboard small-scale fishing vessels. This device allows communication with up to ten previously programmed contacts. It operates using satellites and can therefore be used anywhere in the world. The SPOT has five standard functions that can be used to track the unit's position (Lat/Lon), send SOS alerts, send emergency alerts, provide regular check-ins, and, in more advanced versions, even send short text messages. SPOT trials were conducted from Salaverry port, Peru from May 2011 to August 2012. The function used was 'Check-in' which we programmed so that two email addresses received real-time position alerts. It was not necessary to change the unit's batteries during the study period. We received a total of 163 signals, corresponding to the GPS positions of 163 fishing sets conducted by the observed vessels. A comparison of positions between the SPOT messages and those noted by observers using handheld GPS units indicates that the two devices typically provided locations within 0.20 ± 0.19 km of each other, with the differences accounted for due issues such as vessel drift and timing of position. Given the SPOT's low cost ($120 US, plus a $99 annual subscription), compact size, and ability to gather and transmit real time position information, it can serve as option in facilitating the implementation of an observer program where logistical challenges preclude obtaining more detailed trip or bycatch data. As one of the SPOTs functions is as an emergency alert, it could be of added value to small-scale vessels which frequently lack safety devices such as EPIRBs.

COMPARISON OF CIRCLE HOOK AND J-HOOK PERFORMANCE IN SEA TURTLE REDUCTION RATES IN ARTISANAL LONGLINE FLEETS IN FOUR COUNTRIES OF THE EASTERN PACIFIC OCEAN

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We analyzed the performance of circle hooks in relation to J-style hooks on the hooking rates of target and non-target species in the artisanal surface longline fisheries of four of the nine participating countries in the Eastern Pacific Sea Turtle Bycatch Program, with the largest sample sizes (Peru, Ecuador, Panama and Costa Rica). These fisheries target mahi-mahi, *Coryphaena hippurus*, or a combination of tunas, billfishes and sharks (TBS), and use different techniques and gear configurations to catch their targets. Five different species of sea turtles are incidentally caught in these fisheries, olive ridley (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*). We present the results of comparisons between tuna or J-style hooks and 16/0 circle hooks in the TBS fishery from Peru, Ecuador, Panama and Costa Rica, and between tuna hooks and 18/0 circle hooks in Costa Rica. For the mahi-mahi fishery, we analyzed the performance of 14/0 and 15/0 circle hooks in Ecuadorian and Peruvian vessels and 16/0 circle hooks in Costa Rican vessels vs. the traditional J-style hooks. A total of 1,193,738 hooks were observed, in 4,535 sets. Hooking rates for target and non-target species were not consistent for all fisheries and countries analyzed. However, circle hooks reduced sea turtle hooking rates in most of the comparisons analyzed between 25% and over 75%. In some specific cases, such as mahi mahi fisheries in Ecuador and Peru, results show reduction in target catch rates with circle hooks, which could affect fishermen acceptation on potential fisheries certification. Thus, a complete evaluation of the ecological impact of the replacement of J-style or tuna hooks by circle hooks requires a holistic approach that considers the changes in selectivity for both fish and sea turtle species, and the condition of the stocks impacted (threatened and/or overfished). In any case, applying measures to improve the handling of hooked turtles with the right use of instruments and techniques in regional and national fisheries longline is essential to increase the survival of these species. Acknowledgements: the authors would like to thank onboard observers for collecting data and participating fishermen of artisanal longline fisheries in Peru, Ecuador, Panama and Costa Rica for their trust and cooperation.

ADULT GREEN TURTLES (*CHELONIA MYDAS*) IN OGASAWARA, JAPAN: A STUDY OF ANIMALS LIVING WITH INGESTED MARINE DEBRIS

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Populations of green turtles (*Chelonia mydas*) migrating in Japan's Pacific coastal region return to the Ogasawara Islands, Japan for their mating and nesting activities. The Ogasawara Islands are known as the largest breeding habitat for green turtles in Japan. Their mating season begins in early spring and nesting activity starts at the end of April and continues through September. This is also the season for sea turtle fishing. Sea turtle fishing, an important part of the food culture in Ogasawara, is a legal fishery today. This fishery coincides with a conservation project within the islands, and is highly regulated by Tokyo Metropolitan. It is imperative for all the fishermen to report their daily catch to the Fishery Union of Ogasawara upon returning to the harbor. The seasonal harvest limit is 125 individuals of SCL greater than or equal to 75 cm which considered to be an adult. All harvested individuals are sexually mature since harvesting action is only applied during their mating activity. Harvesting sea turtles is prohibited from June to July, which is the peak nesting season throughout the islands. Harvested individuals are mostly healthy, randomly selected in a biological perspective, and kept in alive in a fish farm pool until the day they are slaughtered. Sex is visually identified and staff members of Everlasting Nature of Asia (ELNA) take the measurements of body mass, SCL, and CCL immediately after landing. Along with the slaughtering process, which is run by a group of local fishermen, ELNA records all the sizes and weights of organs and collect the contents of digestive organs (including the esophagus, stomach, small and large intestines). Our sample size from 2010 is 10 individuals and 29 from 2011. For purposes of this study we discuss our findings regarding marine debris specifically plastics, Styrofoam, and pieces of derelict fishing gear in the digestive organs as well as findings of sea weed and some type of tunicate (*Pyrosoma* spp.). We present our findings on the percentages of harvested individuals containing artificial products in their digestive tract. Of the turtles sampled, 60% (n=10) and 76% (n=29) of the turtles from 2010 and 2011, respectively, contained man-made products. These results are highly valuable in terms of the data collected from live full grown adults of green turtle and significant evidence of individuals that have lived despite consuming marine debris over time. Moreover, they may provide a considerable indication to other areas where only stranded individuals are available to study marine debris effects on sea turtle and even some insights into a variety of studies of sea turtle ecology.

LEATHERBACK TURTLE MOVEMENTS AND BEHAVIOR IN THE PACIFIC OCEAN: ITS APPLICATION IN PREDICTING INTERACTIONS WITH FISHERIES

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Interactions with fisheries are believed to be a major cause of mortality for adult leatherback turtles (*Dermochelys coriacea*), which is of particular concern in the Pacific Ocean, where they have been rapidly declining. In order to identify where these interactions are occurring and how they may be reduced, it is essential first to understand the movements and behavior of leatherback turtles. There are two regional nesting populations in the East Pacific (EP) and West Pacific (WP), comprised of multiple nesting sites. We synthesized tracking data from both populations and compared their movement patterns. A switching state-space model was applied to 135 Argos satellite tracks to account for observation error, and to distinguish between migratory and area-restricted search behaviors. Area-restricted search behavior, indicative of foraging, mainly occurred in the southeast Pacific for the EP leatherbacks, whereas the WP leatherbacks had several different search areas in the California Current, central North Pacific, South China Sea, off eastern Indonesia, and off southeastern Australia. We also extracted remotely sensed oceanographic data and applied a generalized linear mixed model to determine if there were difference between the two populations in their response to oceanic conditions. For the WP population, the probability of area-restricted search behavior was positively correlated with chlorophyll-a concentration. This response was less strong in the EP population, but they had a higher probability of search behavior where there was greater Ekman upwelling, which may increase the transport of nutrients and consequently prey availability. The occurrence of leatherback turtles within both coastal and offshore areas means they have a high risk of exposure to many different fisheries, which may be very distant from their nesting sites. Their movement patterns were integrated with data on broad-scale longline fishing effort in the Pacific Ocean to estimate relative bycatch risk over space and time. Areas of relatively high bycatch risk were predicted to occur in the Western and Central Tropical Pacific, the Central North and Northeast Pacific, Southwest Pacific

adjacent to Australia, as well as in the Eastern Tropical Pacific and the South Pacific Subtropical Gyre. Leatherback turtle bycatch has been of particular concern in the Hawaii-based longline fishery, which was closed in early 2011 in response to the number of leatherbacks in the bycatch. Examination of the timing and location of this fishery, turtle bycatch and leatherback turtle movements indicated that there had been an increase in fishery effort in the fourth quarter of the year and to the northeast from 2005 to 2011. This increased the spatio-temporal overlap between the fishery and leatherback turtles, and hence resulted in higher bycatch. Based on this analysis, the NOAA TurtleWatch tool is being modified to help reduce interactions between the Hawaii-based longline fishery and leatherbacks.

GHOST NETS: A NEW HAZARD TO SEA TURTLES IN THE GULF OF VENEZUELA

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There are many natural problems threatening the survival of sea turtles worldwide; however, it is well known that anthropogenic factors impact the most on reptile populations. The principal threat is ocean pollution, affecting mainly the migratory pathways and feeding grounds. Until recent years, the Gulf of Venezuela was considered as an important feeding ground for sea turtles with ideal conditions for their development during several stages of their life cycles; although these bio-ecological conditions remain present, we have recently evidenced an increase in problems such as contamination. Impact by hydrocarbons, plastic intake and ghost nets are the main new hazards that are affecting this important zone of northwestern Venezuela. During a in-water fieldtrip in the indigenous community of Kazuzain (mid-Guajira) we observed and recorded the information of a juvenile green turtle (*Chelonia mydas*) found dead entangled in a monofilament net (4" mesh size and 15 m long) in advanced decomposition state. Through this report we account a new anthropic threat within this feeding ground; the low incidence of this kind of events could be due to the high costs of the fishing nets for the fishermen (Wayúu indigenous communities) in this area, who tend to reuse the fishing nets, discarding few fishing gears. In addition, we presume that due to the characteristics of the net, it could proceed from bigger fishing ships of the southern communities Gulf of Venezuela, a non-indigenous territory. In this sense, it is necessary to develop systematic assessments in order to evaluate the impact of ghost nets in the study area, extended to all fishing communities connected by the waters of the Gulf of Venezuela, as the consequences could induce not only environmental, but also social problems.

THE SPATIAL OVERLAP BETWEEN NESTING LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) AND NEARSHORE FISHERIES: BYCATCH IN THE TRINIDAD DRIFT GILLNET FISHERIES

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Integrating information on the distribution of fishing, incidental capture (bycatch) and sea turtle movement is critical in reducing sea turtle interactions with fisheries. I examined the overlap of nesting leatherbacks and fishing activity on the north and east coasts of Trinidad, Republic of Trinidad and Tobago. I used kernel density estimation (KDE) to compare the kernel home ranges (KHR) of turtles, and fishing sets, and observed bycatch in artisanal gillnets. Data for the analysis came from a satellite tagging study of 9 nesting females and from experimental gillnet bycatch trials. I applied newer approaches to kernel bandwidth selection and also examined the home ranges of the telemetered animals based on their principal nesting location (east coast or north coast). The Caribbean Sea is the primary oceanic influence of Trinidad's northern coast, while the Atlantic Ocean is the main influence on the eastern shoreline. Differences in habitat use between these two groups may impact the spatial overlap with fisheries and create significantly different bycatch risks. Separating the telemetered animals by primary rookery area (east coast versus north coast) revealed differences in association with several environmental variables and in the spatial overlap with the observed gillnet fishery. Furthermore, an overlay of the kernel density estimates of turtle occurrence and fishing demonstrate that the home range of the north coast turtles overlaps with the fishing areas to a greater degree than the home ranges of the east coast turtles. However, I identified significantly higher frequencies in bycatch for east coast nesters in their core habitat. The high rates in the core areas probably arise from both the behavior of the fishers and the distribution and behavior of the turtles, suggesting that both spatial measures and fishery practice must be included in the mitigation tool kit.

RISK ASSESSMENT OF HEAVY METALS IN THE OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) AT OSTIONAL BEACH, COSTA RICA

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Sea turtles are endangered species as a result of centuries of overexploitation for meat, eggs and shells, incidental capture and habitat destruction. Moreover, several classes of anthropogenic pollutants discharged into the marine ecosystem could affect their survival. Among the environmental pollutants, heavy metals have a great relevance in ecotoxicology because of their persistence and their possible role as endocrine disruptors. In sea turtles, eggs receive their initial burden with maternal transfer during egg formation and are then exposed to contaminants in the nest environment during incubation. The aim of this study is to provide a risk assessment of heavy metals in the olive ridley's (*Lepidochelys olivacea*) nesting population in Ostional beach, Costa Rica. From September to November 2012, during and between arribadas events, we collected blood samples from nesting females during oviposition to measure trace element concentrations. In order to evaluate the maternal transfer, we also collected 2 eggs per sampled female and we will determine heavy metal levels in different eggs fractions (eggshell, yolk and albumen). Following oviposition, exposure to heavy metals in contaminated nest material and soil may also add to chemical

burdens in eggs. To assess risk for incubation success and estimate the uptake from the environment, we will also determine the contamination of the nest, by collecting and analyzing sand samples taken from the nest chamber during oviposition. At the time of hatching, we collected eggshells and dead embryos, in order to measure heavy metal contamination at the end of incubation, as related to the initial maternal burden. Following heavy metals determination, a risk assessment will be performed to determine if contaminant burden could affect embryos survival, starting from available toxic thresholds set for sea turtles, reptiles or birds. Environmental contaminants can severely affect embryonic development and can potentially contribute to embryo mortality, representing a very important cause of population declines. Ostional beach in northwest Costa Rica is the second most important arribada rookery in the world that supports a large mass-nesting assemblage with persistently low hatching rates. Our study will be the first to determine the level of heavy metal contamination in this population of Olive Ridleys and to test whether there is any correlation with hatching success in Ostional beach. The senior author thanks the International Sea Turtle Symposium for their support with a travel grant that allowed me to attend the conference and present my research. Support for this grant was made available through generous donations provided by: International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America.

THE UTILIZATION OF A HATCHERY TO MINIMIZE SEA TURTLE IMPACTS DURING A SEA DEFENSE PROJECT IN ADA FOAH, GHANA.

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Ghana has been exposed to significant coastal soil erosion for over a century, and is responsible for 10 meters of shoreline retreat in some years. Such erosion rates have resulted in the complete loss of coastal villages and several lives. Loss of coastal habitat is also expected to have negative impacts to sea turtles by preventing the female from reaching suitable nest sites or by washing out or flooding eggs during incubation. In 2010, the Republic of Ghana contracted Dredging International Cyprus Ltd to complete a sea defense project in Ada Foah that would reduce or eliminate coastal erosion. The project includes construction of seven groins across 5.3 km of beach, with beach nourishment conducted between. Logistical concerns require this work to be conducted without interruption during a period of 2.5 years. The PIs developed a sea turtle monitoring program to reduce the project's impact by monitoring sea turtle activity, relocating nests located in sites to be impacted by coastal protection work activities, and evaluating hatching success from relocated and in situ nests. During the nesting season 2011-2012, surveys were conducted throughout the project site to identify any nesting activity (*Dermochelys coriacea*, *Lepidochelys olivacea*, and *Chelonia mydas*). Nests deposited in areas that were marked for impact within 70 days were relocated to a hatchery. Mean hatching success for relocated nests was 80.2 % with the production of 7,231 hatchlings. On the other hand, the hatching success for in situ nests was only 23.8% (3,427 hatchlings produced) due primarily to predation and beach erosion. Hatchery nest temperatures were significantly higher than control temperatures at equal depths ($F(3)=57.2$, $p<.0001$) and were routinely within the female producing range (31.7°C for olive ridleys and 31.4°C for leatherbacks). The mean incubation periods of hatchery and in situ nests did not differ. Therefore, we expect the nest temperatures were not significantly different between locations. We will also explore the influence of environmental factors and relocation methods on hatching success of hatchery nests. These data indicate the hatchery served as a successful mechanism to minimize sea turtle impacts by improving hatching success and not affecting offspring sex ratios.

APPLYING LANDSCAPE MODELING APPROACHES TO PREDICT GREEN TURTLE (*CHELONIA MYDAS*) MOVEMENT PATTERNS IN THE NORTHWESTERN PACIFIC

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Unlike most green turtle populations globally, those in the northwestern Pacific are considered to be at high risk for decline. In order to preserve this Regional Management Unit (RMU), it is vital to understand the regional biology/ecology of this species to enhance conservation management strategies to reduce potential threats. This includes understanding their spatio-temporal movement patterns. Studying movement behaviors provides insight into their habitat use. However, underlying oceanographic features that influence their migratory behaviors are poorly understood, yet these dynamic features have been linked to the probability of fisheries interactions with turtles. Here, we use telemetry tracks from 29 post-nesting female green turtles from Taiwan and Japan over a 19-year (1994-2012) period. GIS was used to overlay and extract environmental parameters, such as sea surface temperature (SST) and chlorophyll a, that correspond to these telemetry tracks. Landscape modeling approaches, such as circuitscape theory or least-cost path (LCP) methods, use multivariate techniques to predict potential movement pathways and to identify important corridors. Circuitscape models were developed for assessing landscape connectivity using theories that are analogous to electrical circuits; LCP is a technique that uses area weighted distance functions across a landscape to identify potential corridors between two areas. The geospatial environmental parameters derived largely from satellite sensors will be used to derive resistances for the circuitscapes and weightings for the LCP modeling. In this study, we are evaluating these general types of predictive model to see if they can be applied to the sea turtle migration patterns. These models potentially have management implications to help minimize interactions with fishing operations.

EU PURSE SEINE FISHERY INTERACTION WITH MARINE TURTLES IN THE ATLANTIC AND INDIAN OCEANS: A 15 YEAR ANALYSIS

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Bycatch of marine turtles, vulnerable or endangered species, is a growing issue of all fisheries, including oceanic purse-seine fishery. The present paper seeks to assess marine turtle bycatch at a spatial and temporal level in the European purse seine fishery operating in the Atlantic and Indian Oceans. The study was based on data collected through French and Spanish observer programs from 1995 to 2011, a period where more than 230 000 fishing sets were realized by the UE fleets in both oceans. A total of 15,913 fishing sets were observed, including 6,515 drifting Fish Aggregating Devices (FAD) and 9,398 Free

Swimming Schools (FSC), representing a global coverage of 10.3% in the AO and 5.1% in the IO. Over the study period, 597 turtles were caught during set observations, 86% being released alive at sea. At the same time, from 2003 to 2011, 14,124 specific observations were carried out on floating objects whether they ended in a set or not. A total of 354 marine turtles were observed, where 80% escaped or were entangled alive and, therefore, released alive. At the temporal and spatial level, data were organized and analysed by ocean, fishing mode (FAD vs. FSC) as well as by year, quarter and statistical square of 1°. In order to evaluate the impact of this fishery in both oceans, bycatch distribution was compared to the total fishing effort of the UE fleet, as well as to the known marine turtle post nesting migration routes, nesting population abundances and known feeding areas. The species composition, the size and sex structure of bycatch are also discussed here. Finally, an attempt to raise the data to the total fishing effort was carried out. Based on observations of marine turtle by-catches on sets, we estimated that, globally, 3,500 marine turtles were accidentally captured by the EU-PS fleet in the Atlantic Ocean from 1995 to 2010, and around 2,000 in the Indian Ocean from 2003 to 2010, with a corresponding annual bycatch rate of 218 (SD=150) and 250 (SD=157), with 91 and 77% being released alive, respectively in the Atlantic and Indian Ocean. However, because of important uncertainties mainly due to the low observation coverage and the scarcity of marine turtle bycatch events, it was impossible to produce solid and reliable global estimates of marine turtle bycatch and mortality due to PS activity.

SUMMER OF THE KEMP'S RIDLEY: THE IMMS RESPONSE TO HIGH NUMBERS OF INCIDENTAL CAPTURES AT MISSISSIPPI FISHING PIERS

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Abnormally high numbers of sea turtles, particularly immature Kemp’s ridley (*Lepidochelys kempii*) sea turtles, were incidentally captured in 2012 by recreational fishermen at coastal fishing piers in Mississippi. Whereas only 20-30 captures were reported for each year in 2010 and 2011, almost 200 captures were reported in 2012. The turtles were transported to the Institute for Marine Mammal Studies (Gulfport, MS) where they received care and rehabilitation. Straight-line carapace lengths ranged from approximately 21cm to 48cm signifying the presence of juveniles and sub-adults in the Mississippi Sound. Turtles were grouped by capture date and pier to examine temporal and location trends. Additionally, hook sizes and types were measured and analyzed for any potential influences on incidental captures. Feces were passively collected from rehabbed turtles for the first ten days, if possible, to examine local dietary preferences. Several of the turtles were fitted with satellite transmitters, and their movements displayed site fidelity to the Mississippi Sound often moving towards their original capture site. The waters of the north central Gulf of Mexico has been previously suggested as being important foraging grounds for Kemp’s ridleys (Ogren, 1989); however, this region has been historically understudied. The observed numbers of captures indicate that the Mississippi Sound represents a vital developmental habitat for Kemp’s ridleys. The need for better understanding the regional abundance of these crucial life history stages is emphasized because this critically endangered species is currently experiencing a population recovery due to conservation efforts on nesting beaches and foraging grounds. The substantial increase in incidental captures could be due to a number of factors including increased public awareness and the previously mentioned population recovery. However, the possibility of their local, natural habitat being degraded thus driving the turtles into close proximity to fishing piers cannot be discounted and needs further exploration.

HEAVY METAL ANALYSIS OF MARINE LEECHES (*OZOBRANCHUS* SPP.) TO ASSESS EXPOSURE IN SEA TURTLES

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Knowledge of environmental contaminants to which endangered and threatened sea turtles are exposed is important for conservation efforts. Currently, contaminant evaluation involves necropsy of turtles found dead or moribund or sampling blood from captured turtles. The goal of this research was to explore the potential of the sea turtle leech *Ozobranchus* spp. for use as a surrogate for heavy metal exposure in their sea turtle hosts. The leech acts as a mini-sampler of turtle blood and has the potential to accumulate heavy metals over time providing information on long-term exposure to environmental contaminants. In this preliminary study, the concentration of ten metals was determined in *Ozobranchus branchiatus* and *Ozobranchus margoi* leeches collected from green turtles, *Chelonia mydas*, hawksbills, *Eretmochelys imbricata*, and olive ridleys, *Lepidochelys olivacea*, by collaborators in Barbados, Brazil, Florida, Hawaii, and Mexico. Leeches were received in ethanol, dried, digested with nitric acid and analyzed using inductively-coupled plasma optical emission spectrometry (ICP-OES).Since the leeches are so small, pooled samples were analyzed from the same turtle to determine Al, As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn concentrations. The highest measurements were found in *O. branchiatus* leeches from green turtles (*C. mydas*) in Hawaii that contained Cd levels ranging from 1.85 to 899.7 mg/kg dry wt., Pb levels ranging from 5.36 to 11870 mg/kg, Zn levels ranging from 257.2 to 753.1 mg/kg, and Cu levels ranging from 19.83 to 104.5 mg/kg. *O. branchiatus* leeches from olive ridley turtles (*L. olivacea*) in Mexico had Al levels that ranged from 490.0 to 1286 mg/kg dry wt. and Cu levels that ranged from 77.20 to 179.2 mg/kg. *O. margoi* leeches from hawksbill (*E. imbricata*) in Barbados had Cd levels that ranged from 1.04 to 134.3 mg/kg dry wt. and Zn levels that ranged from 121.3 to 526.7 mg/kg. Most of these levels are well above what would be considered toxic to any organism. Cadmium and lead, in particular, can have serious effects on organisms and accumulate with age. These levels are much higher than those reported by others for sea turtle tissues indicating that the leeches have the potential to concentrate heavy metals from their turtle hosts. Leeches from Brazil had the lowest levels of metals with Florida specimens falling in the mid-ranges. These preliminary results demonstrate the potential of using sea turtle leeches as surrogates of host turtle exposure to heavy metal environmental contamination.

INCIDENTAL BY-CATCH OF LOGGERHEAD TURTLES (*CARETTA CARETTA*) BY BOTTOM TRAWLING IN EASTERN SPAIN

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A survey was conducted to assess marine turtle bycatch in bottom trawling fisheries in Valencian Community waters (Eastern Spain). About 99% of marine turtles in this region are loggerheads (*Caretta caretta*) that represent two distinct Regional Management Units (RMUs): the North-Eastern Atlantic RMU, which makes up the largest population worldwide despite its recent decline, and the Mediterranean RMU, with a much smaller and highly threatened population. Turtles from both RMUs occur in the Western

Mediterranean, but their distribution in the study area is heterogeneous due to the complex structure of surface currents and sea conditions. Mediterranean and Atlantic loggerheads are found to the north and south of La Nao Cape (Alicante province), respectively, although moderate exchange of individuals from each RMU occurs. Drifting longline fisheries represent the largest threat for loggerhead turtles in Western Mediterranean over the last few decades. The impact of this fishery has decreased considerably as a consequence of longline fleet reduction in eastern Spain. However, the bottom trawl fishery could have significantly impacted local stocks of loggerheads both in the past and at present. Here we replicate previous surveys in Catalonia (Northeastern Spain) and the Balearic Islands to fill gaps in the assessment of trawl fishery impacts on loggerhead turtle stocks in the Western Mediterranean. To make the surveys comparable, we used the same questionnaire and methodology as in previous studies. Between 2010 and 2012, a total of 111 interviews (one per boat) were carried out covering 41.3% of the entire Valencian Community fleet. According to the information reported by bottom trawl fishermen, the catch per unit effort (CPUE) was estimated at 0.09, and the total number of turtles captured as bycatch in the Valencian Community was 238 turtles (95%, CI: 173-304). The fishermen's perception was that the local stock of loggerhead turtles is declining and that drifting longline and bottom trawling fisheries are, at least, partially responsible for this trend. Ivlev's electivity index revealed that bottom trawl bycatch was higher than expected in areas with a wide continental shelf (i.e., the north part of the study area). In agreement with previous surveys, the trawl fishery appeared to mainly affect turtles from the Mediterranean RMU. The bottom trawl fishery represents a serious threat for the loggerhead turtle population in the Western Mediterranean and, therefore, urgent conservation measures should be investigated, including possible reductions in tow time to prevent turtle suffocation, the use of turtle excluder devices (TEDs), and specific fishery regulation measures. This project was funded by the VOLCAM program of Caja Mediterraneo. JT is supported by project CGL2011-30413 of the Spanish Ministry of Competitiveness and Economy.

ESTIMATES OF SEA TURTLES BYCATCH IN ARTISANAL FISHING IN SOUTHERN BRAZIL

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The incidental capture is one of the biggest topics of discussion that involve the ecological sustainability of fisheries on threatened species impact, traditional communities and the local economy. In Paraná, southern Brazil, the fisheries are predominantly small-scale, distributed in estuarine and coastal environments. The characterization of the activity and the main fitting equipment that interact with turtles were previously identified by interviews with local community. Six communities of artisanal fishery are monthly sampled and 918 interviews were conducted between October 2010 and December 2011. More than 200 sea turtles was recorded stranded on the beach along this period. Nevertheless, the capture of 52 sea turtles was recorded to the interview day, identified as *Chelonia mydas* (30 individuals), followed by *Caretta caretta* (10), *Eretmochelys imbricata* (4) and *Dermochelys coriacea* and *Lepidochelys olivacea* (1 individual each). The frequencies of catches were higher for bottom driftnet mesh 16 to 25cm which occurred in all seasons, ranging from 2.0 to 3.3% of the fishing landings. Lower frequencies of capture were observed in trawls, in the gillnet of water column mesh 9 to 12c, in the bottom driftnet mesh 5 to 7cm, bottom gillnet mesh 9 to 12cm and 6 and 7cm, and in the driftnet of water column mesh 9 to 12cm. The frequency of capture in bottom gillnet mesh 16 to 25cm was significantly higher (2.0%) between the stations and the mortality rate was observed only for this fishery was 77.8%. Most catches (16 in 17 reports) were related to fisheries conducted in the open sea between 0.2 and 5.6 km from the coast (56.3%), followed by those held in nearby islands (31.3%), and made between 27.8 to 39.8 miles from the coast (12.5%). The average values of Yields Capture (YC=individual / hectare network daily submersion) of turtles was zero in most communities except in bottom gillnet mesh 16 to 25cm. The IC in this fishery between communities ranged from 0.1 to 7.7 individuals / (ha.day). The estimated total catch was calculated in 3 ways: based in the yields of capture, the capture frequencies considering the week fishing and the data only on the day of interview. Based on estimates calculated, the total catch (which correlates to capture the different fitting equipment with frequency of usage) held by the communities studied in different fitting equipment that interacted with turtles ranged between 412 and 2001 turtles per year. Based on these results, it is evident the vulnerability of the species caught in traditional systems of fishing, and more studies should be conducted with fishing and its ecological consequences, economic and social implications for prioritizing conservation efforts. The problem must be addressed in an interdisciplinary manner to create alternatives to reduce the mortality of these organisms and simultaneously promote sustainable fishing.

ALARMING POACHING OF SATELLITE TRACKED INDIVIDUALS RAISES REGIONAL CONSERVATION CONCERNS FOR GREEN TURTLE (*CHELONIA MYDAS*) IN THE WESTERN INDIAN OCEAN.

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A recent satellite tracking study in the Western Indian Ocean reveals several instances of green turtles (*Chelonia mydas*) poaching. In 2008, one of 12 tracked nesting green turtles from Glorieuses (French overseas) was poached in Grande Comores (Comoros). The tag was found and collected from the hut of a villager. In 2010, 16 satellite tags were deployed on nesting green turtles in Moheli (Comoros), with 3 of them having an accelerometer. One turtle was found nesting on the same beach some weeks after deployment, but without its accelerometer. Further observation of the animal showed a piece of net still attached to the device and evidence of net scars were on the turtle. The satellite track demonstrated that the turtle had been a prisoner of a fixed costal net in Anjouan (Comoros) for a few days. The same year, further west in Tanzania, another green turtle nesting track from Europa Island (French overseas, of 10 tracked individuals) revealed that the individual was captured in Okuza Island (Tanzania) and brought back to Kieulela village (Tanzania). The villagers were visited but the tag was not recovered. In 2011, 11 juvenile green turtles were tracked in the marine protected area of Europa Island. One individual later reach the waters of Madagascar and remained there for 2 months before being poached. The tag was found in Tsifota village in the south west, and recovered. The same year, from 3 adult green turtles tracked in Kenya, one was poached only 43 days after deploying the tag. The turtle carcass was found at the nesting beach. The electronic device was still attached to the carapace, but it had been intentionally broken. These five incidences of poaching are of high concern when compared to the small number of tracked individuals. These events occurred in four different countries (Kenya, Tanzania, Madagascar, Comoros) that are known to host important foraging habitats for green turtles. Furthermore, these individuals were tracked for a very short period of their lifetime. When considering the amount of time spent in coastal areas by green turtles, and the level of artisanal fishing activity in those countries, this issue becomes a major concern. While satellite tracking allows us to raise the alarm, there is still a lack of more precise assessment. Artisanal fisheries and poaching data are barely accessible and could be a major source of mortality for the green turtle in this region. We urge future regional conservation actions to address this important issue.

SEA TURTLE INTERACTIONS AT THE BRUNSWICK STEAM ELECTRIC PLANT, SOUTHPORT, NORTH CAROLINA

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The Brunswick Steam Electric Plant (BSEP) is a nuclear power plant located in Southport, North Carolina. The plant is situated along the Cape Fear Estuary and utilizes water from this system via an intake canal to cool its reactors. BSEP has developed measures to reduce entrainment of estuarine life into the intake canal, including threatened and endangered sea turtles, which use the estuary for foraging. Trained employees monitor the intake canal using both boat and diver patrols. Sea turtle interactions are reported to the National Marine Fisheries Service (NMFS), the Nuclear Regulatory Commission (NRC), and NC Wildlife Resources Commission biologists. Though the diversion structure and monitoring measures are effective at reducing sea turtle interactions and mortality, there has been an average of 9 incidental sea turtle captures per year at the BSEP since 2001. In 2012, however, there was an increase in incidental captures at the plant, resulting in 23 sea turtle interactions (15 loggerheads, 4 greens, 4 Kemp's ridleys). Of these interactions, 14 were retrieved alive and subsequently released. There were 9 mortalities, including 3 green sea turtles, meeting the allowed take under the NMFS 2000 biological opinion. Factors contributing to this rise in interactions include high lunar tides in the spring and breaches in the plant's diversion structure, allowing turtles to enter the intake canal. Through the efforts of the BSEP employees, monitoring for sea turtles in the intake canal has increased and modifications to the diversion structure are being considered to limit future interactions.

TRASHING TURTLES: QUANTIFYING GARBAGE ON THREE SEA TURTLE NESTING BEACHES IN COSTA RICA

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The authors tested new methods for investigating the relationship between beach trash and sea turtle activity in a country-wide study in Costa Rica. Costa Rica contains important nesting beaches for green turtles, olive ridleys, hawksbills, and leatherbacks. Beach trash is among the many threats to these endangered species; it can be an obstacle to nesting female turtles and hatchlings traversing the beach, and in near shore waters turtles can ingest or become entangled in floating trash. Our research goal was to determine if beach trash and turtles are spatially and temporally correlated. The study sites were Pejeperro Beach on the Osa Peninsula, Tortuguero on the Caribbean, and San Miguel Beach in Guanacaste. Trash density was measured using methods described in the NOAA Marine Debris protocol during July and August of 2012. The Science Exchange Interns mapped three 100-meter zones on each beach. Each zone

consisted of 20 five-meter wide transects from the mid-tide line to the back of the beach. Four transects per zone were randomly chosen for weekly garbage observations using predefined size categories and type categories such as plastics, glass, fabrics, metals, processed wood, rubber, etc. One of our modifications to the NOAA protocol is that while collecting trash density data, we simultaneously recorded evidence of turtle activity within the transect. Crawls and nest pits were tallied as separate activities. Successful nests were counted the same as false nests. Trash was not collected until the end of the study. Ninety-one percent of the observed trash items in the 252 transects sampled in Costa Rica fell in the macro category (2.5 to 30 cm), with 36 large debris items recorded ranging in size from 0.3 m to 1.10 m. Our new methods also added a micro size category (5mm to 2.5 cm) that could affect the nest chamber. The mean macro trash density from all sites was 0.2436 items/m^2 and the mean turtle density was 0.0084 activities/m^2. Tortuguero beach had the highest average macro trash density, with 0.4287 items/m^2, and also the highest turtle activity density at 0.0202 activities/m^2. Plastics accounted for 93% of all items recorded at our study sites with rubber products coming in second. To determine the spatial and temporal relationship between macro trash (in our case small plastic items) and turtles we used a non-parametric two-tailed Spearman's rho correlation test. There was a moderately strong positive significant relationship ($r = 0.449$; $p <= 0.001$) indicating that as plastic densities increased and decreased, turtle activity densities followed. However, we cannot infer cause and effect from a correlative relationship; many factors influence where turtles choose to crawl onto the beach and dig nest pits, for example natal homing and the presence of artificial lights. The three beaches' trash densities in several notable categories will be compared to each other and to other sites from the literature. Recommendations to managers of sea turtle nesting beaches are increased beach cleanups, community awareness campaigns, and more trashcans on the beaches with regular disposal.

INTERACTIONS BETWEEN SEA TURTLES AND FISHERIES IN BRAZIL. AN OVERVIEW WITHIN THE SCOPE OF PROJETO TAMAR MONITORING AREA (1990 – 2012)

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Projeto TAMAR/ICMBIO has been involved in sea turtle conservation in Brazil since 1980 and currently operates a network of 22 research stations distributed along 1100Km of coastline. Researches aimed to reduce the impact of coastal fisheries on sea turtles which have been prioritized since 1990. At the end of 2001 TAMAR created the Brazilian National Action Plan to Reduce the Incidental Capture of Sea Turtles in Fisheries and started actions also toward to oceanic fisheries. Under this Plan each fishery has been understood as the management unit of the problem: "sea turtle and fisheries interaction". Seeking to better understand why and how sea turtles interact with fisheries, each fishery has been characterized according to 12 criteria. However, here, all fisheries were joined in major categories of gear: a) trawl nets, b) gillnets, c) traps, d) hooks and lines, e) seines. The fishing effort is quite different and is not being considered here. We analyzed almost 22 years of data from TAMAR's database information system (SITAMAR). Trawl nets involve trawls for shrimp, squid and fishes. 210 turtles were captured (90.5% alive; 9.5% dead). 173 *Chelonia mydas* (96% alive, 4% dead), 24 *Caretta caretta* (66.7% alive, 33.3% dead), 3 *Eretmochelys imbricata* (66.7% alive, 33.3% dead) and 10 *Lepidochelys olivacea* (60% alive, 40% dead). Gillnets include coastal set gillnets, fixed gillnets, encircling gillnets and pelagic driftnet. 5384 turtles were captured (75% alive; 24.8% dead; 0.2% in condition not informed - cni); 4891 *C. mydas* (75.4% alive, 24.5% dead; 0.1% cni), 130 *C. caretta* (77.7% alive; 20.8% dead; 1.5% cni); 99 *E. imbricata* (69.7% alive; 30.3% dead); 27 *L. olivacea* (70.4% alive; 29.6% dead); 237 *D. coriacea* (68.8% alive; 30.8% dead; 0.4% cni). Traps include corrals, pound nets and pots. A total of 8367 turtles were captured (97.4% alive; 2.6% dead). 8005 *C. mydas* (97.3% alive; 2.7% dead); 130 *C. caretta* (alive); 75 *E. imbricata* (98.7% alive; 1.3% dead); 155 *L.*

olivacea (98.7% alive; 1.3% dead); 2 *D. coriacea* (alive). Hooks and lines include: longlines and handlines. A total of 4784 turtles were caught (75.3% alive; 7.8% dead; 16.9 cni). 168 *C. mydas* (79.8% alive; 8.9% dead; 11.3% cni); 2935 *C. caretta* (86.5% alive; 6.8% dead; 6.7% cni); 5 *E. imbricata* (80% alive; 20% dead); 615 *L. olivacea* (47.6% alive; 20.7% dead; 31.7% cni); 1061 *D. coriacea* (59.6% alive; 2.9% dead; 37.5% cni). Seine nets include only beach seines and captured 72 turtles (94.4% alive and 5.6% dead). 66 *C. mydas* (95.5% alive; 4.5% dead); 1 *C. caretta* (alive); 4 *E. imbricata* (alive); 1 *L. olivacea* (dead). The mortality rate of sea turtles in fisheries as gillnets or longlines is higher when compared with others like corrals or pound nets, which also capture many turtles. Thus, TAMAR has prioritized to monitor specific fisheries and has tested and implemented mitigation measures among fishermen, which contribute to reduce sea turtle capture and mortality.

SEA TURTLE CELL CULTURES AS TOOLS FOR INVESTIGATING TOXICANT EXPOSURE AND EFFECTS.

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Within the past several decades, sea turtles have seen a major decline in population and all are currently listed as threatened or endangered. A large body of research has investigated several possible factors in this decline, including disruption of habitat, boat strikes, entanglement in fishing gear, and diseases such as fibropapillomatosis. However, the impact of chemical contaminants is not well-studied. Sea turtles come into contact with a variety of contaminants in the marine environment, such as polycyclic aromatic hydrocarbons, organochlorines, polychlorobiphenyls, and heavy metals. It is challenging to conduct toxicological investigations in these animals due to their threatened status. Cell culture work has potential to describe exposure-effect scenarios in an in vitro context and may offer insight on risks to whole organisms. The aim of this study was to develop a method of toxicological testing using primary cell cultures developed from sea turtle skin biopsies. Here, we report on 1) the characterization of loggerhead sea turtle (*Caretta caretta*) primary fibroblast skin cell cultures, 2) the optimization of cytotoxicity assays such as MTT and growth curve assays, and 3) the optimization of biomarker assays such as gene expression of cytochrome P450 1A genes. Characterization of primary skin fibroblast cultures included the determination of optimal growth conditions (temperature, medium, serum concentration, and coating/substrate), observations of morphology, and immunocytochemistry for vimentin, a cytoskeletal protein. Data analyses showed that RPMI 1640 medium, 30°C incubation, 10% serum concentration, and a tissue culture treated growth surface for cell adhesion were optimal growth conditions. Preliminary growth curve analyses of cells exposed to 10 μM benzo[a]pyrene showed markedly lower growth, and MTT assays suggest toxicity to cells following 96-hour exposure to benzo[a]pyrene at all tested concentrations. Benzo[a]pyrene is a prototypical polycyclic aromatic hydrocarbon and known marine contaminant. Following optimization, these toxicological assays will be useful not only in single contaminant exposures but also in examining interactions between these contaminants and other natural stressors. Primary skin fibroblast cultures were grown from skin biopsies obtained from six healthy loggerhead turtles. Cells were dosed with benzo[a]pyrene at concentrations of 10 μM, 1 μM, 100 nM, and 10 nM for 72 hours. The inducibility of CYP1A following exposure was assessed by quantitative polymerase chain reaction. CYP1A1 and CYP1A-like induction is commonly used as a biomarker of exposure to polycyclic aromatic hydrocarbons and planar halogenated aromatic hydrocarbons in wildlife. The present study confirms that sea turtle CYP1A is inducible by a xenobiotic known to induce CYP1A in other species. Further

characterization of sea turtle CYP1A expression and inducibility may provide a valuable biomarker of exposure to these chemicals in this taxon. This research was conducted under U.S. Fish and Wildlife Service Endangered Species Act Section 10a(1)a Scientific Research Permit# TE 676379 4 and TE#676379 5 and Florida Fish and Wildlife Conservation Commission, FWC MTP 015 and complied with all institutional animal care guidelines.

SPATIAL AND TEMPORAL DISTRIBUTION OF LEATHERBACK SEA TURTLES IN THE RIO DE LA PLATA: INSIGHTS FROM STRANDING AND FISHERIES DATA

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The leatherback sea turtle, *Dermochelys coriacea*, is the most migratory sea turtle species. Its geographic distribution spans from tropical to sub-polar waters worldwide. Leatherbacks exhibit seasonal migration patterns and tend to remain for longer times in different areas for specific uses. Understanding the seasonal movements and habitat use of this critically endangered species is essential for its protection and conservation. The aim of this study is to analyze the spatial and temporal distribution patterns of the leatherback turtles in the Rio de la Plata estuary, a high use area for this species in the Southwest Atlantic Ocean. Rio de la Plata is a tapering intrusion of the Atlantic Ocean between Uruguay and Argentina. It operates as an estuarine system where the Paraná and Uruguay rivers drain into its waters - producing a saline and turbidity front. Thus, we can differentiate three zones into the estuary according to a salinity gradient from low to high concentrations: inner estuary, outer estuary and oceanic zone. In addition, this estuary is influenced by a subtropical convergence or a junction of two ocean currents (a warm water current from Brazil and a cold water current from Malvinas). This convergence of water masses, plus the strong halocline, creates a high biological productivity system and foraging area for many species. Records of *D.coriacea* incidentally captured by fisheries and stranding events of this species into Rio de la Plata estuary may indicate this area supports considerable densities of foraging leatherbacks. In this study, Karumbé Environmental NGO, collates data (N=101) regarding leatherback occurrence on the Uruguayan side of the Rio de la Plata estuary in the last two decades. All measured turtles (n=52) were adults or sexually mature (>120cm CCL) and their survival rate was found to be 56.5% of entangled turtles and only 2.5% of stranded turtles. Most events were concentrated in two peak times. Registered strandings (n=78) occurred from November to July with a remarkable peak during the austral fall months (n=61).A total of 75.6% stranding events were located in the outer estuarine area. The aggregation of leatherbacks in this zone might be related to the timing of availability and abundance of preys during this period of the year (e.g. jellyfishes, salps and other gelatinous organisms). Special mention is made to a massive stranding event in April-May 2008 with 28 stranded leatherbacks. While almost all the incidental captures occurred from October to December (n=16) and a few isolated events in March and April (n=6). We estimate that incidental captures increased with the activity of the artisanal fleet in the inner estuarine area following the valuable target of the croaker (*Micropogonias furnieri*) during the austral spring. Some species of scyphozoan medusae tend to aggregate at the bottom of the estuary, mostly beneath the halocline, where Uruguayan artisanal fisheries set coastal bottom gillnets. Thus, the relatively large number of strandings in the outer estuary and incidental captures in the inner zone of the estuary may indicate a higher leatherback aggregation into the Rio de la Plata. Therefore,we suggest more effort should be directed to the assessment of the impact of artisanal fishing gear on leatherbacks, and systematic surveys should be maintained in order to improve our knowledge on the spatial patterns of strandings in this important leatherback foraging area in the Southwest Atlantic Ocean.

INCIDENTAL CATCH OF MARINE TURTLES IN BOTTOM TRAWLING IN SOUTHEASTERN BRAZIL

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Brazil has five of the seven species of marine turtles known in the world, all of which are subject to anthropogenic threats - resulting from the degradation and pollution of terrestrial and marine habitats, and through accidental bycatch in fisheries. Due to the high mortality of sea turtles recorded in fisheries worldwide, marine turtle bycatch studies have become the main focus of several conservation projects. The objectives of these studies are to identify which fisheries have interactions with marine turtles, the impact of interactions on these populations and the development of bycatch mitigation solutions. The accidental capture of sea turtles by bottom trawlers is considered one of the biggest threats to sea turtles worldwide. In Brazil, there is little data to accurately quantify interaction levels or to effectively identify which species are most vulnerable to interactions with bottom trawl fisheries. This study aims to clarify this situation and generate an interest in further developing collaborative research in this pressing field of fisheries science. Between July 2010 and December 2011, 3 shrimp trawlers and 1 fish trawler operating from the city of Niterói, in the state of Rio de Janeiro (located on the coast of Southeast Brazil) were monitored by captains that voluntarily collected data for this study. All the captains were trained to collect date, time, depth and GPS location for all the trawling tows (launching and recovery of nets) on data collection sheets. When interactions occurred the captains recorded species, size, and whether the turtle was alive or dead. To confirm species identification, captains used a camera to photograph the caught turtles. An identification key developed specifically for this project accompanied the data collection sheets. A total of 44 turtles were captured in 1996 tows totaling 8.313 hours which results in a Catch Per Unit Effort (CPUE) of 0.02 turtles per tow, or the equivalent of 1 capture for every 99.8 tows which on average last 4.2 hours ± 0.92. The species caught were: *Caretta caretta*, *Lepidochelys olivacea* and *Chelonia mydas* - totaling 22, 21 and 1, respectively. There were no reports of deaths in catches cataloged by the captains. The curved carapace length (CCC) ranged between 56 and 76 cm (64.3 ± 4.8) for *L. olivacea*, 61 and 150 cm (83.5 ± 22.28) for *C. caretta* and 38.5 cm for the single *C. mydas* captured. There was no significant difference in catches between day time (6:00 to 18:00) and night time (18:00 to 06:00) ($\chi^2 = 0.36$, $p = 0.55$). When compared to six studies which were conducted in the U.S.A, Australia and Costa Rica, our data shows the fifth highest CPUE for marine turtle interactions with bottom trawlers. This work provided the first estimates of the interaction occurring between bottom trawl operations in the southeastern region of Brazil and marine turtles. Further collaborative efforts between scientist and fishers could improve these estimates and provide baseline data for reducing marine turtle bycatch.

PREDICTING THE EFFECTS OF SEA LEVEL RISE ON THREE SEA TURTLE NESTING BEACHES IN COSTA RICA

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Sea level rise, which has been brought about by rapid climate change, is predicted to increase by approximately 0.6 m in the next 90 years according to the Intergovernmental Panel on Climate Change. This increase could affect the availability and quality of sea turtle nesting habitat. This investigation, a collaborative effort of Sea Turtle Conservancy, PRETOMA, Osa Conservancy and The Science Exchange Sea Turtle Internship Program, took place at Pejeperro Beach (Osa Peninsula), San Miguel Beach (Guanacaste), and Tortuguero Beach (Caribbean) in July and August of 2012. These beaches are monitored by the collaborating organizations for nesting of five out of seven of the world's endangered sea turtle species: greens, olive ridleys, leatherbacks, hawksbills, and loggerheads. Data were collected following the World Wildlife Fund (WWF) Temperature Monitoring Manual. At each beach, slope data were collected with an abney level along 60 five-meter transects distributed evenly over three separate 100-m zones that represent zero, low, and high turtle nest density areas according to the expert opinion of the supervisor from each organization. Two of these slope surveys were implemented, one at the beginning of the study and one at the end, in order to capture short-term natural rates of change in topography due to factors such as erosion and accretion of sand from wind, tides, currents, rivers, storms as well as turtle nest excavations and loss of sand from human activities such as beach development and sand mining. To predict the possible beach area loss from sea level rise in the year 2100, we took the average of the first and second survey elevations of each sample point and subtracted 0.6 m to simulate flooding of the beach. Only a few of our 1279 sample points were flooded resulting in a loss of 6% of the sampled beach area at Tortuguero (3% from the low nest density zone and 3% from the high nest density zone). The site with the most dramatic loss was at Pejeperro Beach, with a predicted 14% of the high nest density zone potentially being underwater by 2100. In this zone, 13 out of 20 transects are predicted to shrink five meters in width starting at the mid-tide line towards the back of the beach because there is a gradual slope with low elevations. We will present the natural rate of topographic changes and the actual nest densities observed within these same transects over the six to eight week study period. Our analysis will also include a comparison between these three beaches and with other beaches around the world that have implemented the WWF slope surveys. Conservation recommendations to mitigate for impacts of sea level rise on nesting beaches are continued slope surveys, promoting and enforcing development set back regulations, and hatchery programs to protect nests that are threatened with inundation.

DEAD SEA TURTLES FROM DRINI BAY, ALBANIA DURING 2002-2012

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Sea turtles of Drini Bay in Albania have been studied since 2002. There are four rivers that converge at Drini Bay: Drini, Mati, Droja and Ishmi . These rivers flow through rich, mountainous and open-field habitats - transporting considerable amounts of organic and inorganic elements into the bay. As a result, numerous invertebrate and plant species occur in the bay. These items are important food sources for loggerhead, *Caretta caretta,* and green turtles, *Chelonia mydas*. The highest density of potential food sources for turtles is noted from the Ishmi and Mati river mouths, respectively. During 11 years of intensive research, we have found 78 dead loggerheads and 2 green turtles. Turtle mortalities were attributed to incidental by-catch in locally intensive and illegally-performed fishing operations. Nets are generally soaked for 4-5 hours but will occasionally be placed for 2-3 days. Soak times for either duration typically lend to turtle by-catch and mortality. Turtles that are caught in nets are often suffocated and those hooked on long-lines are injured when swallowing hooked bait. Dynamite is also employed as “fishing gear” in the bay - destroying habitats utilized and occupied by sea turtles, and occasionally causing the direct mortality of individual turtles. Chemical and plastic-waste pollution from the Ishmi River is also a documented source of mortality for turtles in the bay. Moreover, turtles are collected from the bay and then stuffed as curios to decorate some local Albanian establishments.

SEA TURTLE TRADE IN INDONESIA: CURRENT MAGNITUDE AND NEW MODE OF OPERATION

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The illegal trade in sea turtle products has been a long time problem in Indonesia. Despite the legal protection status of sea turtles since 1999, the illegal trade has continued to take place in various places. An assessment was conducted to review the extent of consumption and trade of marine turtle and their eggs in Indonesia. A survey of turtle meat consumption was focused in Bali, the main area for commercial trade of turtle meats and where local consumption takes place. Market surveys of turtle eggs were focused in West and East Kalimantan region where consumption of eggs is widespread and sold in local markets. We provide an overview on the current trade status of turtles and their eggs in Indonesia. The survey on source and trade routes was conducted via interviews with turtle meat/egg sellers, key informants, government agencies and through literature reviews. In Bali, field surveys were conducted from November to December 2009, and in Kalimantan from May-June 2010. The survey findings revealed that despite a decrease trend of trade volume since 1999 due to the legal protection state of green turtles, the illegal trade of turtle meat and eggs still existed. In Bali, turtle trade for consumption predicted to reach up to 60 ton per year (equivalent to approximately 1,000-2,000 individuals). The traded turtle meat involves mainly green turtles that caught locally and outside Bali. Turtle meat shipped from outside Bali was mostly in form of meat loafs/pieces. An mt-DNA analysis of the confiscated green turtles (n=32) in Bali indicated that the captured turtles were from various rookeries in Indonesia and Australasia. Turtle eggs seemed to be in short supply in East Kalimantan (Samarinda city) where the volume of eggs traded ranged from 981 – 1,846 eggs/day while in West Kalimantan was 12,679 eggs/day. The price of turtle eggs in East and West Kalimantan differ. In East Kalimantan, the price of an egg ranged from IDR. 5,000 to 10,000 - depending on the availability; while in West Kalimantan it ranged from IDR. 2,000 to 5,000. Around 36% of the traded eggs in West Kalimantan were traded at the Malaysia-Sarawak border. The traded turtle eggs in East Kalimantan were identified as green and olive ridley turtle eggs and they sourced from major rookeries - including the Berau islands (East Kalimantan) and Kota Baru (South Kalimantan). In West Kalimantan, the eggs were from green and hawksbill turtles and were sourced from Paloh (West Kalimantan) and Riau islands. The result of this study has shown significant trade volume of turtles and their eggs in Indonesia that may jeopardize the sustainability of turtle population in Indonesia and the surrounding region. Strategic interventions are needed including from surveillance activities (patrols) at local markets, apprehension/detention and lawsuit/judicial process with heavy penalties. On the other hand, alternative sources of incomes for the local sellers should be promoted as well as a consumer campaign (at major cities) to reduce the trade demand.

BYCATCH INTENSITY OF SEA TURTLES IN THE MARINE WATERS OF BANGLADESH

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Bangladesh is located at the north of Bay of Bengal with a coastline of 710 kms approximately. A large number of people live along the coast and a vast portion of community depend on fishing in offshore and coastal areas. At least 20,000 artisanal fishing boats operate in our territory. The existing fishing gears utilized are: gill nets of different types, set bag nets, small long lines, and industrial trawl fisheries. The current threat level to local turtles and cetaceans is still unknown to us. But, the mortality rate along the coast of Cox's Bazar is clearly thousands of sea turtle each year and several hundreds of small cetaceans (as per records from the several years study). During 2008-2012 July we conducted various surveys to explore the incidences of bycatch through fishermen interviews, inwater on-board observation and data collection by trained fishermen. A total 1,119 fishermen were interviewed. The highest by-catch instances were recorded from the Marine Set Bag Net (MSBN) fishery, with 579 olive ridley interactions. Small cetaceans like Irrawaddy and finless porpoises were also recorded during the bycatch survey.

GREEN TURTLE INTERACTIONS WITH COASTAL GILLNET FISHERY OF THE RIO DE LA PLATA ESTUARY, URUGUAY

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Incidental catch of sea turtles in fisheries has been recognized worldwide as one of the main mortality causes for these endangered species. The Uruguayan coast constitutes a foraging and development area for juveniles of green turtles (*Chelonia mydas*) that come from different breeding zones. Thus, mortality due to fishing activities may be depleting nesting populations elsewhere in the Atlantic. The aim of this research was to evaluate the impact generated by the coastal gillnet fishery on green turtles in Bajos del Solís fishing zone (between 34º47S; 55º35’W and 34º54’S; 55º14’W), located inside the Río de la Plata estuary and to compare the interaction throughout three sampling periods. Trained observers made onboard observations from artisanal boats totalizing 21 samplings in 2002/03, 193 in 2004/05 and 119 in 2009/10. The existence

of temporal and spatial variation of incidental catches was analyzed. During 2004/05 we used Machine Learning procedures (CART and GLM) to test the effect of environmental, temporal and operational variables on these catches. A total of 20 juvenile green turtles were incidentally caught during 2002/03, 21 during 2004/05 and 66 during 2009/10. The mean capture per unit of effort (CPUE) was higher during 2002/03 (0,614 turtles/1000m2/hour), followed by 2009/10 (0,204 turtles/1000m2/hour), and 2004/05 (0,013 turtles/1000m2/hour), showing no clear pattern of increase or decrease of interactions. Seasonal variation was observed being the summer the most critical season where the highest CPUEs were registered for the three periods. Also spatial variation was recorded and hot spot areas of high risk of incidental captures were identified in insular and rocky areas of shallow waters based on the coincidence of captures observed during the three sampling periods. Gillnet soak time and distance to the coast of the fishing events were the significant variables that together better explained the variations in *C. mydas* incidental catches. The incidental capture probability for this species increased with longer soak time and shorter distance to the coast of the fishing activity. By means of sample-based estimators it was estimated that 497 green turtles were caught during 2004/05 (95% CI= 260 – 781) and 1584 during 2009/10 (95% CI= 1056 - 2158) by the total artisanal fleet that operate within the area. We conclude that the gillnet fishery that takes place in Bajos del Solís area during the summer in the coastal fringe of less than two kilometres from the coast, constitutes a threat to green turtle's juveniles. For the protection of this critical foraging and development habitat it is necessary to implement a marine protected area in the region with spatial and temporal restrictions on gillnets use.

LOGGERHEADS AND MEDITERRANEAN MONK SEALS: TWO FLAGSHIP SPECIES CLASH IN ZAKYNTHOS

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Laganas Bay in Zakynthos, Greece, holds the largest nesting aggregation of loggerhead turtles in the Mediterranean. Turtles of both genders typically begin to arrive in April, while nesting occurs from late May to early August. Zakynthos is also home to a resident population of Mediterranean monk seals (*Monachus monachus*). Since 1999 the wider Bay area is included in the National Marine Park of Zakynthos (NMPZ) which is administered by its Management Agency (MA). ARCHELON, since its foundation in 1983, conducts in Laganas Bay a sea turtle monitoring project, in the course of which turtle strandings are also recorded. Both loggerheads and monk seals are recognized broadly in Greece as flagship species and large national and international effort has been invested to conserve them. It was first noted in 1994 that monk seals in Zakynthos prey upon adult loggerheads by snapping off plastral scutes and feeding on the entrails. This unique behavior, not documented anywhere else in the world, was thought to have been caused by depleted levels of fish resources. Predation incidents were ceased after the death of a male monk seal. Although in subsequent years some similar predation incidents were noted, it was considered that these were occasional. Nevertheless, during 2010 a surge of predation incidents was documented; 21 adult turtles, most of these (85.7%) nesting females, were found predated by monk seals. It was also noted that the predation technique had been changed; instead of snapping off the plastron now monk seals opened the body cavity by tearing the skin at the base of flippers or at the throat. Predation continued unabated during the 2011 nesting season with 16 dead turtles, all nesting females. It should be noted that most turtle carcasses were found at sea and this, coupled with the intense monitoring work on beaches, precludes post-mortem predation by terrestrial mammals. Increased adult mortality of sea turtles can have a serious impact to the population. The most likely non-sustainable loss of nesting females, estimated respectively at 4% and 4.7% of the annual nesting population, made ARCHELON to pull the alarm signal. Indeed, the MA of the NMPZ together with ARCHELON, WWF-Greece and the Society for the Protection of Monk Seals (MOm) drafted a joint plan aiming to investigate the phenomenon and propose remedies. In spring 2012 fishermen reported a carcass of a male monk seal floating offshore. As no predation events were observed during the 2012 nesting season it was assumed that the predation incidents

of the previous two seasons were made by this individual. Despite the cease of predation events, probably temporary, it is apparent that work should be continued to comprehend the interaction between the two flagship species. Are loggerheads an opportunistic prey of monk seals, especially in years of low food availability? Does this behaviour involve all or a few monk seals? Only male monk seals show this behaviour? Further, it is important to manage also the social repercussions affecting the local community, conservation organizations, and national and supranational authorities.

IMPORTANCE OF THE ISLAND OF MAIO (CAPE VERDE) FOR CURRENT AND FUTURE LOGGERHEAD CONSERVATION IN THE EASTERN ATLANTIC

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The Archipelago of Cape Verde hosts the world's third largest loggerhead population. However, the available surveys indicate that more than 85 % of nesting happens on the island of Boa Vista. Previous reports suggest that the island of Maio has many suitable beaches for loggerhead nesting that could host a relevant number of nests every season. During 2011, a partial survey of the entire island provided an estimation of around 560 loggerhead nests on the island. During 2012, intensive and more accurate surveys have provided an estimation of almost 2,000 nests annually. These results indicate that the island of Maio, together with the island of Sal, are the most important areas for loggerhead nesting (in addition to the main rookery on Boa Vista island). The most important beaches for nesting are Djam Padja, Flamengo, Ribeira de Baia, Santo Antonio, Santana, Caletinha and Morro. On the other hand, the survey of 2011 in Maio indicated a severe harvesting of nesting females on the beaches as well as an intense poaching of fresh nests. Around 125 adult females (more than 65 % of nesting females) were hunted on the beach and around 380 nests (more than 65 % of total nests) were poached on the beach. The survey of 2012 has confirmed that the slaughter of females on the beach is very severe and unsustainable, substantially decreasing the overall number of nests laid on the beaches. Using nest counts at the beginning of the season we have estimated that around 450 females arrived this season to the beaches for nesting. However, more than 150 were killed. Several interviews with local people also indicate that the number of females caught at sea is already very significant. Many nests are also poached on the beaches during the first hours after egg laying. Together with this anthropogenic source of mortality, high tides, storms, beach erosion or ghost crabs destroy many nests on the most important nesting beaches and reduce the production of hatchlings on the island. The design and implementation of a nest relocation program to a protected hatchery is strongly recommended on the island. The camouflage of nests immediately after egg laying is also strongly recommended on the beaches by guards and the monitoring team, to prevent their poaching. Despite the intense level of exploitation of sea turtles on Maio, the island has a very important potential for the recuperation of loggerhead nesting in Cape Verde. The availability of many pristine white sand beaches together with the implementation of an exigent and ambitious conservation program may favor a quick increase of the levels of loggerheads nesting here over the following decades. Increasing nesting levels at this island could be extremely important to reduce the risk of extirpation faced by turtles from other Cape Verde Islands.

ANALYSIS OF SEA TURTLE SPECIMENS ON THE COAST OF KANTO AREA, JAPAN

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We surveyed the stranded sea turtle specimens washed up on the coast of the Kanto region of Japan in cooperation with NPO Association Everlasting Nature of Asia. The number of specimens from April 2003 to September 2012 was 404. The coast of the Kanto region hosts the largest stranding zone in Japan, where most of the stranded turtles are loggerheads and greens. Digestive tract contents from stranded loggerheads were crustaceans, seaweed, algae, and human artifacts. Prey item frequency was calculated by using the following equation: number of turtles that consumed the contents / total number of turtles from which we collected the contents x 100. In addition to digestive track contents, carapace size, and tags were analyzed from stranded specimens.

DEVELOPMENT AND TESTING OF A TOW TIME DATA LOGGER TO MONITOR AND ENFORCE TOW TIME RESTRICTIONS IN TRAWL FISHERIES

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Tow time restrictions have been discussed as a viable alternative to Turtle Excluder Devices (TEDs) in fisheries where TEDs are likely to significantly reduce targeted catch. Tow durations less than an hour are usually expected to result in a negligible number of sea turtle mortalities. The Protected Species Branch of NOAA’s Northeast Fisheries Science Center (NEFSC) solicited a contractor to develop and construct a robust, simple, and inexpensive data logger that could be used to enforce tow-time restrictions on commercial bottom trawl fishing vessels. These loggers, which are attached to the trawl net or the trawl doors, were tested for their ability to reliably record trawl fishing times and to detect when a tow exceeded a certain time threshold. The testing occurred on eight vessels operating in six fisheries and has shown that the logger holds up to the physical abuses of the salt environment and the shock and vibration of commercial fishing practices. Currently, we are working with the manufacturer to resolve some software issues, and are close to having a viable tow time logger that works as intended. Because these loggers are also programmable, they may have applications in other fisheries where there is a need to monitor, record, or enforce fishing time.

PELAGIC PREDATOR DISTRIBUTIONS AND ANTHROPOGENIC IMPACTS: IMPLICATIONS FOR EFFECTIVE SPATIAL MANAGEMENT IN THE CALIFORNIA CURRENT

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Predators, including sea turtles have disproportionate impacts on marine ecosystems, yet we lack a spatially explicit assessment of cumulative human impacts to their populations that is essential for effective and comprehensive management of their populations. We created a cumulative utilization impact metric by combining tracking data of eight protected species of leatherback sea turtles (*Dermochelys coriacea*), four species of marine mammals, and three species seabirds (n=685 individuals) in the California Current and 24 species-specific weighted anthropogenic stressors to determine the overlap between relative habitat use of species and the potential human impact on those species. We found significantly greater impacts in the US National Marine Sanctuaries and on the continental shelf, with 82.6 and 98.2% of core cumulative utilization impact areas occurring within these regions, respectively. Species may benefit from increased spatial management in the Sanctuaries and other regions. Variation in how species and impacts are distributed emphasizes that using either alone is insufficient for effective spatial management. Results can be used to concentrate more effective management in areas where efforts will be both ecologically relevant and economically feasible across species.

MORTALITY AND BYCATCH OF SEA TURTLES ASSOCIATED WITH ANTHROPOGENIC FACTORS ON THE SOUTHERN COAST OF PERNAMBUCO STATE, BRAZIL

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Sea turtles occuring along the brazilian seashore are registered nesting, foraging, and using this area for reproduction and rest. At the beaches located on southern coast of Pernambuco State, Brazil, there are nesting registers of *Eretmochelys imbricata* in greater frequency, and in less number of *Caretta caretta*, *Lepidochelys olivacea* and *Chelonia mydas*, also with occurrence of stranded and dead turtles. These species are currently classified by IUCN within endangered categories, due to human impacts that act on populations of marine Testudines, causing unnatural decline of these species worldwide. Thus, the need for studies aiming to assess how these impacts affects the biology of this group are essential to compose management and conservation plans to mitigate the pressure on these animals. Therefore, this study intended to relate the occurrence and possible causes of stranding and death of sea turtles. The mortality records of sea turtles were realized from September 2009 to april 2010, in Cupe, Merepe, Muro Alto, Porto de Galinhas, Maracaípe and Serrambi beaches, totalizing 16 km of monitored coastline, on the southern coast of Pernambuco, Brazil. The monitoring of these beaches were performed daily, where reproductive and non reproductive data such as sea turtle mortality and stranding were registered. The data were gathered by the technical team of NGO Ecoassociados, which acts on monitoring and conservation of sea turtles in Pernambuco. A total of 93 dead turtles were registered, from which the highest percentage was 68% for *C. mydas*, 19% for *L. olivacea*, 6% for *E. imbricata*, 1% for *C. caretta* and 5% could not be identified. It was noticed that 57% of individuals found dead were females, this may be associated with the fact that the observations were made in the spawning period, implying a greater number of female turtles being exposed to several factors that may have been the cause of deaths. Amongst the individuals found dead, 8% had external tumors, 4% had fishing nets marks; 4% with probable death due to accidents with boats; 1% was found injured with knives marks and 80% were found in a high stage of decomposition, being unable to ascertain the cause. The months with the highest number of specimens found dead were November and December with 50% of death records. Were also found 18 turtles weakened,with *C. mydas* (6 females, 1 males and 2 juvenile), *E. imbricata* (3 females) and non defined (6). The data reported here show the importance of continuous monitoring of the area for the conservation and management of sea turtles at this location, and the development of educational activities, being extremely importance to the effectiveness of risk reduction of the species. Furthermore, they can also be used as a basis to fill gaps in knowledge and management of environmental issues.

LEATHERBACK AND GILLNET INTERACTIONS OFF PERU, HIGHLIGHTING IN COASTAL BYCATCH

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Fishing gear interactions with sea turtles have been increasing worldwide, generating high numbers of sea turtle bycatch. Leatherbacks (*Dermochelys coriacea*) are critically endangered in the Eastern Pacific Ocean. This species interacts primarily with artisanal fisheries rather than industrial fisheries in Peru. Despite the fact that all sea turtle species are protected by Peruvian governmental policies, leatherback bycatch persists. A wide range of artisanal fishing gear is used in Peru, however, coastal gillnets are particularly dangerous due to their high mortality rates. In this survey, we compared the leatherback bycatch in both coastal and offshore gillnets. Structured interviews were carried out with local fishermen in three harbors along the Peruvian central coast from March-November, 2012. Most of these interactions occurred in coastal gillnets targeting stingrays, guitarfishes, mullets and humpback smooth hounds, however this interaction also arises in offshore gillnets called “animaleras”, used to capture dolphin fish, shortfin makos, blue sharks and manta rays. Coastal fishing areas were identified as having the highest number of leatherback interactions, at least 5 times greater than in the offshore areas. This information can be used to asses fishing regulations and local and regional mitigation measures, in order to enforce conservation efforts by the Peruvian government on this critically endangered species.

BYCATCH MASS MORTALITY OF LOGGERHEAD TURTLES AT NW MEXICO

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The waters of northwest Mexico’s Gulf of Ulloa host an extraordinarily high concentration of the North Pacific loggerhead turtle. Overlap between this juvenile foraging hotspot and instense artisanal fisheries can produce among the highest turtle bycatch rates reported worldwide. These high bycatch rates were mitigated from 2007-2012 by local fisher leaders who voluntarily changed fishing practices, resulting in thousands of turtles spared each year. During July 2012, 483 loggerhead turtles stranded along the 43km index shoreline of Playa San Lázaro that borders the hotspot, representing a 600% increase over the alarming interannual average of 78 loggerheads stranded there each July since 2003. Turtle mortality in artisanal fleets during July 2012 likely numbered in the 1,000s because a) when mortality occurs at sea only a small proportion of turtles (~20%) strand due to oceanographic factors and b) surveys were conducted on less than 25% of the shoreline of the Gulf of Ulloa. This level of mortality likely jeopardizes the recovery of the North Pacific loggerhead population, which is classified as endangered by Mexico and the USA. This mass stranding event corresponds to unusually high turtle local bycatch rates. During a July 2012 INAPESCA research cruise mean bycatch rates in excess of 2 turtles/24hr/100m net were observed, which translate to 8-16 turtles caught/day/skiff. High bycatch was caused initially by a nationwide shark fishing ban which drove many crews to fish with bottom-set nets for finfish This transfer effect was compounded by unusually high halibut landings which led to increased fishing effort and also unusually high loggerhead turtle abundance in nearshore waters. Government action is urgently needed to mitigate turtle bycatch in the Gulf of Ulloa; enforcement is required to curb illegal fishing by artisanal and industrial vessels. Artisanal fishers require assistance to implement the bycatch avoidance solutions they have helped devleop over the past decade. This mass mortality event reveals the vulnerability of voluntary bycatch avoidance programs. While they can be highly productive, both unrelated government interventions and ecological variability can affect their effectiveness.

FIRST REPORT OF PLASTIC ITEMS IN STOMACH AND INTESTINAL CONTENTS OF GREEN TURTLES (*CHELONIA MYDAS*) IN THE GULF OF VENEZUELA

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Discharge a serious problem of marine pollution in recent years. The incidence of synthetic material intake for sea turtles has been documented and reported in several locations becoming one of the leading causes of death and weakening of these species. In order to increase the knowledge about the feeding ecology of the green turtle (*Chelonia mydas*) in the Gulf of Venezuela, we necropsied three juvenile turtles from Zapara Island (10 ° 58 '57 "N, 71° 33' 52.92 "W), and examined the stomach and intestinal contents. Analysis of prey organisms exhibited common diet items for green juvenile turtles, with the main presence of algae, followed by mollusks (not identifiable items), *Thalassia testudinum* and sponges (*Chondrilla caribensis*). We report for the first time the presence of plastic elements in the digestive tract of sea turtles in the Gulf of Venezuela, including hard and soft plastic bags of low and high density polyethylene, PVC (Polyvinyl Chloride) remains, pipe fragments of containers (HDPE), nylon and baby wipes (made of synthetic fiber based on polyethylene terephthalate). The plastic items were abundant in the intestinal tract (9,93%), however we found them also in the stomach content (4.44%). As juvenile sea turtles feed on pelagic material and are unselective, the consumption of plastic debris can be very probable in polluted waters, leading to possible serious health problems. When consumed in small amounts, this material can cause esophageal obstructions, perforations and lacerations in the intestine, leading to starvation and thus the death of the animal. The Gulf of Venezuela has been widely described as an important feeding area for the development of juvenile green turtles and this study confirms that it ecosystems, as well as the sea turtles, do not escape from the consequences of marine pollution that are prevailing worldwide. We consider this report as an urgent call for increasing the efforts in environmental awareness, developing effective plans for environmental education, recycling and reprocessing of plastic in surrounding communities and inner-city beaches, in order to increase the regional knowledge about the impact of plastic debris and mitigate its impact on sea turtle populations.

SEA TURTLE BYCATCH IN ARTISANAL FISHERIES IN PARANÁ, SOUTHERN BRAZIL

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The incidental capture of non-target species is currently considered one of the biggest ecological, economical and social problems in the world. Sea turtles are directly affected in this way worldwide. In the state of Paraná, southern Brazil, information on incidental catches are limited and fragmented, making it impossible to diagnose the local impact of fisheries. From February 2009 to January 2010, 141 interviews were conducted to characterize the fisheries that interact with sea turtles over 10 artisanal fishing communities. Nearly 70% fisherman reported the incidental capture of at least one species of sea turtle once time in their lifetime. The turtles most frequently caught are green turtles (*Chelonia mydas* - 49),

loggerheads (*Caretta caretta* - 14), leatherbacks (*Dermochelys coriacea* - 6), olive ridleys (*Lepidochelys olivacea* - 2) and hawksbills (*Eretmochelys imbricata* - 1). Incidental capture frequency was recorded from 129 fishery interactions with higher frequency in the bottom nets with 16 to 25 cm mesh (46.5%), followed by drift nets with 9 to 12 cm mesh (12.4%) and bottom trawl fishery (7.8%). The highest catch rates and mortality of turtles were from nets with 16 to 25 cm mesh: on average 44.4 individuals caught per boat per annum (s = 83.7, CI = 37.6, n= 19) and until 90% of turtles die. Although catches of turtles occur at different locations on the coast, areas of consolidated substrate is the main environment-related (islands and emerged and submerged rocky shores). Some fisherman reported larger catches of turtles near rivers and shoals and sandbanks. Regardless of fishing equipment, most incidental capture of turtles occurs in the winter season (37.8%, n = 90), followed by that there is no particular period or that the capture is equal to throughout the year (35.6%). For gillnets of water column reports indicated 2 to 60 catches per vessel per year, usually living, however the mortality rate can reach 60%. Most fisherman reported that there was a reduction in the catch of turtles over the years (47.3%), followed by no change (39.2%) and an increase in the catch (13.5%). The reduction likely being from a decrease in the abundance of turtles. Besides reports of interactions with the equipment used, fishermen highlighted environmental aspects that influence the probability of capture. The information obtained is essential for understanding the dynamics of local fishing and for developing a monitoring program to document incidental catches.

MONITORING OF ORGANOCHLORINE PESTICIDES IN JUVENILE *CHELONIA MYDAS* (TESTUDINES, CHELONIIDAE) CAUGHT IN BRAZILIAN SOUTHEASTERN COAST

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Many are the threats to sea turtles conservation but a special concern remains in the Fibropapillomatosis (FP), which has been considered a big threat principally against the survival of *Chelonia mydas*, on account of its worldwide distribution and multifactorial etiology. Along the Brazilian coast, the historical economic expansion and resource use activities have resulted in increased sources of pollution, for example chemical products such organochlorine pesticides (OCPs), long term use for agriculture purposes resulting in their ubiquitous presence. Banned in Brazil for agriculture in 1985 and in campaigns against vectors since 1998, these compounds are commonly referred as persistent organic pollutants (POPs) because they remain in the environment due to their physical chemical properties and have the potential for bioaccumulation and biomagnification, being constantly incorporated in the trophic web. The contamination for sea turtles occurs mainly through food, also chronic exposure and low levels have been associated with immunological, reproductive and carcinogenic effects. So, due to the potential negative influences to the marine health, pollutants like organochlorines (OCs) are pointed as having a possible relation with widespread diseases like FP. In order to monitoring some OCPs in marine chelonians, 64 juvenile green sea turtles, 24 of them with FP, were necropsied and 51 fat and 64 liver samples were collected. In both tissues, twelve organochlorine pesticides (α-BHC, β-BHC, Heptachlor, Dicofol, op´-DDD, α-Endosulfan, op´-DDE, pp´-DDE, β-Endosulfan, pp´-DDD, Endosulfan sulfate and Mirex) were evaluated with a new extraction method involving 1 g of tissue sample and acetonitrile saturated with n-hexane, two clean up stages (magnesium sulfate and PSA up followed by silica gel column) and analyzed by GC–μECD system. All the 51 fat samples analyzed showed contamination of at least one of the twelve OCs pesticides monitored; highest concentrations (ng g-1) were found for: Dicofol, 2141.0581; α–Endosulfan, 136.3498; Heptachlor, 62.9210; Endosulfan sulfate, 61.7963; α-BHC, 48.0612; op´-DDD, 41.2959; β–Endosulfan, 38.6392; op´-DDE, 34.9153; β–BHC, 33.9309; pp´-DDE, 20.9140; Mirex,19.5694 and pp´-DDD, 4.2328. From the 64 liver analyzed samples, fifty nine showed contamination for at least one of the OCs pesticides monitored; highest concentrations (g ng-1) were found for: Mirex, 597.4578; α–Endosulfan, 111.1567; Dicofol, 93.9027; Endosulfan sulfate, 89.4243; Heptachlor, 54.4362; op´-DDE, 29.2114; β–Endosulfan, 28.0161; β–BHC, 25.9516; op´-DDD, 13.9483; pp´-DDE, 13.4780; α-BHC,13.3562 and pp´-DDD, 10.7563. These results demonstrate that sea turtles are getting pollutants from marine environment probably via food and during displacement, however further studies are required in order to establish baseline contaminant levels and better comprehension of their possible effects. Underway additional studies will attempt to correlate these results with the presence and severity of FP and Body Condition Index (BCI) aiming to clarify the role of these pollutants on the health of green sea turtles providing additional information for environmental decisions towards conservation efforts. Acknowledgements: Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP): 2011/04565-7 and 2010/01781-8; Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq): 578051/2008-7; Projeto TAMAR-ICMBio and the International Sea Turtle Symposium and sponsors.

USING EARTH SYSTEM AND GLOBAL CLIMATE MODELS TO ASSESS THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON SEA TURTLES

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Research examining the potential impacts of climate change on marine organisms, including sea turtles, has been expanding over the past decade. Many of these studies use output from global climate models that are assessed by the Intergovernmental Panel on Climate Change (IPCC). The upcoming IPCC assessment report (AR5) will also include Earth System Models (ESMs) that couple global climate models with biogeochemical models to resolve terrestrial and marine primary production. Unlike global climate models that only resolve physical variables, ESMs provide projections of biogeochemical variables including pH, dissolved oxygen, and macro- and micro-nutrients. The use of IPCC-class model output to project the impacts of climate change on marine organisms must begin with an understanding and statistical treatment of each model's bias and uncertainty. In many cases, this involves downscaling lower resolution global models to resolve regional climate dynamics and/or bias correcting the magnitude and variability of specific variables. For sea turtles, climate change projections can be used for both their terrestrial and oceanic habitat and thus climate model output must be statistically downscaled or bias-corrected before applied to an assessment of potential impacts. Here I discuss specific examples from the major nesting populations worldwide by showing output from a suite of IPCC-class ESMs (i.e. primary production) and global climate models (sea surface temperature) that project the impacts of continued greenhouse gas emissions on critical marine and nesting beach habitat. I also show the consequences of misuse of climate model output in sea turtle/climate change impact assessments while discussing some statistical techniques to bias-correct output. The main goal of this presentation is to inform the sea turtle research community of the caveats and statistical treatment of ESMs and global climate models, as well as the basic structure of these models and how they can be used to assess the impacts of climate change on sea turtles.

IS THE SW MEDITERRANEAN SEA A TRAP FOR NORTH ATLANTIC LOGGERHEAD TURTLES?

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Working alongside fishing vessels in the productive Alboran Sea, we deployed satellite transmitters on sub adult loggerhead turtles (*Caretta caretta*) that had either been caught in longline fishing gear or had been captured while basking at the surface of the water. Over the course of 4 years, 26 turtles were captured and tagged. In this analysis, we describe the movements and tracking durations for both turtle groups in the western Mediterranean Sea, including a westerly movement of loggerhead turtle into the Atlantic Ocean. We present an understanding of turtles' habitat use in relation to oceanographic features in the region and we speculate on potential threats to turtle populations due to both pelagic and fixed fisheries from both European and North African coastlines. We will also discuss our findings of hematological and biochemical parameters of longline-caught and control turtles to determine physiological impacts due to stress of capture.

CONNECTING THE DOTS: THE HIDDEN COSTS OF PLASTIC POLLUTION TO MARINE TURTLES

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Entanglement in plastic debris and ingestion of marine plastics are well known sources of direct mortality to ocean wildlife. However, the problem may be much larger than what can be inferred from stranding networks and necropsies. We review the literature and use marine turtles as a case study to suggest that: (1) non-lethal ingestion may reduce energy budgets and decrease reproductive output; (2) persistent organic pollutants adsorbed on plastic debris may accumulate in turtles and eggs through direct and indirect consumption; and (3) micro plastics in beach sand may change thermal profiles and alter sex ratios of hatchlings. We discuss the potential for population-level consequences and highlight areas in need of future research.

ARE TURTLES EATING MORE DEBRIS? A GLOBAL ANALYSIS SINCE 1900

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Marine debris ingestion can result in both lethal and sub-lethal impacts to sea turtles and other wildlife. Although studies have reported on debris ingestion by marine turtles, and implied that this incidence may have increased over time, there has not been a global synthesis since 1985. To address this, we analyzed 37 studies published from 1985-2012 reporting on data collected since pre-1900 to answer the following questions: Has ingestion prevalence changed over time? What types of debris are most commonly ingested? What is the geographic distribution of debris ingestion by marine turtles relative to global debris distribution, and which species and life history stages are most likely to ingest debris? This study shows conclusively that the ingestion of debris by sea turtles has increased significantly over time, with plastic being the most commonly ingested debris type. Turtles in nearly all regions studied were found to ingest debris, but the probability of ingestion does not relate to modeled debris densities. Comparing turtle species and foraging strategy, carnivorous species are less likely to ingest debris than are herbivores or gelatinovores. This research indicates that oceanic stage leatherback turtles and green turtles are at the greatest risk from ingested marine debris. To reduce this risk, anthropogenic debris must be managed at a global level.

SHADING IN SITU MARINE TURTLE NESTS: A POTENTIAL PRACTICE TO MITIGATE NEST TEMPERATURES IN RESPONSE TO CLIMATE CHANGE

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Although species have shown the ability to adapt to historical changes in climate, it is predicted that population adaptation will not be able to keep up with the accelerated rate of human-driven climate change. Climate warming is expected to result in marine turtle sex ratio bias towards females, because the sex of a marine turtle is determined by incubation temperature, with female hatchlings produced at higher temperatures. Likewise, nest temperatures beyond the thermal tolerance range can result in nest failure. Loggerhead sea turtle (*Caretta caretta*) nest temperatures throughout Florida have resulted in a bias toward the production of female hatchlings; this female bias is expected to become greater due to climate change. Also, an increase in nest temperatures beyond the thermal tolerance range will increase embryo mortality. One option for mitigating the impacts of climate change on hatchling sex ratios and embryo mortality is the use of shading to reduce nest temperatures. In this study, we tested the thermal effects and effects on hatching success of a cotton shade cloth maintained over 21 in situ loggerhead nests for the duration of incubation. The study was completed during the 2012 nesting season, with nests laid during the months of June and July, at Canaveral National Seashore, an important rookery for loggerhead sea turtles on the Atlantic coast of central Florida. We compared two treatments: un-shaded loggerhead nest (n=21) and shaded loggerhead nest (n=21), using a matched-pairs layout. Nest temperatures were recorded using temperature data loggers, with a data logger deployed opportunistically during egg deposition in the center

of each loggerhead clutch in the study. We used mean daily nest temperatures for the middle third of incubation to predict sex ratios for each nest. Hatching success evaluations were completed for all nests in the study to compare embryo mortality between shaded and un-shaded treatments. With this study, we are able to inform the degree to which the application of shade to a loggerhead nest will affect the nesting environment.

CONSERVATION AND MANAGEMENT OF OLIVE RIDLEY SEA TURTLES (*LEPIDOCHELYS OLIVACEA*) AT INTENSIVE SPORADIC NESTING HABITATS OF ANDHRA COAST, BAY OF BENGAL, INDIA

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The olive ridley sea turtle is distributed in the tropics of Indo-Pacific and East Atlantic Oceans. In India it is found all along the east and west coasts and has been placed in Schedule I of the Indian Wildlife Protection Act (1972). It is listed in Appendix -I of the Convention on International Trade in Endangered Species (CITES) which prohibits trade in turtle products. All five species nest on the coasts of the Indian Ocean and its bay islands, where olive ridleys mass (Arribada) nest on the Gahirmatha beaches of Orissa State in the Northern Indian Ocean. Nesting olive ridleys migrate from the oceanic Indian Ocean to mass nesting sites of Orissa, during winter months (November to February), through the coastal waters of Tamilnadu and Andhra Pradesh. Before reaching the mass nesting sites of Orissa some of the turtles utilize the North Andhra coast for their sporadic nesting activity. After mass nesting sites of Orissa, the Northern Andhra Pradesh Coast (NAC) is an important sporadic nesting habitat to olive ridley sea turtles with diversified nesting beach environments. Nesting densities of olive ridley turtles is varied from riverine sandy spits (< 20 nests/km), mainland beaches (>5nests/km) to calcareous shoals (< 2 nests/km). As part of conservation measures in situ management of nests and protection of newly born hatchlings were done at Godavari and Vamsadhara river mouth beaches. Awareness campaigns for the fishermen community were conducted at major fishing harbors for the implementation of Turtle Excluder Devices (TEDs) to reduce incidental mortality. The vulnerable nesting sites of the olive ridleys were frequently monitored to reduce the natural predation and human depredation of eggs.

EFFECTS OF LED ILLUMINATED GILLNETS ON BYCATCH OF LOGGERHEAD TURTLES IN COASTAL MESH NET FISHERIES AT BAJA CALIFORNIA SUR, MEXICO

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Mesh net fisheries are globally ubiquitous and have been identified as one of the leading sources of marine turtle bycatch. Unlike other fisheries with high rates of bycatch, there are few solutions to reduce marine turtle bycatch in mesh nets. The overlap of intense bottom-set gillnet fisheries with a loggerhead foraging hotspot at Baja California Sur produces among the highest marine turtle bycatch rates documented worldwide. The resulting mortality is of international concern because of the status of the North Pacific loggerhead population, which was recently uplisted to endangered under the US ESA in 2011 and identified as one of the worlds 11 most endangered marine turtle RMUs. Thus, there is a pressing need to develop novel bycatch reduction solutions without significantly decreasing catch rates of target species. We conducted controlled experiments at Baja California Sur, Mexico to compare loggerhead bycatch rates, non-turtle bycatch rates, and target catch rates between illuminated nets (nets with green LED lights) and conventional (control) nets. The experiment consisted of a fully crossed design partitioned into four treatments: day control (conventional nets), day experiment (illuminated nets), night control (conventional nets), and night experimental (illuminated nets). In 28 sets of gillnet pairs, 89 loggerhead turtles were caught at an average rate of 0.96 ± 0.97 and 0.84 ± 0.92 turtles per 24 h per 100 m of control and illuminated net, respectively. Loggerhead bycatch rates were lower by 75% in illuminated nets during night versus control nets during day, and 46% lower in illuminated nets during night versus control nets during night. However, there was only a 13% decrease in loggerhead bycatch rates in illuminated versus control nets across 24 h periods. Non-turtle bycatch rates of fish, crab, and squid were lower in both day and night illuminated nets. Target catch rates were higher for both day treatments versus both night treatments, although market values (USD) remained consistent between all four treatments. Elasmobranch and halibut target catch rates were higher in both day treatments versus both night treatments, with higher catch rates in day and night control nets for elasmobranch and higher catch rates in day and night illuminated nets for halibut. Our results suggest that illuminated gillnets may be promising for mitigating marine turtle bycatch in fisheries that operate solely at night.

SYNOPSIS OF THREATS TO SEA TURTLES IN THE GULF OF GUINEA: CONSERVATION IMPLICATIONS OF ILLEGAL, UNREPORTED AND UNREGULATED (IUU) FISHING

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Sea turtle conservation and the maintenance of biodiversity are integral parts of the Ecosystem Approach to Fisheries (EAF), which is one of the most current global environmental management instruments. A wide array of major threats to sea turtle conservation - including the impacts of fisheries - are highlighted. Harvesting by fishermen during nesting at the beach, beach erosion (escalated in some places by ship wrecks), environmental pollution from accidental oil discharge and indiscriminate dumping of solid non biodegradable wastes impact sea turtles. Direct and indirect impacts of fisheries like shark driftnets, seine nets and long lines also impact turtles negatively. Large scale habitat degradation is caused by incessant demersal shrimp trawling (due to overcapitalization of the industry and overexploitation of the resources) despite the installation of turtle excluder devices (TED) in most of the trawl nets in Nigeria and Cameroon. Illegal, unreported and unregulated (IUU) fishing, which takes place both on the high seas and within national zones, by foreign or national vessels, constitutes a major problem with adverse biological, environmental, social and economic effects and implications on sea turtle conservation in the sub region. A Food and Agriculture Organization (FAO) promoted International Plan of Action on IUU fishing (IPOA-IUU), a voluntary instrument to prevent, deter and eliminate IUU fishing is highlighted. Recommendations are also proffered to mitigate the threats to sea turtle conservation and promote responsible, stakeholders-based fisheries management to ensure sustainable development.

OVERVIEW OF SOUTHEAST FISHERIES SCIENCE CENTER FISHERY OBSERVER PROGRAMS AND BYCATCH ANALYSIS

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Sea turtles are incidentally captured in commercial fisheries, and these interactions must be documented and quantified to understand the extent of the problem. The National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) operates Fisheries Observer Programs to collect vital catch and bycatch data from commercial fisheries in the southeast United States. Those fisheries currently observed by NMFS in the southeast include the pelagic longline, reef fish, shrimp trawl, purse seine (menhaden), shark gillnet, and shark bottom longline fisheries. Fisheries observers undergo extensive training to accurately characterize fishing gear, and to identify and quantify target and bycatch species for stock assessment and biological studies. NMFS observers document protected species interactions in careful detail. When a sea turtle is captured by a fishing vessel, the observer records the species, identification criteria, condition at capture and release, fishing gear details, specific hooking location or tow times where applicable, entanglement status, amount and type of gear remaining at release, morphometrics, and resuscitation efforts and condition evaluation for comatose or unresponsive turtles. Interaction data are used to generate estimates of sea turtle bycatch rates and to investigate patterns in injury and mortality. Observers in the pelagic longline fishery also document the presence of required careful release tools on the vessel. Turtles are tagged, measured, and biopsied so that demographic and life history parameters can be used to enhance recovery efforts of these endangered and threatened species.

SEA TURTLE RESEARCH, RESCUE AND REHABILITATION CENTRE (DEKAMER), DALYAN, MUGLA-TURKEY; RESULTS OF THE FIRST FOUR YEARS

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The first sea turtle rescue centre (DEKAMER) in Turkey was established in 2008 and its activities during the first four years are shown in these results. A total of 61 injured, sick or problem turtles were admitted to the centre, 56 *Caretta caretta*, 12 *Chelonia mydas* and 2 fresh water turtles *Trionyx triunguis* were admitted to the centre during the first four years 2008-2012. With 2 of the 70 sea turtles having been readmitted after previous treatment and release. Thirty-nine in total were treated, recovered and released back to the sea as healthy individuals. There are currently 6 sea turtles still undergoing treatment and rehabilitation at the centre. Injured turtles were mainly found and collected from within the Muğla province. In order to determine the true cause of mortality, autopsies were conducted on all dead turtles. The main causes of injuries and deaths were found to be related to fishery and boat activities, such as fishing line and hook ingestion (16%), fishing line entanglement (33%), propeller cuts (14%) and speed boat crashes and impacts (7%). Mean treatments take two and half months (77 days). This varies depending upon the type of injury, and size and depth of wounds being treated.

MORTALITY AND SERIOUS INJURY DETERMINATIONS FOR SEA TURTLES IN THE NMFS NORTHEAST REGION, 2006-2010

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The National Marine Fisheries Service Northeast Sea Turtle Serious Injury Workgroup reviewed all sea turtle interactions recorded by the Northeast Fisheries Observer Program from 2006 to 2010 (n=145). The workgroup determined the condition of individual turtle interactions using guidelines established by the publication 'Technical Working Guidelines for Assessing Injuries of Sea Turtles Observed in Northeast Region Fishing Gear.' Turtles were placed into categories using identified post-release mortality rates, or by 100% mortality determination. Sea turtle records were subsequently delineated by major gear type, resulting in 97 trawl records, 29 gillnet records, and 11 scallop dredge records for which injury determinations were made. In addition, there were three cases with insufficient information to make a determination, two records that described moderately to severely decomposed animals not attributable to the observed fishery, and three records that had injury determinations but were excluded due to confidentiality issues. Considering the 137 records with injury determinations, the resulting mortality rate for trawl gear is 47%, the mortality rate for gillnet gear is 58%, and dredge gear is 80%. Additional factors that may influence sea turtle serious injury and mortality were considered, such as specific fishery (within an encompassing gear type), geographical area, sea turtle species, and life stage.

UNUSUAL COLD-STUNNING EVENT OF GREEN TURTLES IN URUGUAY

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Hypothermic, or cold-stunning, occurs when a sea turtle is abruptly exposed to cold water, normally as a result of unusually cold weather or sudden cold fronts, and it cannot compensate fast enough to avoid a sudden drop in body temperature. When sea turtles are trapped in cold waters they may become lethargic and buoyant, floating at the surface, and the effect of the winds and currents on the sea surface could cause a massive sea turtle stranding. In Uruguayan waters, the hibernation strategy has been described as a survival strategy of juvenile green turtles (*Chelonia mydas*) to tolerate low temperatures during the austral winter. It has been recorded that some green turtles remain in these waters during the coldest months, as reflected by stranding events, radio telemetry studies, in water surveys and satellite telemetry. Hence some juveniles of this species may tolerate low temperatures recorded in the area in winter. During July 2012 record-breaking cold weather occurred throughout Uruguay. The seawater surface temperatures went down under 10 degrees Celsius (°C), normally the seawater mean temperature in Uruguayan coast varies between 11 to 12 °C. From 12th to 19thof July in the Rio de la Plata estuarine influence zone of the Uruguayan

coast; specifically in Punta del Este (department of Maldonado, South-East Uruguay) and in Montevideo where the temperature dropped as low as 9 and 8.5°C, respectively. Prevailing winds those days are from the South and Southwest on the 15th of July there were 25-30 nuts southwestern winds. Ninety juvenile green turtle strandings were registered in the Uruguayan coast from the 13th to 25th of July, being the 15th, 16th and 17th the days with the highest number of strandings. Most of them were recorded in the external estuarine zone (departments of Canelones and Maldonado). Twenty of them were found dead. The others were sent to Karumbé Rehabilitation Center in Montevideo and other civil organizations centers in the department of Maldonado for recovery. Most of the 35 turtles at the Karumbé center appeared to be in good physical condition but half of them presented floating problems, pneumonia, skin infection diseases and septicemia. All the individuals were juveniles (mean± SD curved carapace length, notch to tip [CCLn-t]= 39.9± 3.96 cm). Eighteen of them continue in rehab. Karumbé recorded previous cold-stunned sea turtles in the period of the last 12 years but the 2012 event has been the one with the highest number of turtles stranded recorded. No other species stranded during those days, since density of loggerhead and leatherback turtles seem to decrease in the area during the austral winter. Monitoring these mass stranding events provides a unique opportunity to obtain information about this phenomenon, and the consequent impact on sea turtle populations that spent the whole year in this temperate region of the South Western Atlantic ocean.

INVESTIGATION OF THE EFFECTS OF SEA LEVEL RISE ON SEA TURTLE NESTING DISTRIBUTIONS WITHIN THE SOUTH ATLANTIC BIGHT

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Sea level rise (SLR) and disturbances from increased storm activity are expected to diminish coastal habitats available for sea turtle, seabird, shorebird, and beach mouse nesting by removing habitat as well as inundating nests during critical incubation periods. Our study links long-term survey data for three species of sea turtle to maps of coastal vulnerability to sea level rise (SLR) in order to understand the effects of sea level rise on population viability. We have integrated GIS and location-specific data for sea turtle nests collected across the South Atlantic Bight coastline into a data layer for this study. We are using 2005-2010 annual surveys for sea turtle nests to map the extent of nesting locations for each species along our study region. Coastal habitat will be ranked based on relative density of nests, which will determine its relative importance, or habitat suitability, for each species. We will create GIS map layers of coastal nesting habitat likely to be lost due to SLR as informed by the U.S. Geological Survey's Coastal Vulnerability Index (CVI), created for the Atlantic coast of the U.S. which provides an overall assessment of a coastal area's vulnerability to erosion and inundation as a function of SLR. The published CVI is based on historical trends of SLR, and does not consider future SLR projections with global warming. However, we will use the CVI framework to develop CVI for selected future Intergovernmental Panel on Climate change (IPCC) SLR scenarios to assess changes in CVI with changes in SLR rates. The modified CVI will be combined with coastal nesting density maps of our focal species to create habitat vulnerability maps for selected future SLR scenarios. Our first objective is to present habitat suitability maps for nesting sea turtle species along the South Atlantic Bight. Our second objective is to integrate a model of SLR along with long term field biological observations in order to predict vulnerability to nesting habitat loss for sea turtle species

within our study region. In sum, we will present preliminary data analyses and maps for objective one and two. With the results from our study, planners and decision makers will be able to choose from a portfolio of mitigation techniques for policies relevant to coastal nesting species. There is an urgent need to determine long-term plans so that the most cost-effective strategies of reducing the effects of sea level rise on coastal species can be determined.

UV ILLUMINATION OF GILLNETS REDUCES SEA TURTLE AND ELASMOBRANCH BYCATCH

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Visual cues play important roles in sea turtle foraging behavior. As such, and altering these cues can be a useful strategy to reduce the incidental catch of sea turtles in fisheries. We examined the potential effectiveness of illuminating gillnets with ultraviolet (UV) LEDs in an effort to reduce bycatch of green sea turtles (*Chelonia mydas*) in coastal fisheries. Net illumination was also tested in a commercial bottom gillnet fishery to quantify its effects on target fish catch rates and catch value. When we compared catch rates in nets illuminated by UV LEDs with catch rates in control nets, we found that the UV illuminated nets: 1) significantly reduced mean sea turtle catch rates (by ~40%), 2) had similar rates of target fish catch and catch value, 3) increased the catch of California halibut (*Paralichthys californicus*), the most valuable species in the fishery, by ~ 32%, 4) decreased the bycatch of elasmobranch species by 29% and 5) decreased the bycatch of scalloped hammerhead sharks (*Sphyrna lewini*) by 57%. Taken together, our findings indicate that UV illumination may have application in global fisheries to both reduce sea turtle and elasmobranch bycatch. These results illustrate the potential for modifying fishing gear with visual deterrents to effectively reduce bycatch species rates without affecting fishers' revenues.

FEEDING BEHAVIOR OF LOGGERHEAD (*CARETTA CARETTA*) AND LEATHERBACK (*DERMOCHELYS CORIACEA*) SEA TURTLES: A MODEL TO UNDERSTAND BYCATCH

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Loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) turtles are two sea turtle species caught commonly as bycatch in longline fishing. The leatherback feeds primarily on gelatinous zooplankton while the loggerhead is a carnivore feeding on mollusks, echinoderms and crustaceans. Hence, the attraction and capture of loggerheads to baited longline hooks is not surprising but the attraction and capture of leatherbacks is somewhat unexpected. We measured and compared the responses to olfactory cues and investigated the responses of these two species to bait odors in controlled laboratory experiments to better understand releasers of feeding behavior. Previous studies quantified and compared feeding responses including increased diving, biting, gaping, and altered swimming behavior including abrupt shifts in swimming speed. The two species share some behavioral components in response to bait odors such as changes in swimming behavior and snapping but others were species specific. Our comparative study

highlights the differences in the two species, unexpected similarities, and suggests aspects of their behavior that may predispose these species to incidental capture in fisheries.

IN VITRO TOXICITY OF PERFLUORINATED COMPOUNDS IN LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) PRIMARY SKIN CELL CULTURES

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Perfluorinated compounds (PFCs) are globally distributed contaminants which have been measured in both human and wildlife blood and serum. Sources of PFCs include polymerization aids, stain repellents, surfactants, and medical devices. These compounds have been shown to cause a variety of adverse health effects in mammals, including the development of tumors in the liver and thyroid, hepatotoxicity, developmental delays, interruption in lipid metabolism and adipogenesis leading to decreased body weight, and a significant increase in both internal and external morphological abnormalities. These compounds are extremely persistent in the environment, and the global concentration of PFCs is expected to continue to rise even if the chemical is regulated as consumer products continue to break down. There is currently no PFC toxicity data available in any reptile species. PFCs have been found in both juvenile and adult loggerhead sea turtle tissues with variation depending on geographical location. Body burden of PFCs in sea turtles seems to be dependent upon body size, species, age, and habitat, as PFCs bioaccumulate and occur in higher amounts in older, larger turtles, and in species which are more carnivorous. Blood serum levels of PFCs found in loggerhead sea turtles are at concentrations which are known to cause significant toxicity in mammals. However the possible adverse health effects of PFCs in turtles are currently unknown. Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS) are the dominant PFC compounds found in sea turtle blood. This is consistent with global distributions of PFCs, as PFOS and PFOA represent the largest portion of PFCs globally both in production and in environmental measurements. Here, we report on the use of cytotoxicity assays to assess effects of PFOA on sea turtle cells, using loggerhead sea turtle primary skin cell cultures which were established and characterized in our laboratory. Because PFCs are known to affect mitochondrial activity and lipid production in mammalian toxicity studies, (3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) and lactate dehydrogenase (LDH) were selected as initial cytotoxicity assays due to their measurements of mitochondrial activity and cell membrane integrity, respectively. Initial testing used PFOA, with a variety of test concentrations of (0.05 μM, 0.5 μM, 5.0 μM, 50 μM, 500 μM) which encompass chemical concentrations found in the environment, in sea turtle serum, and in prey animals. Significant toxicity occurs at the highest dose (500 μM) with cells from n=6 turtles for MTT and n=5 turtles for LDH, a large sample size when working with endangered species. Following initial testing, dose range was narrowed between the highest dose (500 μM) and the highest dose showing no significant toxicity (50 μM). Both MTT and LDH assays were performed on this second dose range (50 μM, 140 μM, 230 μM, 320 μM, 410 μM, 500 μM). Significant toxicity occurs at 410 μM and 500 μM with cells from n=2 animals in initial testing, with further testing to follow using both PFOA and PFOS.

REDUCING ENTRAPMENT OF MARINE TURTLES IN WASTE FISHING GEAR AROUND THE COASTAL WATERS OF BONAIRE, DUTCH CARIBBEAN

Sue Willis and Mabel Nava

Sea Turtle Conservation Bonaire

Entangled and loose lines in the waters around Bonaire are a major concern. There is a considerable amount of fishing line, sometimes with fish hooks attached, in the water and tangled amongst the corals and sponges on the reef. Non-biodegradable monofilament lines last for several hundred years before they fully decompose. During this time, the lines can become a major problem as they are known to trap marine life. Every year Sea Turtle Conservation Bonaire (STCB) encounters resident green and hawksbill sea turtles that have been accidentally trapped and killed by fishing debris. In January 2012, STCB launched a new project to clean up the discarded fishing gear from Bonaire's reefs. The ‘Fishing Line Project’ aims to reduce the amount of fishing line, hooks, nets and other debris found on Bonaire’s coral reefs. In partnership with the Dutch Caribbean Nature Alliance, the project will also serve as a model for other Caribbean islands, so that they may better find solutions to this common and widespread issue. The Fishing Line Project aims to recruit volunteer experienced recreational SCUBA divers, snorkelers and walkers to remove the fishing lines that have become snagged on our reefs and shores. When they sign up for the project, volunteers are given special instruction in safely removing the lines including an easy-to-understand poster which has been made to instruct diving, snorkeling and non-diving volunteers. In addition to individuals collecting lines during their regular recreational dives or snorkels STCB is working in partnership with the dive operators on Bonaire and a number of “clean-up dives” have been organized to clean the areas where most of the fishing debris occurs, notably around Bonaire’s piers. In the first nine months of the project 131 volunteer SCUBA divers have registered and over 1000L/265 gallons of waste fishing gear have been removed from the reefs around Bonaire. “TAngler Bins”, pvc-pipes specially constructed to be used as bins for fishing lines, have been positioned at several polluted beaches, popular fishing spots and dive sites around Bonaire with instructions in Papiamentu and English. These are for the collection of waste fishing line, hooks, lures and nets. STCB is also working with our local fishermen to inform them about the dangers that some of the fishing methods they may use have for both marine wildlife and humans, whilst also introducing our fishermen to environmentally-friendly fishing methods. Fishing lines cannot be recycled on Bonaire yet, so at the end of the first year of the project all the collected lines will be made into a special piece of art by a local artist and this will be displayed to mark the project’s success.

FIRST RECORD OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) IN SINALOA, GULF OF CALIFORNIA, MEXICO

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The Gulf of California Region is recognized as an important developmental and foraging habitat for three of the five species of sea turtles known to occur in the Eastern Pacific. To date, monitoring and conservation programs in this region have focused primarily on the Baja California Peninsula and northern Mexican Pacific (both coasts being represented by the States of Baja California Sur and Sonora). We began prospective sea turtle surveys in bays and lagoons located in northern Sinaloa during 2006 and initiated off-shore sea turtle surveys in 2012. From May to June 2012, a group of fishermen from "La Reforma" community, reported the sighting and bycatch of sea turtles while fishing in the off-shore area of the municipalities of Guasave-Angostura (24º 57 ', 25° 09', 108° 23 ', 108° 01'), they reported the capture of 3 different species: *Lepidochelys olivacea*, *Chelonia mydas* and *Caretta caretta*. These fishermen agreed to participate with the sea turtle monitoring and were trained to record basic sea turtle data. We present the first data which demonstrates the presence of loggerhead sea turtles in the Gulf of California. Turtles were captured alive with surface gillnets designed for shark fishing. Fishermen reported the sighting ≥100 loggerhead turtles during 15 days of fishing using 3 boats. 19 turtles were captured to collect data including the mean CCL (61.81±6.76 cm) and CCW (57.81±6.27 cm). Each turtle was then tagged with Inconel tags, the capture site was georeferenced (GPS), and the turtle released. Our data reveals the presence of juvenile loggerhead sea turtles in the Gulf of California. However the sightings and captures occurred in an area of high fishing activity, which in previous studies and surveys in fishing communities we identified as at high risk for bycatch and direct sea turtle capture. We propose a detailed study of the area to assess the abundance of loggerhead turtles and the bycatch affecting this population.

In-Water Biology

A FAIR "EGGS" CHANGE: COMPARING STABLE ISOTOPE RATIOS OF FRESH-LAID VS. ADDLED EGGS*

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Loggerhead turtles (*Caretta caretta*) are a highly migratory species of marine turtle, often traveling great distances between their foraging grounds and the beaches on which they lay their eggs. In recent years, stable isotope analysis has become a valuable technique for assessing migratory connectivity and foraging ecology, with a significantly lower cost than traditional satellite telemetry, allowing for a greatly increased sample size. Many tissue types may be used to test questions on migratory connectivity and foraging ecology, including blood, skin, and in the case of marine turtles, eggs. However, fresh eggs are potentially viable and sacrificing them for stable isotope analysis must be considered when permitting for study of this threatened species. Moreover, some research groups do not survey their study area daily, thereby preventing them from acquiring freshly laid eggs or within 12 hours of deposition. Collecting a fresh egg more than 12 hours after deposition can have deleterious effects on other eggs within the clutch. Another option available to researchers is to collect addled, or "rotten" eggs at the time that nests are excavated for hatchling productivity evaluation. These un-hatched, non-viable eggs are readily available to researchers, providing an opportunity to increase sample size dramatically without sacrificing potentially viable eggs and removing the need to encounter the nesting female or discover recent nests within a restricted time window. However, fresh and un-hatched addled eggs may not be interchangeable isotopically if decomposition and variations in the microenvironments of the nest cause isotopic differences. We compared carbon and nitrogen isotopic values of a fresh egg (collected at the time of deposition) and an addled egg (collected post-hatch) from the same loggerhead clutch from the Archie Carr National Wildlife Refuge, Melbourne Beach, Florida (USA) from 2009-2012. Fresh and addled eggs from the same clutch did not differ in carbon or nitrogen stable isotope ratios, suggesting that addled eggs and fresh eggs provide the same information on foraging history. These results could have far reaching ramifications by markedly increasing sample sizes for stable isotope research, thereby improving our understanding of migratory connectivity at the population level. Acknowledgements: Special thanks to the following organizations, International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America for their continued, generous support.

DEPTH AND WATER TEMPERATURE PREFERENCES OF LOGGERHEAD TURTLE DURING INTER-NESTING PERIOD ON DALYAN-IZTUZU BEACHES, TURKEY

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Innovations in the science and technology provide advantages in uncovering unknown issues of positive science. One of this innovations is Time Depth Recorders (TDRs), have allowed researchers to study the dive behavior of sea turtles in their natural habitats. Female sea turtles typically lay several clutches during each nesting season and rest in the time between laying clutches (the inter-nesting period) in the waters off the nesting beach. The available information about diving behavior of inter-nesting turtles has provided significant evidence on how to protect nesting turtles from human interactions. This study was conducted on Dalyan-Iztuzu nesting beach during 2012 nesting season, and aimed to determine depth preference of loggerhead turtle between the inter-nesting period and temperatures at that depth. Therefore each TDR device is programmed to record data at 2 minute intervals according to the user manual (CEFAS G5, 2007). TDR device is mounted to 10 loggerhead sea turtle using fishing line and chrome wire; however data have been obtained from seven of them. According to the results of the average temperature was measured as 28±1.77°C, (range=16-34°C), and the average depth was calculated as 1.7±1.64 m below the sea level. In addition, the maximum depth was found as 78 m below the sea level. During the interesting period, we found significantly important relationships between depth and water temperature preferences of Loggerhead turtle. These results were discussed in term of habitat usage and preparation of egg shell formation in the time between the two nesting in a season.

CHARACTERIZATION AND SATELLITE TRACKS OF THE MIGRATORY ROUTES OF TWO HEAD-STARTED HAWKSBILL TURTLES 13 FROM SANTA MARTA, COLOMBIA*

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Due to the ecological role of *Eretmochelys imbricata* promoting the matter and energy flow between trophic levels above and below during its life cycle and high human pressure (capture to obtain carapaces, bycatch), this species is listed by the IUCN as Critically Endangered. In order to verify the success of the head - start process, two young hawksbill turtles (named Colombianita and Tuggy), both 13 months old, were introduced back into the wild at Casa Grande Beach, Mendihuaca, Santa Marta D.T.C.H. The turtles were tagged and monitored for 6 months with Wildlife Computers SPOT 5 AM – S 206 D satellite devices, and their movements were related with ocean currents. During the study, Colombianita traveled 4240 km (mostly in oceanic areas) passing through the continental shelves of Colombia, Panama, Costa Rica and Belize. Colombianita stayed in coastal waters only in the Rosario Islands and San Bernardo National Park for about 55 days. While overlapping this turtle's route with the paths described by oceanographic drifters in the Caribbean (National Oceanographic Partnership Program - NOPP) it was clear that surface currents played an important role in the direction of the route. However currents were not entirely responsible for the path of the turtle because it had the ability to enter and leave the currents. Tuggy made a short trip (90 km), compared to Colombianita's journey, passing Cinto, Gayraca and Concha Bay in Tayrona National Park. After two months, Tuggy was found entangled in a gillnet by a fisherman in Gairaca Bay and so bycatch remains a major source of mortality of these turtles. The results obtained indicated that turtles from the head - start process have a positive coupling to the natural environment and behave in a similar way to that reported for wild specimens. This confirms that head-starting procedures are a viable alternative for the conservation of sea turtles.

SEASONAL VARIABILITY OF MIGRATING CORRIDORS AND FORAGING AREAS OF ADULTS GREEN TURTLES REVEALED BY SATELLITE TRACKING AT THE REGIONAL SCALE

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Marine turtles do not recognize political boundaries, nor do they have regard for Exclusive Economic Zones (EEZ s), cooperative agreements, international conventions, or memoranda of understanding between countries. So is it in the Southwest Indian Ocean (SWIO), a region that hosts some of the most important green turtle nesting sites in the world, most of which are isolated on remote islands (e.g. Europa and Glorieuses, Aldabra and Cosmoledo, Moheli and Mayotte). This region of the world is known to have year round nesting of green turtles but all sites display a marked nesting season. However, very little is known about migratory pathways that sea turtles ply between their nesting and feeding grounds in this region where this species faces numerous threats such as fisheries interaction at both open sea and coastal waters. From 2009 to 2011, we deployed 90 satellite transmitters on nesting green turtle females during (d) and opposite (o) to the nesting peak in 5 important rookeries of the South West Indian Ocean (SWIO): Europa (Nd=10; No=10), Glorieuses (Nd= 10; No=10), Tromelin (Nd= 10; No=10), Mayotte (Nd=10; No=10) and Mohéli (Nd=7; No=3). First results showed that 20% of the tracked turtles used Madagascar costal foraging ground while more than 80% used the east African ones. It is worthwhile noting that the North Mozambique and South Tanzania remain the most important foraging ground for the tracked turtle (45% of the tracked turtles), but that they are mainly used by turtles tagged during the nesting season. On the other hand, we highlight here that green turtles also use a large range of foraging ground in the area (55% of the tagged turtles), some of them being hot spots (e.g. south of Maputo – Mozambique, Tulear lagoon – Madagascar) and being used mainly by turtle nesting opposite to the nesting peak. Spatial distribution estimation allowed identifying an important year round migrating corridor centered along the latitude 12°S and that extends westward from Tromelin until the east African coast. The corridor covers 5° in latitude (10 to 15°S) in open waters, while it covers a larger area in coastal area (from 18°S to 7°S). The 90 tracked green turtles also crossed as many as nine different EEZs in the region before reaching their foraging grounds, which themselves are shared by six countries. Such spatial migrating pattern of adult green turtle, the temporal corridors and the regional feeding hot spots identified are of high importance to implement targeted mitigating measures for artisanal and industrial fisheries and encourage conservation on key foraging grounds.

SPATIAL AND TEMPORAL DISTRIBUTIONS OF SEA TURTLES WITHIN THE FLORIDA CURRENT AND SURROUNDING WATERS AND THEIR IMPLICATIONS FOR OCEANIC ENERGY DEVELOPMENT

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The spatial and temporal distributions of a species are essential to identifying its basic habitats, including areas used during large-scale movements and seasonal changes in behavior. For marine turtles, such basic information is often limited to satellite tag data, which can be heavily biased to adult females, or to coastal

observation. In species that undergo oceanic habitat shifts through various life stages, such information is often incomplete. We conducted aerial surveys of the Florida Current between the southeast coast of Florida and the Bahamas banks to establish when and where sea turtles occur in this fast-moving component of the Gulfstream. Twelve line transects were flown approximately monthly during 2011-12 from a northern boundary near West Palm Beach, Florida to a southern boundary near Miami, Florida. Surveys were conducted at an altitude of 150 m and ground speed of 185 km hr-1. Loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) turtles were the most frequently detected species. Leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*) and other sea turtles not identified to species were also observed. Percent of turtles not identified to species decreased from 38.0% (2011) to 10.8% (2012) of total observations. The total number of sea turtle sightings increased from 79 observations (2011) to 120 (to date, 2012), with consistent survey effort between years. Locations of sea turtle sightings suggest increased presence of turtles along the western edge of the Florida Current in the spring and early summer during breeding season. Increased sightings in 2012 were coincident with very high nesting numbers in this region. Additionally, few to no sightings in offshore regions (20-60nm from shore) suggest turtles seldom use these waters or are ephemeral in the survey area. Our data expand both our understanding of current use by migratory turtles and characteristics of their spatial distributions in a central area of interest. The area of this study encompasses one of many regions under consideration for ocean energy development, including current-capture technologies which have the theoretical potential to interact with migratory turtles. The value of collecting robust assessments of sea turtle distributions cannot be overstated as they provide the foundation on which conservation strategies will be based. Such data provide the necessary perspectives for assessing possible threats as development and utilization of oceanic energy resources continue to grow.

A PRELIMINARY ASSESSMENT OF THE SPATIAL DYNAMICS OF IMMATURE GREEN TURTLES (*CHELONIA MYDAS*) WITHIN A FORAGING GROUND ON THE ATLANTIC COAST OF ELEUTHERA, THE BAHAMAS

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Shallow water, neritic habitats such as mangrove creeks and sea grass beds, serve as critical developmental and foraging habitat for juvenile and sub-adult sea turtles. Tagging studies have elucidated long term use of foraging areas and site fidelity, but very little research has been conducted on the short term movements and habitat partitioning of turtles within foraging habitats. This information is vital for effective management of sea turtle populations throughout their early life stages as harvest or other anthropogenic disturbances could reduce the reproductive potential of the entire population. This study investigated the spatial dynamics of immature green turtles (*Chelonia mydas*) at foraging grounds on the east coast of the island of Eleuthera, The Bahamas. Half Sound is a large (~3 km^2) previously un-studied, semi-enclosed embayment which encompasses mangroves, rocky shoreline, seagrass beds, and sand flats in depths ranging from 0 – 3m. A narrow channel (~175m wide) connects this diverse mosaic of habitats to the Atlantic ocean. Mangrove and reef-associated fish and sharks are also known to utilise the sound. Standardised, boat-based, visual surveys were conducted to determine estimates of abundance throughout the sound. Turtles were captured, measured, weighed and tagged to determine movements and habitat use within the sound, in addition to facilitating population size, growth and survivorship estimates. Data collection is ongoing through December 2012 and additional surveys will elucidate movements, habitat association, and size-based dispersal of individuals within the sound. Identifying these fine-scale patterns within foraging grounds will contribute to a better understanding of habitat and resource use within discrete populations of foraging sea turtles.

POWER ANALYSIS USING PROGRAM SOFTWARE MONITOR GREATLY INFORMS EFFECTIVENESS OF MONITORING MARINE TURTLES IN NERITIC HABITATS

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The establishment of a sea turtle research and monitoring program at The Cape Eleuthera Institute (CEI), south Eleuthera, the Bahamas, facilitated preliminary research into the distribution and abundance of sea turtles in the coastal waters of Eleuthera. In-water surveys and turtle captures were conducted to determine relative abundance and size distribution of green turtles in eight survey sites distributed across the three sides of south Eleuthera; the Great Bahama Banks (west), the Exuma Sound (south), and the Atlantic side (east). Size distribution of green turtles indicated juvenile to sub-adult life stages, which is in keeping with aggregations reported in the wider Caribbean region. Abundance was significantly higher on the Atlantic side of the island, and tidal mangrove creeks on the south and west side also provided key foraging and developmental habitats for juvenile greens. Future survey effort required to accurately detect population trends was calculated using the abundance data from in-water surveys and the simulation software MONITOR. Simulations revealed that detection of trends at individual survey sites requires impractical survey effort; however when survey sites were combined into one network, a 10% trend could be detected with monthly surveys over a four year period. Recommendations for a future monitoring program are made with consideration of the accurate detectability of population trends.

TOP-DOWN CONTROL IN A RELATIVELY PRISTINE SEAGRASS ECOSYSTEM

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Coastal marine ecosystems have degraded dramatically worldwide and continue to be threatened. Seagrass ecosystems that provide critical habitat for juveniles of many species, including commercially important ones, have been particularly hard-hit. Of particular interest is the loss of large herbivores (e.g. sea turtles and sirenians) and top predators (e.g. sharks), which may have disrupted top-down processes that were historically important. We used exclusion cages to elucidate the effects of large herbivores (green sea turtles (*Chelonia mydas*) and dugongs (*Dugong dugon*) on seagrass community structure, nutrient dynamics, and ecosystem dynamics in the relatively pristine seagrass ecosystem of Shark Bay, Western Australia. We also investigated the possible indirect effect of top predators (tiger sharks (*Galeocerdo cuvier*) on seagrass beds) mediated by spatiotemporal shifts in grazing by green turtles and dugongs. Excluding large grazers from mixed beds of *Halodule uninervis*, *Cymodocea angustata*, and *Halophila ovalis* for thirty-two months resulted in a shift in seagrass community composition, increased shoot lengths in all species and increased total seagrass biomass. However, seagrass responses to exclusion were species-specific. There were increases in percent cover and shoot density for *Cymodocea angustata* but a decrease in cover and density for both *Halodule uninervis* and *Halophila ovalis*. Overall, our findings suggest that spatiotemporal shifts

in foraging habitat use by megagrazers may mediate indirect effects of tiger sharks on the seagrass communities of Shark Bay and that declines in these taxa in other parts of their range are likely to result in changes to seagrass communities.

ROTTEN LUCK: USING NON-VIABLE LOGGERHEAD EGGS TO INFER FEEDING GROUNDS ALONG FLORIDA'S EAST COAST*

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In recent years, there has been growing interest in using stable isotopes as a tool to study migratory connectivity and identify foraging areas of marine turtles. Sampling on the nesting beach is relatively easy as the turtles are accessible to researchers. Recently, using a combination of satellite telemetry and stable isotope analysis, we demonstrated that red blood cells (RBC) can be used to assign foraging areas of loggerhead nesting at the Archie Carr National Wildlife Refuge (ACNWR), Florida. Florida hosts ~90% of all the loggerhead nesting activity in the SE USA, yet few research groups encounter nesting females at night. In contrast, thousands of nests are marked to assess hatchling production through an extensive nesting survey program in Florida. Although precise turnover rates are unknown for adult sea turtle tissues, skin, RBC and egg-yolk isotopic values from nesting turtles appear to represent an integration of diet and geographic location over the 4-7 months prior to migrating to the nesting area. Thus, these tissue types have been used to unravel migratory connectivity. Collecting blood or skin samples requires intensive night patrolling and trained personnel, while collecting a fresh-laid egg poses ethical questions related to sacrificing a potentially viable egg. However, a non-viable (addled) egg retrieved at post-hatching excavation might be used as a proxy to infer foraging grounds of loggerheads. To test the usefulness of addled eggs, we collected one fresh laid egg and one unhatched egg at inventory from each nest laid by loggerheads equipped with satellite tags (n=26) and un-hatched eggs from additional females sampled (n=150) at the ACNWR between 2008 and 2012. We used telemetry to validate the use of both tissues to infer non-breeding ground locations. Fresh-yolk isotopic signatures and telemetry-derived foraging locations yielded similar patterns, with no isotopic differences between fresh-yolk and addled eggs collected from the same nest at inventory. Isotopic relationships for both δ13C and δ15N among RBC, fresh-yolk and addled eggs reflect similar resource use at similar timescales. As seen with RBC, females from the three foraging areas (identified by telemetry) segregated by the isotopic signatures of their eggs. Our results suggest that it should be possible to use addled eggs to assign females to foraging grounds, providing an opportunity to (1) sample at a much larger scale, fostering collaborations among research groups, (2) obtain information that is more representative at the population level and (3) begin understanding the relative importance of foraging areas. Acknowledgments: Thank you to the International Sea Turtle Symposium and the following organizations, International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America for supporting the attendance of SA Ceriani to the Symposium.

WHAT'S THE SKINNY? TESTING WHETHER SHOULDER AND REAR FLIPPER SKIN PROVIDE THE SAME ISOTOPIC INFORMATION

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Innovations in genetics and stable isotope analysis (SIA) have helped unravel migratory connectivity in marine turtles. The collection of tissue samples for genetic analysis is commonplace and has become routine in several research programs. Since both techniques require very small amounts of tissue, splitting samples between genetic and isotopic applications may allow researchers to address multiple questions or similar questions using complementary techniques, thereby maximizing the information obtained from each sample collected. Currently the protocols used for genetics studies and SIA differ slightly; thus, there is a need to investigate whether samples collected can be shared. Standardized protocols for stable isotope sampling include collecting skin from the shoulder area, while tissue for genetics is usually collected either from the trailing edge of the rear flipper or the shoulder area. Though genetic information is maintained regardless of anatomical sampling location, to our knowledge, no researcher has tested whether epidermis isotopic values are consistent between anatomical positions. In 2012, we collected shoulder and rear flipper skin samples from 25 loggerheads (*Caretta caretta*) with SCL>65 cm and compared epidermis isotopic values collected at these two sites. Whereas the $\delta 15N$ values did not differ between sampling locations, the $\delta 13C$ values were significantly higher in samples from the shoulder than from the flipper, contrary to our predictions. To test whether consistency in sampling procedure affected this result, as rear flipper samples could contain both scale and epidermis tissues, we sampled an additional 30 nesting loggerheads. Rear flipper sampling locations were chosen with care, insuring that collected skin samples were from the fleshy part of the trailing edge. As seen before, the $\delta 15N$ values did not differ, but our $\delta 13C$ results were equivocal. We suggest caution when combining skin samples collected from these two sites for SIA, as care needs to be taken when sampling from the rear flipper to obtain isotopic results that are comparable to shoulder skin samples. However, our results suggest it may be possible to foster collaboration between geneticists and isotope biologists and dramatically increase the sample size of turtles included in stable isotope studies. Special thanks to the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America, and the International Sea Turtle Symposium for their continued, generous support.

GOLFO DULCE TROPICAL FJORD A SPECIAL SITE FOR GREEN AND HAWKSBILL FEEDING GROUND

Didiher Chacón-Chaverri, Didiher A. Chacón-Vargas, and David Rojas-Morales

WIDECAST -Costa Rica

The project was developed since 2010 in the inner zone of the Golfo Dulce, Costa Rica South Pacific. In this area was established by the National Fisheries Institute (INCOPESCA) as a responsible fishing area, given the interaction of baitfish fishery and sea turtles, as well as the destruction of mangrove forests and the deteriorating physicochemical water by agriculture and coastal development. The objective of the research was to document the population structure of the green turtle (*Chelonia mydas agassizii*) and hawksbill (*Eretmochelys imbricata*), and the magnitude and significance of environmental impacts.

Information was collected biometric and-blood tissue samples of each organism captured, documented the abundance determination with CPUE and developed habitat restoration activities in the mangrove forest. More than 150 green turtles and 50 hawksbill turtles were sampled and tagged, including two satellite tags were deployed in two years of activities, biometrics and sex ratio was determined as well as more than 5000 plants were planted mangroves.

PLASTICITY OF THE DIVING BEHAVIOR OF LOGGERHEAD SEA TURTLES IN DIFFERENT HABITATS

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Animals change their behaviors in different habitats in order to maximize fitness and increase survivorship. Sea turtles have been known to change their depth utilization in different water mass. It has been suggested that this relates to prey distribution. However, little is known about the differences in dive patterns between two distinct habitats, such as the coast and open ocean. Two immature loggerhead sea turtles, one caught in a pound net and one cold-stunned and rehabilitated) were satellite tracked with SRDLs to determine their preferred marine habitats and dive behaviors. The turtle that was caught in a pound net was tagged on December 31, 2011, and the rehabilitated turtle was tagged on June 28, 2012. Results showed that the net-caught turtle forged mainly on the continental shelf east of mainland China, while the rehabilitated turtle resided in the nearshore waters north and northeast of Taiwan. Dive analyses showed that the net-caught turtle performed mainly S dives and other types of dives on the continental shelf. The rehabilitated turtle performed mainly U and S dives in the coastal waters. This suggested that both turtles used energy-conserved S dives to move in both waters. However, they performed different dive patterns to explore different habitats. The turtle on the continental shelf conducted more than one dive type. This included exploring new foraging areas and opportunistic feeding behaviors. The turtle in the coastal waters conducted the lengthened bottom residential U dive. This suggests that the loggerhead turtles either forage or rest along the rocky coasts of north and northeastern Taiwan. This is the first study ever done to determine the diving behavior of coastal residential loggerhead sea turtles in Taiwan.

LONG-TERM MARINE TURTLE POPULATION AND FIBROPAPILLOMATOSIS TRENDS IN THE INDIAN RIVER LAGOON SYSTEM, FLORIDA

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The Indian River Lagoon system serves as an important developmental habitat for immature green turtles (*Chelonia mydas*) and loggerheads (*Caretta caretta*). For the past 30 years the University of Central Florida Marine Turtle Research Group has been documenting population trends in this habitat. This is accomplished by deploying a 430 m large-mesh tangle net and removing the turtles almost immediately after they become entangled in the net. Each individual is then measured, tagged, photographed, and examined for Fibropapillomatosis (FP). Since 1982 this in-water population sampling process has been done a minimum of twice per month, with greater sampling intensity in the summer months. The number of turtles caught during the entire period of net soak allows us to calculate the catch per unit effort (CPUE).

Using these long-term data we have found significant seasonal variation in green turtle abundance and population structure, with capture rates being higher in the winter months and lower in the summer months. However, loggerheads do not share this seasonal variation characteristic in capture rates. Mean straight carapace length (SCL) of green turtles is 43.95 cm with a range of 22.0-106.1 cm while loggerhead mean SCL is 65.62 cm with a range of 41.5-106.0 cm. The size distribution confirms this aggregation is composed mostly of immature individuals. This means the turtles are not permanent residents in the lagoon, but instead are occupants during an important life history stage. Frequency of captures with FP has remained relatively constant throughout the study period, remaining at approximately 52.2% prevalence in green turtles. It is rarely presented in loggerheads (approximately 5.1%). This long-term FP data set can be useful for current and future research regarding the causes and prevalence of FP in marine turtles in the lagoon, and even in other locations such as Hawaii, USA. Long-term population monitoring of in-water populations, like this one, is important for obtaining a better understanding of how the population is functioning. Many researchers spend about 99% of their time collecting data on nesting beaches, but only 1% of their time collecting data in-water. Population trends found in the in-water data set can be compared to disasters, pollution changes, in-water policy enforcement, and even large-scale events like climate change. The increasing trend in lagoon green turtle captures, in conjunction with the observed exponential increase in green turtle nest production on the adjacent nesting beach (Archie Carr National Wildlife Refuge), suggests that the species is on the road to recovery. Unlike the green turtle, immature loggerheads have not seen any significant change in CPUE during the 30-year study period. These data suggest that the Florida loggerhead population is more stable than previously believed. Acknowledgments: I want to thank everyone who donated funds for the travel grants that were awarded. Receiving this travel grant allowed me to attend and present at my first conference. I am very excited to meet other members of the sea turtle community as well as gain important knowledge for future presentations and my career.

CATCHING MALE GREEN TURTLES (*CHELONIA MYDAS*) NEAR ISLA DE AVES, VENEZUELA

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Understanding the reproductive patterns of male green turtles (*Chelonia mydas*) is of interest for clarifying population structure in this endangered species, but studying adult males in mating areas has proven difficult because they are not easy to observe and capture. Isla de Aves (Venezuela) is unusual among *C. mydas* nesting populations in the Caribbean because of the large concentration of adult males that congregate in shallow waters just offshore to court and mate with adult females. Our goal was to develop a reliable and minimally stressful technique for capturing these males, and to compare their sizes with males from other areas since females from Isla de Aves are larger than females from many other nesting populations. We conducted four field sessions to capture, measure and mark males: June and July 2008, September and October 2009, July and August 2010 and June and July 2012. The first and last of these sessions occurred during peak reproductive activity. We tested three capture methods: 1) using nets set from shore and from a buoy anchored in 4-5 m deep waters; 2) by hand, in a nearshore area less than 1m deep; and 3) by hand, with free diving to 5-20 m. Recorded measurements included curved carapace length (CCL), curved carapace width (CCW), and tail length (TLC). We captured 93 males and recaptured six of these in subsequent years. Estimates of capture per unit effort (CPUE) indicated that hand capture at greater depths was the most efficient (CPUE = 1.5 turtles/person-hours), followed by hand capture in nearshore waters (0.53 t/p-h), with net capture the least efficient (0.10 t/p-h). These results are probably due to the high concentration of turtles in intermediate depths during the reproductive season. Isla de Aves males were larger than males from other regions, with an average CCL of 105.2 cm (SD: 4.8; range 92-116.7), a CCW of 96.3 cm (95% CI 86-106.1), and tail length of 53.0 cm (95% CI 44.1-63.9). The larger size of

these animals may be due to the high quality of their feeding grounds (the location of which remain unknown) and/or because the adult males here are older than in other areas where males have been caught.

TRANS-EQUATORIAL MOVEMENTS OF LATE JUVENILE INDIVIDUALS CHALLENGE THE UNDERSTANDING OF LOGGERHEAD TURTLE (*CARETTA CARETTA*) LIFE HISTORY IN THE INDIAN OCEAN*

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The loggerhead turtle, *Caretta caretta,* is the main species of marine turtle accidentally caught by drifting longline vessels operating in the South West Indian Ocean. Since 2006, in collaboration with longline vessels from Reunion island (-21°09'S; 55°30'E), captured individuals are brought to the Kélonia sea turtle care center to be treated and released. Between 2008 and 2011, we conducted a satellite tracking study on these by-caught turtles to improve knowledge on open sea spatial and diving behaviors of this species in the region in order to mitigate the risks of interaction with fisheries. Eighteen late juvenile individuals (mean CCL: 67.7 cm; SD = 5.4 cm) were equipped with satellite transmitters and released in Reunion island coastal waters. Fourteen of these transmitters also permitted us to compute animal diving profiles. The deployment period lasted between 20 and 310 days. Turtles exhibited various spatial behaviors, either remaining oceanic or heading to coastal waters. They surprisingly covered a large latitudinal range across both hemispheres from the 40th parallel south to the 20th parallel North, sometimes swimming more than 4,000 km away from the release point. A majority of the tracked turtles (n = 11) swam northward, while another group of individuals (n = 4) went south. The swimming direction for each group did not significantly differ from the main northern and the main southern rookery respectively located in Oman (20°N) and at the border between South-Africa and Mozambique (29°S). The other turtles (n = 3) remained in the vicinity of Reunion Island. Ultimately, five individuals stopped transmitting less than 1,000 km from Masirah Island (Omanese rookery), probably the largest nesting population of loggerhead turtles in the world. This suggests that turtles from the Omanese rookeries may frequent waters from the southern hemisphere during their developmental cycle. An ongoing regional genetic study should confirm this surprising result. This constitutes a new advance towards the understanding of loggerhead turtle life history in the Indian Ocean. Regarding diving behavior, three types of dives have been identified: short subsurface dives (<30 m, <800 s) accounted for 79% of the total number of dives, long subsurface dives (<30 m, >800 s) for 15% and deep dives (>30 m) for 6%. Maximum diving depth occasionally exceeded 200 m. Data analysis showed varying patterns between diurnal and nocturnal diving behavior. During the day, a greater number of dives occurred subsurface (0-10 m) while turtles exhibited slightly deeper dives (10-30 m) during the night. It is worthwhile noting that diving behavior is also dependent on spatial movement with turtles in transit diving significantly deeper than turtles in residency. Such behavioral changes may possibly be explained by the availability of prey according to the spatial movement pattern of individuals. Despite the great attention given to loggerhead turtles worldwide, our study is one of the first tracking programs on this species at juvenile stage in this part of the world. In addition to ongoing conservation actions with fishermen at the local scale, understanding life history of loggerhead turtle in the Indian Ocean is also required for appropriate regional conservation planning.

TRACKING NESTING HAWKSBILLS "CHEL" AND "GINGER" FROM THE BAY ISLANDS, HONDURAS

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The ability to track animal movements can give vital insights into important aspects of life history. Satellite telemetry has been a key to broadening our understanding of the migration patterns of nesting sea turtles. In this study, we attached Wildlife Computer Spot 5 satellite tags onto two nesting hawksbill sea turtles on the Bay Island of Utila, Honduras. One satellite tag was launched August 12, 2012 on a turtle named "Ginger". Ginger left Utila the following day and set off in a northwest direction, navigating through the islands off the coast of Belize and halting her northward migration about 10 km off the coast, just south of Belize City and approximately 15 km south of the Drowned Cayes. She traveled a straight-line distance of 181 km and covered a total distance of 325 km over 19 days, maintaining an average speed of 17 km/day. The other satellite tag was attached to a turtle named "Chel" and was launched on July 12, 2012. Chel spent 10 days in the waters off Utila and then also moved northwest toward Belize, hugging the coast of the Yucatan Peninsula, and finally reaching her feeding grounds just south of Cozumel, Mexico. Over a period of 90 days, Chel traveled a straight-line distance of 402 km, with a total distance traveled of 1,060 km. Her average traveling speed was 15 km/day. This turtle has now spent approximately 65 days in the Bahia de la Ascension, a large bay that is bordered on several sides by the Reserva de la Biosfera Sian-Ka'an in the state of Quintana Roo, Mexico. These types of data from hawksbill turtles are particularly lacking for turtles found in the waters of Honduras. Continued transmittance from these and other satellite tagged turtles will provide information that will strengthen conservation efforts for the species both locally and internationally.

DIET ANALYSIS OF STRANDED LOGGERHEAD SEA TURTLES IN VIRGINIA, 2011

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The Chesapeake Bay provides important seasonal foraging grounds for juvenile loggerhead sea turtles (*Caretta caretta*). Historical analyses of stranded loggerheads in Virginia indicated a diet primarily composed of horseshoe crab, blue crab, and other decapod crustaceans. Recent studies indicated a diet shift to include a larger portion of fish. To better understand the foraging ecology of loggerheads in the Chesapeake Bay and surrounding ocean waters, the Virginia Aquarium & Marine Science Center Stranding Response Program (VAQS) analyzed the gastrointestinal (GI) contents of 43 loggerheads that stranded in Virginia in 2011. The loggerheads ranged in size from 49.8 cm to 97.5 cm straight carapace length (SCL, mean: 73.1 cm, SD: 13.8 cm). Prey items were identified to the lowest taxonomic level and minimum counts were estimated for each prey type based on methods previously used to examine Virginia samples from 1983-2002. Each food item was categorized as crustacean, fish, horseshoe crab, mollusc, plant, or other invertebrate. The 'fish' category included bony fish and elasmobranchs. Three non-prey categories

were documented but excluded from the analyses: anthropogenic items (n=2), parasites (n=36), and non-prey organic matter (n=30). Percent numbers (%N, number of specific prey type/total number of prey items) and percent frequency of occurrence (%F, number of GI tracts containing a prey type/total number of GI tracts examined) were calculated. VAQS documented and analyzed a total of 755 prey items from the 43 GI tracts. These were comprised of 41% (n=308) crustaceans, 38% (n=290) molluscs, 10% (n=73) horseshoe crabs (*Limulus polyphemus*), 6% (n=43) other invertebrates, 4% (n=29) fish, and 1% (n=12) plants. Large whelks and Atlantic moon snails (*Neverita duplicata*) comprised 63% (n=183) of the mollusc group. Atlantic blue crabs (*Callinectes sapidus*) were the most abundant crustacean found in the GI tracts, comprising 45% (n=137) of the crustaceans. Identified species of fish and elasmobranchs were: Atlantic croaker (*Micropogonias undulatus*, n=7), Atlantic menhaden (*Brevoortia tyrannus*, n=6), bluefish (*Pomatomus saltatrix*, n=1), and spotted sea trout (*Cynoscion nebulosus*, n=1). Eighty-four percent of the examined GI tracts contained crustaceans, 51% contained horseshoe crabs, and 23% contained fish, which could indicate that loggerhead diets have shifted again. The frequency of occurrence of the remaining prey groups were: 63% molluscs, 23% plants, and 54% other invertebrates. VAQS will continue analyses of the GI contents of loggerheads in Virginia from 2008-2011, including measuring weights of each prey type, calculating index of relative importance for each group, and examining trends over time. These analyses will be coupled with stable isotope analyses to further investigate loggerhead diet and with examinations of sea turtle-human interaction in the Chesapeake Bay. Results of these studies can and should be used by resource managers to improve conservation management plans for sea turtles in the Chesapeake Bay region.

THE U.S. NAVY MARINE SPECIES DENSITY DATABASE: CURRENT STATUS AND IMPROVEMENTS OF IN-WATER DENSITY ESTIMATES OF MARINE TURTLES AND MAMMALS

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The Navy Marine Species Density Database (NMSDD) is a collection of GIS-based, in-water density data for marine turtles and mammals compiled from numerous peer reviewed and federal agency models and sources. The result is one master set of season specific density data that covers several of the Navy's operating areas globally, and that are used in the Navy Acoustic Effects Model (NAEMO) for acoustic impact assessment modeling. The combination of NMSDD and NAEMO allows the Navy to use the best available science to determine how many marine turtles and mammals may be affected by its training and testing activities that put sound into the water. Currently, marine turtle density data in the Atlantic exists only within less than 100 nm of the US East Coast and Gulf of Mexico Coast. Unfortunately, some data gaps occur near shorelines, bays, and ports where the Navy operates, and offshore beyond the coverage of aerial surveys. The data currently included for estimating sea turtle density within the U.S. EEZ is from 1998-2005, and only provides coverage out to the shelf break, not the entire EEZ. New surveys have been flown in recent years which have included additional inshore and offshore areas, including the Atlantic Marine Assessment Program for Protected Species (AMAPPS) project of which the Navy is a co-sponsor. As new data and methods become available, the use of predictive modeling is becoming worthy of being revisited to generate new density estimates for future environmental assessments. Effort is underway to develop predictive models beyond survey coverage, and the groundwork is now being laid for an effort to update the marine turtle density data and models by ensuring ongoing data collection for sea turtles. The new model will seek ways to incorporate data beyond ship track and aerial survey data, such as bycatch records, satellite telemetry, and remote sensing of habitat. In addition, thought is being given to generating better estimates of g(0) for sea turtles, which directly affects modeled densities, and to assess the detectability of different age/size classes as an input into density models. Here, we discuss the current state and uses of the NMSDD, as well as the efforts underway to improve it.

DO HATCHLING SWIMMING PATTERNS MATTER WHEN IT COMES TO PREDATION?*

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We compared diurnal and nocturnal swimming patterns of recently hatched olive ridley (*Lepidochelys olivacea*) neonates from Punta Raton, Honduras. We followed individual hatchlings tethered to a modified Witherington float by 1.5 m of sewing thread during an average time of 25.4 min (SD ± 4.8), and recorded the time intervals for swimming at the surface (less than 20 cm of depth) and swimming at depth (more than 20 cm). Hatchlings were released from a small skiff located 200 - 500 m from the shore in the coastal waters of the Gulf of Fonseca. We tracked 21 hatchlings during the day and 11 at night. To locate the hatchlings during night observations, we glued a 1.5 inch chemical glowstick on their carapaces. To ensure that the presence of the glowstick didn't affect the swimming pattern, we also glued the glowstick to 8 of the hatchlings observed during the day. We calculated the percent of time spent swimming at the surface and compared it among the three groups (day without glowstick $n = 13$, day with glowstick $n = 8$, and night $n = 11$). We log-transformed the data to improve normality, but one group remained non-normal and the data remained heteroscedastic. Nevertheless, the results were the same whether subjected to a parametric one-way ANOVA or non-parametric Kruskal-Wallis one-way ANOVA, therefore we report the parametric results only. There were significant differences in the percent of time swimming on the surface among the groups ($F(2,29) = 37.998$, $p < 0.001$). Post hoc comparisons using the Bonferroni test indicated that the percent of time swimming on surface at night was significantly greater than during the day ($p < 0.001$), but there was no significant difference between the groups observed during the day, with and without glowsticks. Differences between day and night swimming patterns during the frenzy period have not previously been described in the literature. We suggest that this is a characteristic behavior of *L. olivacea* that has remained undetected since, although several studies have been performed on hatchling movements during the first hours of their offshore migration, few have included this species, or that this swimming pattern is an adaptation for enhancing survival under the local conditions of the Gulf of Fonseca not shown by hatchlings at other locations. Increased swimming at depth during the day may serve to reduce visibility of the hatchlings to aerial predators, and may also help them avoid high temperatures in surface waters. Further research is needed to test these hypotheses and assess the adaptive significance of this behavior.
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PREVALENCE OF OCEANIC FORAGERS AMONG ADULT FEMALE LOGGERHEAD SEA TURTLES *CARETTA CARETTA* NESTING IN CAPE VERDE (NORTHWESTERN AFRICA)

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Neritic foragers prevail in most of the populations of loggerhead sea turtles (*Caretta caretta*) studied to date, probably because of the much higher food availability in neritic foraging grounds than in oceanic habitats. However, previous satellite tracking of a few individuals ($n = 10$) suggested that oceanic foraging was prevalent among the adult females in Cape Verde, probably because of the very high oceanic productivity fuelled by upwelling off northwestern Africa. We used stable isotopes in bone to assess the actual proportion of neritic and oceanic females in this population, using the ratios of stable isotopes of marine mammals with well known habitat preferences as a benchmark. Carapace length, clutch size and egg volume were used to assess differences in turtle fitness and skeletochronology to assess age. Stable isotope ratios confirmed that the adult female population in Cape Verde is dominated by oceanic foragers, as 63 of the analyzed adult females grouped with oceanic minke whales (*Balaenoptera acutorostrata*) in a cluster analysis based on stable isotope ratios, whereas the remaining nine adult females grouped with coastal monk seals (*Monachus monachus*). The resulting proportion of oceanic (87.5%) and neritic foragers (12.5%) in the sample did not depart significantly from that expected if turtles settled opportunistically between the archipelago and mainland Africa at the end of their developmental migration (Chi-square = 0.23, df = 1, $p = 0.630$), without any preference for the continental shelf. However, settlement on oceanic feeding grounds had a cost for females, as adult neritic foragers had a higher fitness, as revealed by larger curved carapace length (neritic range 87 - 100 cm vs. oceanic range 74 - 101.5 cm, $U_{9,59} = 15.0$, $p < 0.001$) and clutch volume (4188.9 ± 475.2 cm3 for neritic turtles vs. 2906.9 ± 502.4 cm3 for oceanic turtles, $U_{9,59} = 15.5$, $p < 0.001$). Furthermore, neritic turtles were older than adult oceanic foragers, (14 to 62 lines of arrested growth for neritic turtles vs. 7 to 31 lines of arrested growth for oceanic turtles; $U_{9,38} = 91.5$, $p = 0.032$), thus indicating that some animals shifted from oceanic to neritic habitats with age, probably because a higher accumulated probability of detecting the African shelf over time. These results are consistent with the hypothesis that immature loggerhead sea turtles are probably picking suitable foraging grounds to settle from the sites they have encountered previously during their developmental migration and these settlement sites may not be optimal simply because turtles do not have knowledge of other better areas because they have not encountered them during their developmental migration. In the particular case of loggerhead sea turtles from Cape Verde this is because juveniles drift westward and the most profitable, neritic feeding grounds are found 500 km east of the archipelago.

DO GREEN TURTLES (*CHELONIA MYDAS*) NESTING IN PRINCIPE ISLAND, WEST AFRICA, EXHIBIT SIMILAR ISOTOPIC NICHES?

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Recent studies with green turtles (*Chelonia mydas*) have suggested polymorphic foraging strategies and habitats but information is scarce and inexistent for West African populations. In this work we used nitrogen and carbon stable isotope ratios (δ15N and δ13C) to test if green turtles nesting in Principe Island, a recent UNESCO Biosphere Reserve, exhibit distinct isotopic niches. The epidermis of 60 nesting females, collected on two Príncipe beaches (‘Grande’ and ‘Infante’), were analyzed for stable isotopes and the minimum curved carapace length (CCL) was measured in each individual. δ15N varied from 7.9 to 17.3‰ (13.6 ± 1.5) while δ13C from -19.4 to -8.6‰ (-17.3 ± 1.8). CCL ranged from 87.0 to 108.0 cm (100.0 ± 5.1; mean ± SD). Even though the large variation in isotopic ratios detected within the population, their distributions were uni-modal indicating, according to baseline isotope signatures, that foraging grounds are distributed by the entire Gulf of Guinea region and, to a lesser extent, the adjacent areas. SIBER results revealed that smaller size class females (< median, 100.8 cm) occupied a much larger isotopic niche (four times higher) than larger ones. Those differences were not significant (Mann-Whitney U Test) but Levene’s test indicated a significant difference in the variances of δ15N among the size classes ($F = 8.59$, $df = 58$ $P < 0.01$). Furthermore, the larger females showed “preference” to nest on the ‘Infante’ beach located on an area with lower human densities. Those differences suggest that mature green turtles may forage or nest opportunistically on the resources and habitat available, in each of their foraging or nesting ranges, strongly connected to a risk avoidance behavior.

TROPHIC ECOLOGY OF *CHELONIA MYDAS* (LINNAEUS, 1758) IN SOUTH COAST OF BRAZIL: SEASONAL AND INTER-ANNUAL VARIATION OF THE DIET.

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The green turtle(*Chelonia mydas*)is the most frequent species in the South-Western Atlantic Ocean (ASO), using coastal area for feeding and development. Sea turtle’s diet evaluate its relationship with its’ natural habitat, and also helps detect anthropogenic impact, such as the ingestion of debris. Other studies focusing the green turtle’s diet identified the most frequent items and records of seasonal and regional variations. Parana coast is an important preserved marine area of south Brazil, presents habitat diversity for *C. mydas* feeding such as shoals, mangrove, rocky shores, seagrass meadows. Juvenile of green turtle are recorded the whole year on this area and 80 dead stranded specimens have been collected from 2008 to 2012 in order to identify their consumed items and to evaluate the animal’s diet changes over eight years. Digestive tracts of the green turtles have been analyzed and the results were compared with a previous research in the region with animals collected from 2004 to 2008. Measures of individuals curvature carapace length (CCL) range from 30 to 62 cm (X=39.69cm±6.61), with no great variation seasonally or yearly. Twelve feeding

items have been found, including six new genders of marine algae (*Enteromorpha* sp., *Pocockiella papenfuss*, *Porphyra* sp, *Cladophora* sp., *Rhizoclonium* sp., *Halimeda* sp.). The three items with the highest occurrence frequencies (OF%) were: the green alga *Ulva* sp. (OF%=35), the seagrass *Halodule wrightii* (OF%= 30) and angiosperms (OF%=27.50). The three highest gravimetric frequency (GF%) and volumetric frequency (VF%) were: *H. wrightii* (GF%= 59.73; VF%= 55.23), *Ulva* sp. (GF%=19.40; VF%=22.11) and *Gracillaria dominguensis* (GF%=9.09 ;VF%=12.96). *H. wrightii* had the highest occurrence frequencies in the early rainy season (ERS) (January to March) - (OF%= 50). The highest *H. wrightii* gravimetric and volumetric frequencies were in the early rainy season(GF%=89.11;VF%=92.38) and in the late dry season (LDS) (October to December) (GF%=90.06; VF%=84.83). The high frequency values of *H. wrightii* in ERS and LDS are the result of the growing biomass of seagrass. Costello's graphic analysis supports the conclusion that *H. wrightii* is the *C. mydas*' individuals dominant diet item, and in the absence of it, the green turtle assumes a generalist role, utilizing other available resources. Therefore, the conservation of this species depends not only on the conservation of the seagrass, but also on its foraging areas inside the estuary, as *C. mydas* diet varies according to seasonal availability of the feeding items. Debris had not been considered part of the turtle's diet, in spite of being the most frequent item (OF%=68,75) in the whole sample (n=80) and in every season.

POSSIBLE HYBRIDIZATION BETWEEN EAST PACIFIC GREEN AND OLIVE RIDLEY SEA TURTLES IN NORTH WEST MEXICO

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The East Pacific green turtle (*Chelonia mydas*) and the olive ridley turtle (*Lepidochelys olivacea*) both nest throughout the Mexican Pacific. Here we present the photographic record of the mating between a male EP green turtle and a female olive ridley sea turtle in front of the coast of Sinaloa, Mexico. We also present photographic records of the presence of sea turtle neonates and embryos from the state of Nayarit which present characteristics from both EP green and olive ridley turtles which we conclude may represent hybridization between the two species.

HABITAT-USE OF BREEDING HAWKSBILL TURTLES *ERETMOCHELYS IMBRICATA* TAGGED AT BUCK ISLAND REEF NATIONAL MONUMENT, U.S. VIRGIN ISLANDS

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Buck Island Reef National Monument (BIRNM) includes one of the most important nesting areas for federally endangered hawksbill turtles (*Eretmochelys imbricata*) in the U.S. The Recovery Plan for hawksbills in the U.S. Caribbean Sea, Atlantic Ocean and Gulf of Mexico identified Buck Island as an index beach necessary for the recovery of this species in the eastern Caribbean. Since 1987, numbers of nesting hawksbills have increased from 12-15 per season in early years up to >85 per season in recent years, resulting in ~400-600 nests per season. Previous telemetry work in the 1990s and early 2000s revealed general destinations of tagged adult hawksbills that departed protected BIRNM waters and at-sea behavior of several additional turtles. However, earlier studies were limited in scope due to small sample sizes and relatively short tracking periods. In 2011, we initiated an interagency 3-year satellite-tracking project on BIRNM nesting female hawksbills to determine 1) locations of high-use inter-nesting habitat locations with respect to BIRNM boundaries, and 2) locations of foraging sites. Thus far we have used satellite transmitters to track the movements of 20 nesting hawksbills (N=9 in 2011; N=11 in 2012). Inter-nesting habitat was concentrated on the north side of BIRNM, and foraging sites include locations in Puerto Rico, the British Virgin Islands, Anguilla, Saint Maarten, Saint Kitts and Nevis, the Netherlands Antilles (Saint Eustatius), and Guadeloupe. Several other turtles had not yet reached their foraging destinations as of 1 October, 2012. These locations reveal previously unknown connections for BIRNM hawksbills, which presents opportunities for conservation at both local and regional scales.

INTEGRATION OF GUT CONTENT AND STABLE ISOTOPE ANALYSIS TO INVESTIGATE ONTOGENETIC SHIFTS IN DIET AND HABITAT BY JUVENILE GREEN SEA TURTLES (*CHELONIA MYDAS*) ALONG THE TEXAS COAST*

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Effective population management of green sea turtles (*Chelonia mydas*) necessitates understanding the temporal variation in foraging grounds used by multiple life history stages. The coastal waters of Texas provide developmental grounds critical to immature green turtles (18–70 cm) foraging in the northwestern Gulf of Mexico. Stomach contents and stable carbon (δ13C) and nitrogen (δ15N) isotope values of successive layers of carapace scute tissue were determined for 114 juvenile green turtles that stranded during 2007-2010. Green turtles were grouped into 10-cm size class increments to characterize sequential shifts in their foraging strategy in Texas waters. Mean SCL of turtles from the middle Texas coast (MTC) was 31.5 cm (Range = 17.6-65.4 cm, n = 63) while that for greens from the lower Texas coast (LTC) was 37.9 cm (Range = 15.5-69.6 cm, n = 51). Results revealed green turtles exhibit multiple ontogenetic shifts

in diet and habitat upon recruitment to Texas coastal waters. Relative values of stable isotopes in the newest scute tissue of turtles 15-25 cm SCL suggests recent recruitment to jetty habitat, while other turtles exhibited depleted δ13C and enriched δ15N values, indicative of oceanic habitat. A diet dominated by oceanic items such as *Sargassum* spp., *Scyphozoa* spp., and plastic debris reinforced the conclusion that many of these immature greens were recent residents of the oceanic realm. Enriched values of δ13C and δ15N in the newest scute layers demonstrate most turtles 25-35 cm SCL had recently inhabited jetty structures, where macroalgae is a dominant forage material. High % IRI diet ranking of seagrasses in 25-34.9 cm SCL turtles from the LTC suggests these greens may transition to bay systems at a smaller size than do MTC turtles that exhibited a high macroalgae % IRI ranking. A definitive shift by turtles >35 cm SCL to inshore habitat in both the LTC and MTC was complemented by a seagrass dominated diet and the newest tissue layer enriched in δ13C and depleted in δ15N. This study is the first to incorporate stomach contents of multiple size classes of green turtles with stable isotope analysis of 13C and 15N in serial layers of scute. Our findings indicate that when integrated these techniques are especially effective for characterizing ontogenetic shifts in habitat use and foraging strategy of immature green turtles. Furthermore our results provided an assessment of the effectiveness of isotope analyses in documenting diet and habitat shifts. Size-related variation in sea turtle foraging activities in Texas requires unified management strategies that minimize impacts to juveniles utilizing nearshore, jetty and seagrass habitats.

POST-NESTING MOVEMENTS AND FORAGING GROUND UTILIZATION BY UPPER TEXAS COAST NESTERS

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Current satellite telemetry data indicate Kemp's ridley (*Lepidochelys kempii*) females utilizing Texas' nesting beaches engage in directed post-nesting movements paralleling the coastline to neritic foraging grounds in northern or eastern Gulf of Mexico waters, with heavier concentrations noted between Louisiana and the Florida Panhandle. However, a paucity of data exists for the small but increasing number of Kemp's ridleys recurrently utilizing upper Texas coast (UTC) nesting habitats. Additional satellite telemetry research on UTC nesters is needed not only to examine nest site fidelity within and between seasons, but also in support of a recovery task in the Kemp's ridley recovery plan that mandates the protection and management of conspecifics in the marine environment, in part via the determination of migratory pathways between and among foraging grounds and nesting beaches. Between 2007-2009, Sirtrack KiwiSat 101 platform terminal transmitters were deployed on eight individuals (mean straight carapace length (SCL)=62.6 cm, SD=2.4 cm) intercepted following clutch deposition on UTC beaches. Seven of these individuals were captive-reared for approximately the first year of life, including six Mexico-imprinted headstarted turtles; one ridley was sourced from the wild stock. All females remained in continental shelf waters for the duration of monitoring, which averaged 422 d (range 26-710 d, SD=194 d). Internesting periods for seven females were characterized by restricted nearshore movements coincident with fidelity to upper Texas coast beaches. However, one ridley monitored for 26 d made directed movements south to coastal waters adjacent to Corpus Christi before returning north to enter Matagorda Bay, where transmissions ceased. The seven remaining adults established post-nesting residency at fixed destinations in waters less than 50 m in depth spanning from the UTC to Key West, Florida. Neritic foraging grounds utilized by numerous females were concentrated near the Mississippi River Delta (N=7) and the Florida Panhandle (N=2); four ridleys established residency at multiple sites. No seasonal delineation was apparent between foraging grounds and overwintering areas. While nesting and telemetry data indicate the UTC is becoming increasingly important to the Kemp's ridley population, current regulations do not afford ridleys using associated habitat protections equivalent to those enforced along the middle and lower Texas coast. In addition, continued proliferation of the Kemp's ridley population will likely result in heavier concentrations of adult females exploiting identified migration corridors and foraging zones, thus increasing the risk of negative interactions with various commercial, industrial, and recreational activities. Sustained recovery of the endangered Kemp's ridley may be facilitated by increased emphasis on conservation activities to maintain or improve the health and accessibility of known feeding grounds and migratory corridors in the northern and eastern Gulf of Mexico, particularly locales deemed critical for adult conspecifics. Acknowledgements: The NOAA Sea Turtle Facility permitted access to turtles and site resources for satellite tagging. Telemetry research was funded by grants from the Texas General Land Office, while the South Carolina Aquarium covered all costs associated with this ISTS.

FIRST REPORT OF CHANGES IN δ13C AND δ15N VALUES IN SCUTE FROM AN ADULT KEMP'S RIDLEY TURTLE (*LEPIDOCHELYS KEMPII*) FOLLOWING A DIET SHIFT

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Analysis of δ13C and δ15N isotope values from successive layers of sea turtle scute have provided insight into ontogenetic shifts, foraging regimes, and habitat use of multiple sea turtle species of different age classes. Isotope analyses of scute assist in capturing substantial expanses of a turtles' foraging history as scute is an inert tissue, produced continuously throughout the life of a turtle. However, there is a paucity of knowledge regarding the time required for δ13C and δ15N from the assimilated portion of the turtles diet to be incorporated into their scute. These data are vital to establishing a timeline that will aid in interpretation of diet and habitat changes as inferred by stable isotopes of δ13C and δ15N. The objective of this study was to track the shift in δ13C and δ15N isotope values in scute following a diet change. The study was conducted using scute collected from a captive adult female Kemp's ridley sea turtle. Scute samples were collected when the turtle (SCL 66.6 cm, SCW 64.2 cm; n=1) arrived at the NMFS Galveston sea turtle facility with blunt force trauma to the left posterior margin of her carapace in May 2011. Additional samples were collected prior to her release in June of 2012 following successful rehabilitation by NMFS Galveston and Houston Zoo staff. Stable isotope analysis of δ13C and δ15N values in 5 layers of posterior scute showed no significant change in isotope values one year after a diet change. Isotope values from the anterior scute samples changed significantly, reflecting the δ13C and δ15N values of the new diet in four of five layers of scute. These results indicate that the δ13C and δ15N isotope values from the poster and anterior portions of scute from an adult turtle may be incorporated into the ventral layer at different rates. To our knowledge, this study provides the first data tracking the shift in isotopic values of δ13C and δ15N in scute layers of an adult sea turtle following a change in diet.

NEW INSIGHTS FOR SEA TURTLE DISTRIBUTION IN COASTAL WATERS OF JAPAN INFERRED FROM FISHERMEN SURVEYS

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The coastal waters of Japan is one of the major habitats for loggerhead and green turtles in the North Pacific. Loggerhead turtle nesting activity is concentrated in southern Japan along the Pacific coast,

whereas green turtle nesting beaches are located primarily in the Ogasawara Islands and Nansei Islands. Large juvenile loggerhead turtles are distributed along the southern part of the Pacific coast, although their distribution extends to northern parts of Japan. Foraging habitat of green turtles overlap with that of loggerhead turtles. To date, information on sea turtle distribution in Japan has been primarily based on nesting beach monitoring conducted by hundreds of independent researchers and stranding reports from researchers and citizens, and studies to systematically assess foraging habitat distribution have been limited. Since 2009, we have conducted informal interviews with fishermen to assess the state of coastal fisheries in Japan and determine the extent of sea turtle interactions. This study has also resulted in increased understanding of sea turtle distribution in the coastal waters of Japan, and we present these preliminary findings here. From 2009 to 2011, a total of 940 fishermen were interviewed at 150 ports across Japan, excluding Hokkaido, Tohoku, and Nansei Islands. Consistent with previous studies, Kyushu and Ki-i Peninsula regions were found to have relatively high sea turtle sightings and interactions compared to the Sea of Japan. Fishermen appear to interact with sea turtles more frequently in areas that directly face the Pacific and East China Sea, suggesting that loggerhead and green turtle abundance in southern Japan may be higher in areas facing the Pacific Ocean and East China Sea, whereas very few turtles enter the inland sea. The lower sea turtle density along the coast of Sea of Japan compared to the Pacific coast may be attributed to the geographical characteristics of Sea of Japan, which appears more like an inland sea surrounded by the Japanese archipelago, continental China and the Korean peninsula. We also found an interesting characteristic in turtle distribution in the Sea of Japan region, where sea turtles were found more often inside bays, such as Toyama Bay and Wakasa Bay, rather than coastal areas directly facing Sea of Japan. This is contrary to the Pacific side of Japan. Another interesting finding regarding sea turtle distribution in bays is that fishermen reported interacting with a handful of loggerhead turtles in Ise Bay throughout the year and even during the winter. Ise Bay opens to the Pacific, and previous studies along the Pacific coast near Ise Bay had shown that sea turtle interactions substantially decrease in winter. Similarly along the Pacific coast, very small number of loggerhead and green turtles are known to enter Osaka Bay and Seto Inland Sea only during the summer and exit the bay by late fall when SST declines below approximately 20 degree centigrade. These new insights to sea turtle distribution in coastal areas of Japan highlight the value of local knowledge fishermen possess, and will encourage further ecological research to validate the findings.

DETERMINATION OF SEA TURTLE MIGRATION PATHWAY BY SATELLITE MONITORING SYSTEMS IN THE EASTERN MEDITERRANEAN COAST OF TURKEY

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Sea turtles in the eastern Mediterranean are isolated from the Atlantic populations and information about migration patterns of males and females in this region is sparce. The understanding of migration patterns, distribution, habitat use and resource requirements is essential for determining the appropriate conservation methods for sea turtle populations. Satellite tracking has become a widely used tool for sea turtle researchers over the past decade. We attached satellite tags to nine loggerhead sea turtles between 2010-2012 to study the migration patterns of sea turtles (nesting or rehabilitated at the Rescue Center (DEKAMER)) on Dalyan beach, Turkey. We are still receiving data, but our initial results indicate that most of the male sea turtles from western Anatolia coasts did not migrate to other countries, but remained near the Turkish coast. Some females showed similar patterns, but a few females migrated to the shores of Tunisia, Libya, Egypt, and Israel. Our initial results suggest that collaborative conservation efforts are necessary for the protection of sea turtles in the Mediterranean.

LONG-DISTANCE TRAVEL DURING INTER-NESTING: UNIQUE AND DEVIANT MOVEMENTS OF LOGGERHEAD NESTERS IN THE NORTHER GULF OF MEXICO

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Little is known about movements and habitat-use at sea for loggerhead sea turtles, *Caretta caretta*, in the Northern Gulf of Mexico. In 2010, we initiated sea turtle tagging and tracking program, focused on obtaining inter-nesting habitat-use information for N=4 nesting females from the longest-term Northern Gulf loggerhead nest monitoring site on the St. Joseph State Peninsula, Florida. In 2011, we continued the tagging and tracking program on SJP (N=5), but expanded it to include loggerheads nesting at Bon Secour National Wildlife Refuge and adjacent beaches in Gulf Shores, Alabama (N=13). Most recently, in 2012 we deployed 23 tags, 10 from AL and 13 from Florida. In 2011, definitive links emerged for loggerheads between these two sites (i.e., one turtle that nested in June in Alabama later nested on SJP in July, and several turtles that nested in Alabama were re-migrants from SJP from as far back as 10 years). In 2012, additional links to the SJP site became apparent as one turtle that nested in Alabama in June had previously been tagged at SJP 6 years prior. In addition to documenting turtle exchanges between the two sites, we also observed remarkable movements by turtles during the inter-nesting period. Of the 45 turtles tracked, 25 made inter-nesting movements greater than 100 km and eight traveled between the two study sites (straight-line distance of 250 km). Several turtles traveled over 360 km within a 2-week span of time. Other turtles made looping movements out into deep areas of the Gulf of Mexico, never returning to nest. We also documented exchanges between the Northern Gulf of Mexico nesting group and the Southwest Florida nesting group. Such movements have not been documented for other loggerhead populations during inter-nesting intervals, even for others in the southern Gulf of Mexico (i.e., the Dry Tortugas sub-population). It is often suggested that the majority of loggerhead turtles remain within 5-km of their nesting beach during the inter-nesting period. The results of this ongoing study demonstrate loggerheads in the northern Gulf of Mexico frequently and consistently make movements much greater than 5-km during inter-nesting periods. Only 9 of the 45 turtles remained within 10-km of their original tagging site during inter-nesting. These findings suggest loggerheads in this region are not restricted to one "nesting beach" but frequently use the entire region during one nesting season. These findings have implications for protection of this species from threats in nearshore waters, such as commercial fishing, and for critical habitat designations, as protection of one nesting beach would not encompass their entire range.

VARIATION IN REMIGRATION INTERVAL IS LINKED TO FORAGING DESTINATION OF WESTERN PACIFIC LEATHERBACK TURTLES

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Timing of reproduction and productivity of migratory species reflect ecological conditions of their foraging regions. Non-breeding habitat quality has been linked to arrival time to breeding areas, reproductive performance and breeding population abundance. Leatherback turtles (*Dermochelys coriacea*) obtain resources for reproduction from distant foraging regions, and they do not typically breed every year. The number of years separating successive nesting seasons or remigration interval includes the amount of time to complete migration and to accumulate enough reserve for reproduction in the foraging region. In this study, we compared remigration intervals of leatherback turtles that foraged in distinct regions of the Pacific. The largest remaining nesting aggregation of western Pacific leatherback turtles is in the Bird's Head peninsula on the northwest coast of Papua, Indonesia. Turtles that nest during April to September migrate to temperate (Northeast Pacific and North Pacific Transition Zone) and tropical (South China Sea) foraging regions, which vary in the distance from nesting beach, latitude, biogeochemical process, and productivity. To infer foraging regions of nesting turtles, we used stable nitrogen and carbon ratios ($\delta15N$ and $\delta13C$) of satellite-tracked turtles as predictors of foraging region in a linear discriminant analysis. The resulting functions were then used to classify turtles sampled in 2010 and 2011. Remigration intervals of assigned turtles were calculated from historic tagging data, and compared among the three groups using analysis of variance. As predicted, turtles that foraged in the Northeast Pacific had greater $\delta15N$. Turtles that foraged in the North Pacific Transition Zone were distinguished from those that foraged in the South China Sea by their lesser (more negative) $\delta13C$. Means of $\delta15N$ and $\delta13C$ were 15.04‰ (95% CI from 14.04 to16.04‰) and -17.14‰ (-17.66 to -16.63‰) for turtles that foraged in the Northeast Pacific, 12.69‰ (11.42 to13.97‰) and -18.21‰ (-18.86 to -17.56‰) for turtles that foraged in the North Pacific Transition Zone, and 11.03‰ (9.89 to 12.17‰) and -16.82‰ (-17.41 to -16.24‰) for turtles that foraged in the South China Sea. The discriminant functions correctly classified 74.2% of satellite-tracked turtles. Turtles that foraged in the Northeast Pacific had a longer remigration interval (>3 years) than turtles that foraged in the North Pacific Transition Zone and South China Sea (2 and 3 years). Variable remigration intervals may explain fluctuations in the number of turtles nesting annually and has implications for estimating population size. We thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, and CLS America for providing a generous travel grant award. Funding and logistical support for this study were provided by the Bird's Head Leatherback Program of State University of Papua, U.S. National Oceanic and Atmospheric Administration – National Marine Fisheries Service, Dr. Earl H. Myers and Ethel M. Myers Oceanographic and Marine Biology Trust, PADI Foundation, and Friend's of Moss Landing Marine Laboratories' Signe Memorial Scholarship.

FIRST SATELLITE TRACKS OF NEONATE GREEN (*CHELONIA MYDAS*) TURTLES USING A NEW TAG ATTACHMENT METHOD

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Satellite tracking of neonate turtles is challenging due to limits imposed by turtle size, shell characteristics, and behavior. The shell of neonate green turtles differs from that of loggerheads in shape and surface properties. The acrylic-neoprene-silicone tag attachment method described by Mansfield *et al*. (2012) does not adhere to small green turtles. We developed and lab-tested a new tag attachment method specific to neonate green turtles that relies upon a flexible, low temperature adhesive. Using small, solar-powered satellite tags and this novel tag attachment method, we satellite tracked 11 neonate green sea turtles (15 to 18 cm straight carapace length) in 2012. Sea turtles were lab-reared, weighed between 500-860 g and ranged in age from 6-9 months post-hatching. All turtles were released in the Gulf Stream off the southeast Florida (USA) coast proximal to their natal beaches. Turtles traveled 475 to 3,500 km minimum distance. The average duration of tag transmissions was 67 d (range: 10-102 d). Similar to neonate loggerheads tracked in our previous study, the green turtles remained in or within close proximity to the Gulf Stream immediately post-release, traveling north with the current, along the eastern coast of the US. Initially, most turtles remained east of the Continental Shelf, and were constrained by the western Gulf Stream boundary. Five turtles traveled in the Gulf Stream to the northwestern Atlantic where they associated with the edges of mesoscale eddies prior to tag cessation. However, unlike neonate loggerheads, four green turtles returned to near-shore neritic waters off South and North Carolina for periods of 1-3 weeks prior to re-entering the Gulf Stream. Five turtles traveled as far as Cape Hatteras, North Carolina or up to 1,000 km beyond before traveling south again into the region associated with the western Sargasso Sea. One turtle returned to the same latitude as its release. All turtles remained within average available sea surface temperatures (SST) of 21-25˚ C. Our data represent the first successful satellite tracks of any neonate green sea turtle and provide the first in situ, empirical evidence of the long-term movements and habitat use of neonate green turtles in the Atlantic. Acknowledgments: Funding and support for this project was provided by: the Florida Sea Turtle Grants Program, Save Our Seas Foundation, Disney Worldwide Conservation Fund, National Marine Fisheries Service Southeast Fisheries Science Center, Ashwanden Family fund, Nelligan Sea Turtle Fund, J. Abernethy and personal funds.

IDENTIFYING IMPORTANT FEEDING AGGREGATIONS OF GREEN SEA TURTLES (*CHELONIA MYDAS*): THE GULF OF VENEZUELA

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Green turtle foraging habitats have been studied less than the nesting habitats in the Caribbean, but are known to harbor an important anthropogenic threat: the intentional harvest and bycatch of juveniles and adults. We examined a foraging area with traditional turtle hunting in the Gulf of Venezuela (GV) by estimating: a) the area of available feeding habitat within the portion of the GV with most intense extraction, the “high extraction zone” (HEZ); b) relative turtle density, using catch per unit effort (CPUE); and c) turtle size class structure. We visited fishing ports, markets and beaches between 2002 and 2005, and interviewed and observed artisanal fishers to define the HEZ. Then between 2005 and 2008, we characterized the bottom cover at 400 points and set tangle nets to capture turtles at a rate of 15.03 km-hr. The area of estimated foraging habitat was 226 km^2 (including only seagrass areas), which was much smaller than similar habitat surrounding an HEZ in Nicaragua, which is considered the most important in the region to date. Nonetheless, the relative density of green turtles was significantly higher in the HEZ-GV than in Nicaragua (1.21 vs. 0.61 turtles/km-net-hr, $p = 0.01$). Furthermore, 63% of green turtles observed were juveniles (avg. CCL 63.9 cm) and the remaining 37% were subadults (avg. 77.0 cm) or adults (97.0 cm), making the GV the only other feeding habitat in the Caribbean identified to date with both large juveniles and subadults present, and one of just four with adults. The unusual combination of extensive available foraging habitat, high relative turtle density, presence of larger size classes, and continued turtle fishing pressures highlights the importance of the GV both as a foraging ground for *C. mydas* in the Caribbean, and as a location of interest for future monitoring.

AN APPLICATION OF VIDEO ANALYSIS TO THE COGNITIVE STUDY: THE RELATIONSHIP BETWEEN LOOKING-AROUND BEHAVIOR OF GREEN TURTLES AND THEIR HABITAT ENVIRONMENT

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An animal-borne video recording system has recently been developed to study underwater behavior of marine animals, which enable us to understand the meaning of their behavior, habitat and prey items.

However, the way of using the video data is just watching, and almost all of these studies have not employed a quantitative video analysis for understanding the behavior and ecology of animals. In this study, we used the computer vision technique which was developed in the human sensing, and applied to the cognitive study of sea turtles. The objective of this study was to clarify the relationship between looking-around behavior of green turtles and their habitat environment. We used 17 juveniles in total (one individual in 2010, 13 individuals in 2011, three individuals in 2012). In 2010, the turtle was attached the video data logger (modified from HDR-CX180, SONY Ltd.) with time-scheduled release system (Little Leonard Ltd.) on the carapaces. In 2011and 2012, the turtles were attached the Fast-loc GPS and depth data logger (Mk10-FB, Wildlife Computers Ltd.) and video data logger (modified from GoProoR Ltd.) with the time-scheduled release system on their carapaces. The turtles were released at the place where they had been captured before. At the scheduled time after the releases, the data loggers were automatically detached from the turtles by the time-scheduled release system, and then popped up to the sea surface. As the result of this study, we succeeded in retrieving the loggers and consequently obtaining video data from nine turtles (one individual in 2010, five individuals in 2011, three individuals in 2012). Then, the looking-around behavior of turtles was detected using the template matching technique. Our result demonstrated that green turtles made looking-around behavior more time when they were not in their home range than when they were, and before and after breathing at the sea surface.

COMPLEX HABITAT USE BY HAWKSBILL TURTLES IN LAC BAY, BONAIRE, DUTCH CARIBBEAN - PRELIMINARY RESULTS

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The Lac Bay lagoon covers an area of about 7 km^2 and contains a variety of habitat types including mangrove stands, seagrass beds and coral reefs, all constituting potential hawksbill turtle habitats. Due to its diversity value and vulnerability, the area has been designated as a legally protected Ramsar site. Turtle surveys conducted at Lac Bay since 2003 have resulted in the capture, tagging and measurement of 76 individual immature hawksbills (plus 37 recapture events). In addition, hawksbill habitat use is examined in detail through GPS/depth/temperature dataloggers, measuring diving behavior and movement patterns. Here we present preliminary data on size range, displacement, diving behavior, somatic growth rate and body condition index data of hawksbills using Lac Bay. The high growth rates and body condition index exhibited by the Lac Bay hawksbills indicate that food quality and/or food availability is greater than in other habitats around Bonaire and the region. Our preliminary results indicate that immature hawksbills are successfully foraging in the seagrass beds and mangrove stands of Lac Bay, habitats complementary to the coral reefs with which the species is typically associated

FEEDING ECOLOGY OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) STRANDED ALONG THE PORTUGUESE SOUTHERN COAST – ALGARVE

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Up to the last two years, studies on the biology and ecology of marine turtles were non-existant along the Continental Portuguese coast. The Portuguese southern coast, the Algarve, is an area of high stranding records for loggerhead turtles, *Caretta caretta*, where population status is unknown and interactions with fisheries are the main cause of death. The present study is the first attempt to determine the feeding ecology of loggerhead turtles occurring off the southern Portuguese coast in order to evaluate possible competition and interaction with fisheries. We analyzed the contents of the digestive tract of 53 loggerhead sea turtles (range of curved carapace length, CCL: 33.2 – 71.5 cm) stranded dead along the Portuguese southern coast (Algarve) between 2010 and 2012. The food items were identified to the lowest taxonomic level possible. Seasonal differences, animal's size/maturity (carapace length) and main causes of death were taken into consideration. Crustaceans were the most important prey group occurring in 73.6% of the examined stomachs, followed by fish (56.6%) and molluscs (43.4%). The most important crustacean species were Henslow's swimming crab, *Polybius henslowi* (49.1%) and the hermit crab, *Pagurus* sp. (22.6%). Also, debris in the gastrointestinal tract occurred in 70% of the analyzed sea turtles. The percentage of occurrence of pelagic prey is higher in the first semester (January to June), while benthic prey is most frequent in the second semester (July to December). Unlike other diet studies for the same species worldwide, in our study loggerhead turtles with the smallest CCL showed a tendency to feed on benthic prey, while turtles with the highest CCL preferred pelagic prey. However, number and diversity of prey increased with turtle size indicating an increase of selectivity with age/maturity. Percentage of occurrence of prey with commercial value was higher in loggerhead turtles whose cause of death was related to interaction with fisheries (incidental capture) corroborating that fisheries represent an important food source for loggerhead turtles. Evidence that commercially important fish species are consumed as discarded by-catch or depredation by loggerheads, may suggest a worrisome interaction with fisheries, that requires monitoring in order to attain better estimates of its impact.

AN ENERGY STRATEGY OF FEMALE GREEN TURTLES DURING INTER-NESTING PERIOD IN ISHIGAKI ISLANDS, JAPAN

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In terms of reproductive strategy, animals are assumed to have evolved to maximize reproductive output. Sea turtles deposit several nests during a single nesting season and spend the next 10-20 days offshore until the next clutch is ready to deposit. Therefore, it is assumed that the turtles save energy for the next nesting event during the inter-nesting period, but detailed movement and behavior patterns of females have not yet been investigated. This study was conducted between June and August of 2008, 2009 and 2010 at Ishigaki

Island, Japan. The objectives of this study were to investigate the 3-D movements and behavioral patterns of nesting green turtles (*Chelonia mydas*). We attached the speed, tri-axial acceleration, tri-axial magnetism, water temperature and depth data loggers (W1000L-3MPD3GT, Little Leonard Ltd.) on 8 turtles after nesting, with Fast-loc GPS dataloggers (Mk10-FB, Wildlife Computers) on 4 of the turtles. Dataloggers were retrieved at the next nesting event. We obtained behavioral data for 9-12 day periods for each turtle. Our results demonstrated that all females stayed along the coast in front of the nesting beach with a small home range during the inter-nesting period. At night, much time was spent resting in one place, while during the day they moved around the resting place. These results indicate that the nesting female turtles save their energy by resting for long periods of time. Additionally, they seem to save their energy efficiently, not by searching for a resting place each time, but by selecting a fixed place.

FIRST SATELLITE TRACK OF A HEAD-STARTED HAWKSBILL (FOUR YEARS OLD) IN THE COLOMBIAN CARIBBEAN

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Due to the absence of information on residential and migratory behavior of hawksbill turtles, *Eretmochelys imbricata*, in the Colombian Caribbean, this study monitored the post – release movement of a four year old head – started turtle named "Cumbiarey" using satellite transmitter SPOT5 AM–S244B during a period of six months. The turtle was released on 5 December 2009 in Gayraca Bay, Tayrona National Park, Colombia (11°19’5.98’’ N – 74°6’24.96’’W) where it remained during the first 21 days covering most of the extension of the Park’s water, after that, Cumbiarey started an oceanic journey in which had the highest average speed (3.4 ± 0.19 km/h) across the road, showing the possible influence of the Caribbean current and the southern part of an anticyclonic eddy that led her to the Costa Rica's inland waters, then she might have been driven by Panama - Colombia countercurrent to finally reach to the Bocas del Toro archipelago (Panama).The tag transmitted location data for 64 days and showed that the maximum distance traveled by the turtle was 1463.66 km from the release site, furthermore, we received 69 temperature recordings within the range of 25.1°C to 30.6°C. The results of the Pearson test indicated a strong correlation ($r(69) = 0.70$) between the station data from the Smithsonian and temperature sensor data from the SPOT5; indicating that temperature is an important variable that may be useful for validating geographic locations. Cumbiarey demonstrated that juvenile hawksbill turtles from head-started projects are able to migrate and survive in the wild for a period of at least of 6 months, travelling within surface currents to successfully arrive at documented areas known for sea turtle nesting and foraging.

IDENTIFYING BEHAVIORAL STATES IN LOGGERHEAD TURTLES USING SATELLITE TELEMETRY DATA

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The purpose of this study was to identify behavioral states of loggerhead turtles from satellite telemetry data. We also determined how shifts in behavioral states were influenced by environmental conditions. During the 2010 and 2011 nesting seasons in Rethymno, Crete, Greece, we successfully deployed 15 satellite transmitters on postnesting female turtles to determine their at-sea behaviors. All of these transmitters lasted until the turtles reached their foraging sites, with some transmitters continuing to function into overwintering. We used two statistical methods to determine behavioral states of each turtle: (1) change point analysis and (2) state space modeling. (1) Change point analyses were used to determine subtle shifts in dive data. We found that for several turtles, changes in dive behavior occurred prior to arrival at a foraging site and then again as the turtle established residency. This transition period may represent a type of searching behavior to identify an optimal foraging site. Another common change in dive behavior occurred if the individual moved to a new site of residency. Finally, we found obvious shifts in dive behavior as turtles transitioned into overwintering. (2) We applied state-space modeling to the horizontal location data to identify changes in behavioral states. These location data were then related to remote sensed environmental data to identify correlations between behavioral shifts and sea surface temperature or chlorophyll concentrations. The 15 loggerheads all traveled to relatively shallow regions. Six went north into the Aegean Sea where chlorophyll levels were relatively low, while nine turtles went south to the coasts of Tunisia and Libya, where levels of chlorophyll were much higher. These two areas also differed consistently in sea surface temperature by two degrees; however, this did not seem to impact turtles' behavioral states. By consolidating these analyses, we can develop an ecological niche for loggerhead sea turtles in the Mediterranean Sea. This will allow us to predict which areas could have higher loggerhead abundances and potentially how this species will react to a changing environment.

POST-NESTING BEHAVIOR OF *LEPIDOCHELYS OLIVACEA* NESTING IN CAMP LA GLORIA, JALISCO, MEXICO

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This preliminary study examines the post-nesting behavior of *L. olivacea* nesting in Camp La Gloria. Empirical data characterize where sea turtles go after nesting and the frequency of post-nesting diving behaviors to address whether the current boundaries of the Naturally Protected Area are sufficient for the protection and conservation of *L. olivacea*. Preliminary data provide information regarding the spatial distribution of the nesting behaviors of *L. olivacea*, and document two patterns of movement: A north-south movement that complements the existing literature on *L. olivacea* post-migration, and a second south south-west post-migration pattern that is poorly documented. We demonstrate how all five turtles moved beyond the boundaries of the Naturally Protected Area, currently shaped as 4 nautical miles, and post-migration data suggest that the turtles move in and out of the Naturally Protected Area more frequently than expected.

SEA TURTLE STUDY IN ALBANIA DURING 2011

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During 2011, we collected taxonomic and morphometric data on 121 *Caretta caretta* individuals and 2 *Chelonia mydas* individuals. All turtles were captured in two stavniks (a kind of fishing trap) in Drini Bay, except 2 in Orikum and Durres. Recorded measurements included Curved Carapace Length (CCL), Curve Carapace Width (CCW), Total Tail Length (TTL), distance from posterior margin of plastron to midline of cloacal opening (Plas – Clo), and distance from tip of the tail to posterior margin of the carapace (+/- cara). All turtles were then allocated into size classes. We counted the epidermal scales on the head, dividing them into prefrontal and frontoparietal scales. Sex was determined using morphological characteristics. All turtles larger then 30 cm CCL were tagged with Albanian titanium tags and were checked for epibionts, wounds, missing flippers, parasites etc. Loggerhead CCLs ranged from 32-85 cm, but most were in the 60 cm size class. The two *Chelonia mydas* individuals were very small (28 and 30 cm). The highest numbers of turtles were captured in June (35 individuals) and August (30 individuals). We found much deviation in the number of carapace scales. Three of the 121 individuals were dead, 3 had missing flippers and 3 had hooks in their digestive tracks.

DISTRIBUTION AND RELATIVE ABUNDANCE OF SEA TURTLES IN BUCK ISLAND REEF NATIONAL MONUMENT, ST. CROIX, US. VIRGIN ISLANDS

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Buck Island Reef National Monument (BIRNM) provides important habitat for green (*Chelonia mydas*) sea turtles and is listed as an index site for hawksbill (*Eretmochelys imbricata*) sea turtles. In October 2011 and June 2012 we conducted snorkel surveys to assess the distribution and relative abundance of sea turtles at our study site within BIRNM. Our study site was divided into 18 approximately 0.15 km^2 survey blocks and timed snorkel surveys were conducted along transects within each survey block to record the abundance, location, life-stage and species of the sea turtles sighted. We spent a total of 70.3 hours (431.5 surveyor hrs) surveying a distance of 133.7 km within the study site. During the two survey periods we observed a total of 168 sea turtles, including 122 green and 46 hawksbill sea turtles. We observed sea turtles in all 18 survey blocks, however, sea turtle sightings within just three survey blocks along the southeast forereef accounted for 50% of the total sightings. Using the relative abundance data we generated density estimates and catch per unit effort (CPUE) estimates for sea turtles for each survey block; these represent the first effort-corrected estimates for BIRNM. We also investigated the effect of benthic composition within each survey block on sea turtle abundance. Specifically, we investigated the effect of rugosity, depth, hard coral cover, soft coral cover, hydrocoral cover, sponge cover, algae cover, seagrass cover and over-all cover on sea turtle abundance. As part of a renewed effort to collect in-water data from sea turtles at BIRNM, this study is first in almost a decade to document sea turtle distribution and abundance at this index site.

USING MULTIPLE METHODS TO LINK THE LOGGERHEAD FORAGING POPULATION IN AMVRAKIKOS GULF, GREECE, TO SOURCE NESTING POPULATIONS IN THE MEDITERRANEAN

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A decade-long study in Amvrakikos Gulf, Greece, has identified the area as a hot-spot for loggerheads within the Mediterranean, with over three hundred large-juvenile to adult turtles (>46 cm SCL) identified in only 71 days fieldwork. Establishing links between this foraging site and the different nesting areas is important to identify which source populations which are impacted by turtle survivorship rates in the Gulf and to highlight the shared responsibility of marine turtles in the region. To validate these links we employed multiple research methods. Capture-mark-recapture using flipper tags on turtles caught by rodeo technique from an inflatable dinghy has been the standard method employed to trace turtles in time and space over the duration of the study. Additionally we have used satellite telemetry to track several individuals (N = 6 turtles) from their capture locations within the Gulf and mixed stock analysis from short (380 bp) and long (815 bp) mtDNA sequences (N = 38 turtles) to generate estimates for the relative contributions of the region's nesting populations. Flipper tagging results have linked 11 adult female loggerheads to nesting areas in Greece (1 Mounda Beach, Kefalonia; 6 Laganas Bay, Zakynthos; 4 southern Kyparissia Bay, Peloponnese; 1 Rethymno, Crete). One of the tagged turtles displayed poor nest site fidelity and was observed nesting at both Kyparissia and Laganas Bays in a single season. Satellite tracking revealed one adult-sized female migrated over 3,400 km with its last location placing it near the Fethiye nesting area in Turkey during the breeding season. Published tracks of three other adult turtles from the Laganas Bay breeding area (1 male and 2 female) reported the turtles migrated into Amvrakikos Gulf. Lastly, short-sequence mtDNA analysis revealed negligible potential contribution from Atlantic breeding stocks and hence these nesting areas were excluded from further analysis. Long sequence analysis, that provides greater resolution between breeding stocks, indicated the majority of turtles were of Greek origin including Zakynthos (42.7%), Lakonikos Bay, Peloponnese (27.7%) and the Island of Crete (12.9%). Long-sequence haplotypes present in Kyparissia Bay have not yet been analysed, but previous studies with short sequences suggested that this area is similar to the other Greek nesting beaches and hence its contribution would be probably included in the contribution from Lakonikos and Zakynthos. This hypothesis should be tested in the future using long sequences. Using multiple methods we have revealed that the loggerhead foraging population in Amvrakikos Gulf is inextricably linked with the more proximal major nesting grounds in Greece and probably to a lesser degree Turkey. The results highlight that, though not exclusively so, developmental and adult foraging areas may hold individuals from more localised breeding assemblages, conferring deeper spatial structure to the region than may be expected. Amvrakikos Gulf is confirmed as a nationally important loggerhead foraging ground where local threats would impact nesting populations across the country. Acknowledgments: Satellite tracking was undertaken through and part-funded by EU LIFE project LIFE99NAT/006475. We thank all the field assistants for their help over the ten years of research. AFR thanks International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America and the International Sea Turtle Symposium for a travel grant.

FACTORS AFFECTING NEST AND IN-WATER SURVIVAL OF HAWKSBILL HATCHLING SEA TURTLES AT JUMBY BAY, ANTIGUA, WEST INDIES*

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A number of studies suggest that the most dangerous time for hatchling sea turtles occurs during the first hours after nest emergence. Sea turtles produce large clutches consisting of small offspring, presumably in response to these threats. Hawksbills in particular, produce very large clutches (mean ~150 eggs) of small (13.5-19.5 g) hatchlings, presumably to offset typically higher rates of hatchling mortality than are experienced by other marine turtle species. However, few previous studies specifically document hawksbill hatchling mortality rates. The purpose of our study was (i) to describe presumed morphological adaptations shown by hawksbill hatchlings to promote their emergence from nests under canopy vegetation and through plant roots; (ii) to compare and contrast their time of emergence to the temporal pattern shown by their closest relative, the loggerhead; and (iii) to document predation rates the hatchlings experienced during offshore migration. We chose a confined beach site (Pasture Beach on Long Island also known as Jumby Bay, Antigua) where turtles nest at high densities. The primary nesting beach facilitated tracking hatchlings offshore to estimate predation rates. We conducted this research during late July through September, 2012, when hatchling emergence was at its seasonal peak. We recorded nest emergence times, measured a sample of hatchlings, and completed nest excavations. Hatchlings towing small floats, illuminated from above, were followed by kayak for 25 min as they migrated offshore immediately after an emergence. A GPS location was taken every 5 minutes, and predation events were recorded. Hatchlings most often emerged from nests between dusk and 9PM, which is much earlier than loggerheads from Florida that emerge most often between 10PM and 2AM. An earlier emergence time might allow hawksbill hatchlings, which are relatively slow swimmers, more time to reach deeper water before sunrise. Emergence success for the majority of the nests exceeded 70%. When emergence success was lower, it was often because eggs didn't hatch or because hatchlings were entangled in plant roots. Morphometric data revealed that hawksbills hatchlings have a deeper body and proportionally larger rear flippers than loggerhead hatchlings. These morphological differences might enhance successful burrowing through root networks that invade many nests. A total of 50 hatchlings were tracked as they swam offshore. The overall predation rate was 57% but on the west side of Pasture Beach, where females nest at higher densities, 88% of the hatchlings were predated. On the east side of the bay rates were much lower (18.2 %). Predators may have learned to forage where hatchlings were most abundant. Over the past 3 years, there has been a decline in nesting by both experienced females and (first time nesting) recruits. High rates of hatchling predation over many years might be a factor, but it's impossible to know if present predation rates represent a historical norm or are a recent phenomenon. If this decline persists, alternative management procedures might be required to enhance hatchling survival, and hopefully stem any further reduction in this important breeding assemblage.

TROPHIC BEHAVIOR DIVERSIFICATION OF GREEN TURTLES FROM MEXICAN PACIFIC IN RELATION TO CLIMATE CHANGE

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The knowledge of diet and foraging ecology can identify important food resources and guide decisions regarding the management of endangered populations. Changes in trophic behavior of green turtles (*Chelonia mydas*) in relation to the benthic community structure in their feeding grounds may affect net nutritional gain and in turn, reproductive output and demography. It has been reported that the seagrass *Zostera marina* is one of main dietary items of *C. mydas* in northwest Mexico; however, this once-abundant seagrass has decreased substantially due to environmental changes. Elevated sea temperatures produced by global warming or El Niño Southern Oscillations (ENSO) are responsible for major reductions of seagrass populations around the world. In these conditions, it is possible that climax seagrass species (*Z. marina*) could be partially or completely replaced by opportunistic species like *Ruppia maritima*, thereby producing a radical change in the trophic structure of the community. In this study, we conducted an extensive evaluation of seagrass populations found 29 sites along Baja California Peninsula, Sinaloa and Sonora based on literature surveys and in situ sampling efforts for more than 20 years. We found noticeable amounts of *R. maritima* growing close to *Z. marina* meadows in areas and in densities unknown for the region. Moreover, during 2008-2009 we obtained several samples of stomach contents from dead, bycaught turtles and oesophagic contents for live juvenile green turtles from three coastal lagoon of Pacific of Baja California Peninsula. According to esophageal and stomach samples, the *R. maritima* constituted between 0.40 and 24.33% of the diet of green turtles, while Z. *marina* values were between 3.33 and 44.21%. To our knowledge, this is the first documentation of *R. maritima* featuring more prominently than *Z. marina* in the diet of green turtles in northwest Mexico. It is also the first study linking the Bottom-Up effect by ENSO and climate change in trophic relationships on shallow areas, as well as the ability of green turtle to modify their feeding behavior at foraging areas in northwest Mexico. We thank International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America and the International Sea Turtle Symposium for their generous donations for attend to 33rd Annual Symposium on Sea Turtle Biology and Conservation.

USE OF NON-OCEAN HABITAT BY SEA TURTLES AS FORAGING OR RESTING GROUNDS

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Sea turtles use a variety of foraging and resting grounds near nesting sites. Several nesting beaches in Belize are in close proximity to the Northern and Southern Lagoons. These nesting beaches have typical foraging and resting grounds in front of the beaches, but rivers also provide access to the lagoons. The use of the Southern Lagoon as a sea turtle habitat has been reported by residents of Gales Point Belize, but only by word of mouth. In July and August of 2011, three female hawksbill sea turtles were satellite tagged

during nesting attempts at the Manatee Bar. Each of these sea turtles was tracked for over 100 days and they remained in areas in front of the nesting beaches where they would be expected to be resting and foraging between nesting events. On one occasion, the satellite transmissions from one of these females suggest that she traveled up the Bar River and entered the Southern Lagoon. She stayed in the lagoon for two days before returning to the ocean. As this is the first evidence that places sea turtles in the Southern Lagoon, the possibility of transmission error is also analyzed.

COASTAL OR PELAGIC: UPDATING THE LEATHERBACK PARADIGM

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The current paradigm is that leatherback turtles (*Dermochelys coriacea*) are pelagic specialists. Indeed, the majority of leatherback turtles satellite-tracked to date have occupied pelagic foraging grounds or crossed vast expanses of open-ocean en route to coastal foraging grounds. However, it is feasible that leatherback turtles would not travel to open ocean if suitable foraging grounds existed in coastal waters near the nesting beaches. The coastal waters of Mozambique may represent such a site. While leatherback turtles are often sighted in the coastal waters of Mozambique, it has yet to be confirmed whether this is a foraging ground. Nevertheless, approximately 500 km south along the coast in South Africa are known nesting beaches for leatherback turtles. To test whether the leatherback turtles nesting in the iSimangaliso Wetland Park, South Africa forage in the coastal waters of Mozambique and thus remain coastal throughout their adult lives, we deployed satellite transmitters onto post-nesting females in 2011/12. We recorded the post-nesting migrations of 8 individuals over a combined total of 956 tracking days. Four turtles headed south with the prevailing Agulhas current before turning westward into the pelagic regions of the South Atlantic Ocean or eastward into the Indian Ocean. One turtle headed due east from the nesting site until transmissions ended 600 km south of Madagascar. The remaining three turtles headed northwards. During these northward migrations the turtles rarely ventured beyond 100 km of the coast. Upon reaching 18 to 20 °S, speed of movement decreased to below 5 km day-1 and all three turtles appeared to have taken up residence. Subsequently, these turtles remained resident within an area less than 100 km2 and where the sea floor was less than 200 m deep. At this time, they dove far more frequently than those in pelagic foraging grounds (coastal 4 dives hour-1; pelagic 2.5 dives hour-1) and mean dive duration was shorter (coastal ~ 8 mins; pelagic ~ 16 mins). Although coastal turtles mainly dove to depths less than 30 m, dives to the depth of the sea floor were not uncommon. Three out of the 8 turtles tracked in this study remained in coastal waters during their post-nesting migrations and later as they became resident in their foraging grounds. Thus, it is possible that a portion of this population may exhibit completely coastal habitat preferences. Interestingly, the movement patterns of the three coastal turtles from this study were similar to a single leatherback turtle (out of 46) tracked from Playa Grande, Costa Rica and that during its post-nesting migration and subsequent residence remained entirely in coastal waters. Similar patterns have also been observed in the number of turtles nesting in New Guinea. Contrasting with the common perceptions of leatherback turtles as pelagic specialists our study indicates a greater level of diversity in the life history of this species. Finally, as this coastal cohort remained with the Exclusive Economic Zones of South Africa and Mozambique during the tracking period this could represent a unique chance for an otherwise complex multinational conservation plan.

DIET, FOOD AVAILABILITY AND SELECTIVITY OF *CHELONIA MYDAS* JUVENILES AT GORGONA NATIONAL PARK, COLOMBIAN PACIFIC*

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Gorgona National Park (GNP) is the only known feeding ground for *Chelonia mydas* juveniles on the Colombian Pacific. This project was undertaken to determine diet and food selection by *C. mydas* in coastal waters of GNP. Four sampling trips were carried out between November 2011 and August 2012, and three more will be undertaken in October, November and December 2012. Sea turtles were captured by hand at night at the two main reefs where *C. mydas* can be found during the day and resting at night; standard measurements were taken and esophageal lavages performed. Food availability was determined by recording items in 15 randomly placed 0.0625 cm2 quadrats on each reef, during each sampling trip. Relative abundance was calculated by dividing percent cover of each item by total percent cover sampled. The most abundant items were: *Pocillopora damicornis* (58.42%), rhodoliths (22.22%), *Cladophora* sp. (4.61%) and algae mats (3.58%). A total of 43 *C. mydas* juveniles have been sampled so far, ranging from 48.7 to 71.9 cm curved carapace length, and weighing from 12.0 to 48.0 kg. The volume collected from the esophageal lavages ranged from 0.2 to 4.0 ml, and weighed from 0.20 to 4.07 g. A total of 23 items have been identified. Due to advanced digestion and low sample volume, not all sample matter could be identified. The most frequent items in esophageal lavages were unidentified organic matter (OUM; 100 FO%), sand (100 FO%), vegetable matter, including small leaf pieces and seeds (97.67 FO%), and *Gracilaria* algae (27.91 FO%). The N%, W% and index of relative importance (IRI) were also calculated. According to the IRI, the most important components in the *C. mydas* diet in GNP are OUM (11 368), vegetable matter (647.61), *Gracilaria* spp. (333.95) and *Dictyota* spp. (109.03). Sand and plastic fibers were also commonly found. Selectivity was calculated using Ivlev´s index; *C. mydas* showed preference for leaves (0.99), sand (0.92), *Dictyota adnata* (0.76) and *Gracilaria* sp. (0.62).

TROPHIC ECOLOGY OF KEMP'S RIDLEY TURTLES IN THE CHARLOTTE HARBOR ESTUARY, FLORIDA

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Analysis of stable isotopes has become an increasingly common tool for investigating the trophic relationships of marine turtles, but such information is lacking for Kemp's ridleys in coastal waters. Ongoing research efforts in southwest Florida have identified a locality in Charlotte Harbor as foraging grounds for Kemp's ridleys. The purpose of the present study was to determine the trophic status and foraging ecology of the turtles inhabiting this estuarine complex. Kemp's ridleys (n = 80, including 5 recaptures) were captured via strike net and held overnight in a seawater tank for fecal sample collection. Prior to release turtles were measured, flipper and PIT tagged, and skin biopsy samples were collected for stable isotope analysis. Samples were also collected from decapod prey and habitat components (seagrass, macroalgae, and sessile invertebrates) to characterize the food web in the study area. All but the smallest (24 – 31 cm) Kemp's ridleys in Pine Island Sound fed upon spider crabs including adult-size (> 60 cm)

turtles. As such, the aggregation in these nearshore waters appears to be opportunistic foragers utilizing the most readily available prey. Kemp's ridleys occupied the highest trophic level in the study area, but enrichment in δ15N from primary prey to predator was less than expected and more similar to that of published values for captive juvenile loggerheads. There was no evidence of an ontogenetic shift in stable isotope values for smaller size classes of Kemp's ridleys; however, turtles > 50 cm exhibited higher δ34S and, to a lesser degree, δ15N values. Decapod prey in the Charlotte Harbor estuary demonstrated temporal and possibly spatial variation in their isotope signatures. The seasonal pattern was less pronounced in Kemp's ridleys and warrants investigation using a tissue with a higher isotopic turnover. Future applications to these data will include isotope mixing models to compare estimates of prey contribution to that observed in the diet studies.

CALETA CHASCOS IN NORTHERN CHILE: RESEARCH AND CONSERVATION IN THE MOST AUSTRAL FORAGING SITE FOR BLACK TURTLES (*CHELONIA MYDAS AGASSIZII*)

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Qarapara Sea Turtles, Chile

The most austral congregation of black turtles (*Chelonia mydas agassizii*) in the Eastern Pacific is located in Caleta Chascos, Bahía Salado, in northern Chile. *Chelonia mydas agassizii* occurs here with *Zostera chilensis*, an endemic species of seagrass that is located only in two sites in northern Chile. Historically, the diets of benthic juveniles and adults of *Chelonia mydas* consist primarily of algae and seagrasses, although some Eastern Pacific populations have omnivorous diets. Sporadic studies on the black turtle population at Caleta Chascos have been conducted and the presence of algae has been considered a possible factor in promoting this congregation. However, to date, there is no information about the importance of *Z. chilensis* for this population of *C. mydas agassizii*. In April 2012, we conducted the first campaign of identification and monitoring of *C. mydas agassizii* and *Zostera chilensis* in Caleta Chascos, together with a description of the habitat (biotic and abiotic). Bahía Salado was divided into six sectors in which coastal sightings and water temperatures were recorded daily. Additionally, underwater explorations were conducted to identify the species of flora and fauna presnt and the distribution patterns of seagrasses. We identified a total of at least 8 *C. mydas agassizii* juveniles and adults in Caleta Chascos inside an area of 0.13 km^2. Here turtles remain near the coast and their foraging areas which coincide with the presence of *Z. chilensis*, suggesting that this species is part of their diet. Water temperature ranged from 17.5ºC-19ºC and the highest values were recorded in the congregation area of turtles, where there is also a high abundance of algae. In Bahía Salado we identified algae belonging to the genera *Lessonia, Ulva*, *Chaetomorpha* and *Macrocystis*. In addition we observed the presence of several species of cnidarians, sponges, mollusks and crustaceans. All of these groups have been described as part of the diet of the black turtle. Additionally, we conducted workshops with the Totoral community, a small town close to the study area, in order to provide information about this important foraging site for black turtles and educate locals about the ecosystem dynamics and fragility. Currently we are continuing studies on trophic ecology of *C. mydas agassizii* and biological value of Caleta Chascos in order to propose this area as a marine protected area in the future.

ECOLOGICAL CORRELATES OF DIFFERENCES IN ABUNDANCE OF JUVENILE GREEN TURTLES (*CHELONIA MYDAS*) ON NEARSHORE REEFS IN SOUTHEAST FLORIDA

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Nearshore reefs in southeast Florida function as important developmental habitats for juvenile green sea turtles (*Chelonia mydas*). Turtles recruit to these habitats after spending the first years of their lives as oceanic omnivores. A gradual dietary shift occurs when juveniles return to coastal waters and begin feeding as herbivores on the reef. Nearshore reefs provide turtles with algae to sustain growth, as well as shelter from predators. Differences exist in turtle densities from one reef location to the next. However, little is known about what characteristics turtles use to select nearshore habitats. One important characteristic of the nearshore reef environment is its lack of stability. Reef habitats fluctuate with sand exposure and changes in current and wave action associated with storms. The extent of these changes over time and how they affect green turtle fidelity to reef areas are still unknown. This study had two objectives: to quantify differences in green turtle abundance on local nearshore reefs and to determine the ecological factors most closely correlated with those differences. We measured turtle abundance on several reefs over time and compared the differences in abundance with two ecological variables: (i) algal abundance and distribution and (ii) nearshore reef stability over time. We hypothesized that green turtles would be more abundant on reefs exposed for longer time periods, as these should contain a more stable environment for resting sites and abundant distribution of food (preferred algal species). We conducted quarterly in-water surveys at six reef locations in Palm Beach and Broward Counties, Florida, USA, and found that the turtles were consistently more abundant on some reefs than on others. We also found that turtles at some reef sites disappeared when those sites were covered by shifting sands. We are presently comparing sites showing density differences with respect to (i) algal species abundance and composition, (ii) substrate type, (iii) width and length of exposed reef, (iv) water depth, and (v) available light. We are analyzing these data to determine which variables are most closely correlated with differences in turtle abundance. We are also analyzing historical aerial images of nearshore reefs in Palm Beach and Broward Counties to determine the percentage of change in exposed reef area over a 10-year period.

SUMMARIZING IN-WATER SEA TURTLE RESEARCH IN ST. JOSEPH BAY, FLORIDA

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In-water studies of sea turtle populations in near-shore coastal habitats are important for examining trends in the composition, abundance, distribution, and health of this imperiled marine vertebrate. Little knowledge exists regarding the biology and ecology of sea turtles in near-shore environments, especially in temperate developmental habitats. St. Joseph Bay is a coastal lagoon located in the northern Gulf of Mexico. It is characterized by low current regimes, limited freshwater inflow, and high salinities, and supports one of the most dense seagrass stocks in Florida. Hypothermic stunning events have highlighted the heavy use of this coastal habitat by juvenile turtles and in 2001, researchers at the Florida Cooperative

Fish and Wildlife Research Unit at the University of Florida began studying the assemblage of turtles using St. Joseph Bay. This 4-year study demonstrated the importance of St. Joseph Bay as a developmental ground for juvenile green, Kemps ridley, and loggerhead turtles; however this study was terminated in 2005. Because of the demonstrated importance of this habitat to in-water populations of sea turtles and the vulnerability of these populations to events like the Deepwater Horizon Spill, we began capturing turtles again in St. Joseph Bay in May 2011 to re-initiate a long-term mark-recapture program. The primary objective of this presentation is to provide a summary of the first year of these captures from September 2011 through September 2012. During this time, we captured turtles using four methods: set netting, strike-netting, dip netting, and hand capture. After capture, all turtles were taken onboard the boat and metal Inconel tags were applied to both front flippers and Passive Integrated Transponder (PIT) tags were injected into the left front shoulder muscle. Body morphometrics including straight and curved carapace measurements and mass were recorded. Skin biopsies and blood for genetic, stable isotope, and health analyses were also collected. A total of 46 turtles (19 greens, 24 Kemp's ridley's, 2 loggerheads and 1 hawksbill) were caught during this year. In total, 13 turtles were caught by set net, 26 caught by strike-net, 6 caught by dip net, and 1 caught by hand capture. Turtles ranged in size from 25.8 cm to 83.4 cm (mean= 40.9 cm) curved carapace length (CCL min). Turtles in the 30-40 cm and 40-50 cm size classes were the most frequently captured. The data being collected in this long-term project are contributing to mark/recapture studies, satellite tracking, population dynamics and structure, and the overall understanding of the biology of juvenile sea turtles.

MIGRATIONS OF POST NESTING AND MOVEMENTS OF JUVENILE HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) OF AMERICAN SAMOA

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Migratory behavior of hawksbill turtle populations in American Samoa, a small group of seven islands in the south Pacific (Tutuila Island: 14°16'S, 170°42'W) was unknown until recently. Five post nesting turtles, five juveniles and one male turtle were satellite tagged. One post nesting turtle was satellite tagged on Ofu Island, approximately 110km east of Tutuila, travelled a total distance of 5964 km (straight line distance: 3582 km) with the last transmission located near the Pitcairn Island. Of the other five post nesting turtles, one travelled to Sava'i Island in Samoa, one travelled to the Cook Islands, and two travelled to the southwest of Tutuila. Four of the five juvenile turtles exhibited site fidelity staying near Tutuila Island, while one juvenile (CCL: 51.5cm) travelled southwest to the Cook Islands area. The only male hawksbill stayed around the island of Tutuila. These data reinforce the recent findings that hawksbills are indeed migratory, capable of traveling long distances. A regional approach of management efforts is imperative to ensure effective conservation.

STABLE NITROGEN ISOTOPES IN *THALASSIA TESTUDINUM* ON THE FEEDING GROUNDS OF GREEN TURTLES (*CHELONIA MYDAS*) IN AKUMAL, QUINTANA ROO, MEXICO

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Akumal Bay is an important foraging area for juvenile green turtles and is considered to have medium-touristic impact on the site in comparison with surrounding areas. However, tourism may be affecting nutrient load in the region. In order to assess changes in the nutrient load, δ15N was analyzed in seagrass from Akumal Bay. Samples of *Thalassia testudinum* were collected during dry season (February) of 2011 and 2012. The δ15N values obtained in both years were similar (7.3-7.0 ‰). When compared to previous studies, *T. testudinum* has not shown significant change in the isotopic composition of N in the last seven years. Nevertheless, these values are considered enriched compared to other sites. This enrichment may be associated with an increase of touristic development, thus continuous monitoring of N in the environment is suggested. The anthropogenic N input has the potential to environmentally impact the seagrass meadows, and consequently all species associated with it, including sea turtles. Funding for this project was provided by CONACYT (SEP-CONACYT 157993), and CICIMAR-IPN (SIP-IPN 20120689 and 20130541). We thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America and the International Sea Turtle Symposium for the grant support.

INDIVIDUAL-LEVEL DIET VARIATION IN A GENERALIST POPULATION? FORAGING ECOLOGY OF GREEN TURTLES IN WESTERN AUSTRALIA BASED ON TURTLE-BORNE VIDEO AND STABLE ISOTOPES

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We used turtle-borne video and stable isotope analysis to study the foraging ecology of green turtles (*Chelonia mydas*) in Shark Bay, Western Australia. In previous work, wide variation in $\delta^{13}C$ signatures in skin samples, not related to sex or body size, suggested a diverse diet at the population level, and the potential for long-term dietary variation among individuals. New turtle-borne video data, obtained using affordable tags fitted with GoPro cameras, confirm that green turtles in Shark Bay have a highly general population-level diet that includes temperate and tropical seagrasses, benthic macroalgae, sponges and gelatinous macroplankton. Preliminary analysis supports the potential for among-individual variation in diet, and confirms a low overall consumption of seagrasses despite ca. 4000 km^2 of seagrass coverage in Shark Bay. For example, in 2011, 12 of 16 turtles that fed frequently during camera deployments consumed some combination of macroalgae, plankton and sponges despite high availability of seagrasses. Future work will determine whether short-term dietary preferences from video data align with isotope signatures for these individuals to more rigorously test the hypothesis that wide $\delta^{13}C$ variation reflects long-term, individual-level dietary variation.

TRACKING HABITAT USE AND LIFE HISTORY PATTERNS OF EAST PACIFIC GREEN TURTLES (*CHELONIA MYDAS*) USING STABLE ISOTOPE ANALYSIS WITH SKELETOCHRONOLOGY*

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The green turtle (*Chelonia mydas*) population in the Eastern Pacific Ocean is listed as endangered on the IUCN Red List and by the U.S. Endangered Species Act. Once the target of a large fishery that peaked in the 1970s, this population is gradually recovering, and, despite decades of ongoing research, much of these turtles' complex life history remains unknown. Elucidating the duration of time turtles spend in distinct habitats – particularly in the remote pelagic habitats of the Eastern Pacific – is critical to successful conservation as threats and management strategies vary greatly between coastal and open ocean habitats. Here we describe the general patterns of habitat use by Eastern Pacific green turtles among sequential years, obtained by a novel method combining stable isotope analysis with skeletochronology. Our goal is to determine the duration of the pelagic juvenile stage (i.e., the "lost years") of green turtles in the Eastern Pacific and improve understanding of green turtle ontogeny. We first applied skeletochronology to identify and measure annual growth marks in cross sections of turtle humeri. Using this technique, we also estimated the size (curved carapace length, CCL) of the turtle at each incremental growth mark. Sequential bulk bone samples were then micromilled for stable isotope analysis. We then identified habitat use over time by comparing stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope values of sequential humerus bone growth layers. The $\delta^{13}C$ and $\delta^{15}N$ values reflect a turtle's geographic location and diet because isotopes vary between habitats ($\delta^{13}C$ varies between neritic vs. oceanic, northern vs. southern latitude, and pelagic vs. benthic habitats) and trophic levels ($\delta^{15}N$ becomes enriched with each trophic step). Analysis of both $\delta^{13}C$ and $\delta^{15}N$ gradients in bone layers allows us to predict turtle foraging and movement patterns over time, including potential habitat shifts. For this turtle population, we identify ontogenetic shifts from the pelagic juvenile stage to the neritic juvenile and adult stages. Results from 14 green turtles (CCL 51 - 95 cm) collected from beach strandings along the Pacific coast of Baja California, Mexico from 2004 – 2011 are included in this analysis and the $\delta^{15}N$ values of the bulk bone tissue show trends in trophic level that appear to correlate with life stages, growth rates and ontogenetic shifts. The mean $\delta^{15}N$ values of new recruits and subadult turtles (estimated CCL < 70cm) were significantly higher than the $\delta^{15}N$ values of adult-sized turtles (estimated CCL > 70cm), 15.9 ± 2.0 ‰, and 13.0 ± 0.9 ‰ (mean ± SD) respectively, $p<0.0001$. These results support the hypothesis that juvenile pelagic and newly recruited green turtles forage omnivorously and at a higher trophic level, which can support more rapid growth, than adult neritic turtles. This approach grants us insight into patterns of habitat use and ecology of Eastern Pacific green turtles over time. Acknowledgments: We thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics, CLS America and UCSD for providing assistance to attend the 33rd Symposium.

GREEN TURTLES: CREATURES OF HABIT*

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Not all individuals in a population use the same subset of resources. Patterns of individual specialization have been documented in an increasing number of organisms, but there have been few studies to examine individual specialization through the ontogeny of an organism. We quantify and compare temporal consistency in resource use and individual specialization in three life stages of the green turtle (*Chelonia mydas*) using stable isotope analysis of carbon and nitrogen in successive subsections of scute tissue from the carapace. The three life stages include adults, neritic juveniles, and oceanic juveniles. Temporal consistency was measured through the mean intra-individual variation in stable isotope values through time, whereas the degree of individual specialization was calculated as a ratio of the individual variation to that of the whole population. The scute record maintains a chronological history of resource use and was estimated to represent a minimum 0.8 years in juveniles to a maximum of 6.5 years in adults. Both temporal consistency and individual specialization varied significantly among life stages. Adults were highly consistent through time, and individual site specialists formed a generalist population with individuals maintaining long-term fidelity to foraging location and trophic level. Oceanic and neritic juvenile life stages trended toward less temporal consistency in resource use with less individual specialization than adults. These observations are important when considering the ecological roles filled by green turtles in each life stage; individual differences in resource use may result in differential fitness consequences.

WINTER DIETS OF IMMATURE GREEN TURTLES (*CHELONIA MYDAS*) ON A NORTHERN FEEDING GROUND: INTEGRATING STOMACH CONTENTS AND STABLE ISOTOPE ANALYSES

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The foraging ecology and diet of the green turtle, *Chelonia mydas*, remain understudied, particularly in peripheral areas of its distribution. We assessed the diet of an aggregation of juvenile green turtles at the northern edge of its range during winter months using two approaches. Stomach content analyses provide a single time sample and stable isotope analyses integrate diet over a several-month period. We evaluated diet consistency by comparing the results of these two approaches. We examined stomach contents from 64 green turtles that died during cold stunning events in St. Joseph Bay, Florida, in 2008 and 2011. Stomach contents were evaluated for volume, dry mass, percent frequency of occurrence, and index of relative importance of individual diet items. Juvenile green turtles were omnivorous, feeding primarily on seagrass and tunicates. Diet characterizations from stomach contents differed from those based on stable isotope analyses, indicating the turtles are not feeding consistently during winter months.

DOES A TROPICAL STORM AFFECT THE INTERNESTING BEHAVIOR OF A LOGGERHEAD SEA TURTLE?

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Newly developed animal motion tags (OpenTag, Loggerhead Instruments) with 3-axis accelerometers, 3-axis gyroscopes, 3-axis magnetometers (sample rate 100 Hz), and temperature and pressure sensors (sample rate 1 Hz) were attached to six female Loggerhead sea turtles (*Caretta caretta*) together with satellite tags at Casey Key, Florida between May 2012 and July 2012. Two tags were successfully retrieved during re-nesting. One tag was recovered at the same beach where the turtles were tagged and another one at a distant beach (Keewaydin Island). Four tags were not recovered because the turtles had moved to nearby islands north or south of the study site. The two recovered tags contained continuous 15-day and 16-day recordings, respectively. One tag was deployed when tropical storm Debby passed through the Gulf of Mexico, whereas the other was deployed during relative benign sea states. We analyzed whether the tropical storm affected the swimming and diving behavior of the loggerhead sea turtle as a function of time spent at the surface, dive profiles, and fluke rates. We find that the before the tropical storm the turtle spent 7.4% of the time at the surface (0-0.5 meters) and 20% of the time in the upper water column (0-5 meters). During the tropical storm the turtle spent 14% of the time at the surface (0-0.5 meters) and 55% of the time in the upper water column (0-5 meters).

OCCURRENCE AND DISTRIBUTION OF THE BARNACLE *STEPHANOLEPAS MURICATA* FISHER,1886, ON SEA TURTLES IN THE GOLFO DULCE, PACIFIC, COSTA RICA

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The Golfo Dulce, in Pacific Costa Rica, is utilized as a foraging habitat by green and hawksbill sea turtles. Immature and adult turtles are sympatric in this tropical fjord-like embayment throughout the year. And, seasonal migrations by post-nesting green turtles to and from distant rookeries, such as the Galapagos Islands, influence the cheloniid population structure observed in the Golfo Dulce. The barnacle, *Stephanolepas muricata*, is a commensal of turtles in the Golfo Dulce, and evidence derived from recent in-water captures suggests that post-nesting green turtles are colonized by *S. muricata* when they enter the neritic habitats of the eastern Pacific. And, it appears likely that the same turtles carry this embedding, potentially injurious barnacle species with them when they return to distant courting/mating areas and nesting beaches. The current presentation introduces and discusses the aforementioned scenarios, and data on the biology of *S. muricata* from the Golfo Dulce are also presented.

Nesting Biology

EVALUATION OF HAWKSBILL TURTLE STATUS ALONG THE DARIEN GAP-CHOCÓ REGION OF PACIFIC PANAMA AND COLOMBIA

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Hawksbill turtles inhabiting the eastern Pacific Ocean are considered one of the world's most endangered sea turtle populations. The Darien Gap-Chocó region constitues an extensive stretch of approximately 300 kilometers along the Pacific coast of Panama and Colombia, which has never been investigated for the presence of marine turtles. Between March and May of 2012 a total of 16 coastal communities were visited along the Darien Gap-Chocó region to conduct local interviews and evaluate the potential existence of hawksbill (*Eretmochelys imbricata*) nesting sites and to generate information on the status of the species in the region. A total of 68 interviews were conducted in both countries, primarily with fishermen. In Colombia, interviewees reported a total of 14 beaches where hawksbills nest, most of which is considered sporadic (1-20 nests/season) with the exception of Chaquera, where approximately 21-50 nests are reportedly deposisted per season. In Panama, interviewees reported a total of 22 beaches where hawksbills nest, most of which is also sporadic (i.e. 1-20 nests/season). However, four beaches were reported to receive 21-50 nests per season, while another beach (Sugaran) was reported to receive more than 75 nests per season. The overwhelming majority of nests were reported to be poached at rates of 95-100% in both countries and locals reported that hawksbills were much more abundant in the past. Nonetheless, locals also reported that hawksbills can be frequently seen year-round at in-water habitats along the coasts of both countries. It is vital to corroborate the reported nesting at the primary beaches to evaluate the potential for establishing conservation projects for hawksbills. Local stakeholders showed a strong desire and willingness to collaborate with research and conservation efforts in both countries. We recommend a bi-national plan to undertake such research that incorporates local community members in monitoring efforts, thus factilitating the evaluation and promotion of potential conservation and management plans. Such efforts will be vital to hawksbill recovery efforts in the eastern Pacific.

CHARACTERIZING THE INTER-NESTING BEHAVIOR OF LOGGERHEAD TURTLES (*CARETTA CARETTA*) AT KYPARISSIA BAY, GREECE

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The second most important loggerhead turtle (*Caretta caretta*) rookery in the Mediterranean Sea is found along Kyparissia Bay, Greece. Recently, the number of nesting females at this site has begun to increase, concurrent with local human activity (e.g. tourism, and beach development). There is currently no governmental protection of this rookery's beaches or bay habitats. Due to these facts, understanding of the habitat usage of loggerhead turtles will help guide potential conservation efforts. The inter-nesting behavior

of loggerhead turtles was studied with temperature and depth loggers (TDLs, deployed on 13 turtles) along with GPS satellite transmitters (seven turtles) at Kyparissia Bay. Six TDLs were recovered following a subsequent nesting attempt. GPS transmitters were removed when the individual returned for a subsequent nest, and redeployed providing both inter and post nesting data. TDL results show that the turtles maintained a relatively constant thermal habitat, with combined average temperatures of 25.0 (±2.3 (SD))° C. Minimum temperatures experienced by the turtles reached as low as 15.6° C, while maximum temperatures exceeded 31.2 ° C. The turtles cumulatively spent 99.6% of their time in the top 5 m of the water column (average depth 0.35 m, ±0.99 SD). Maximum dives were likely limited by the bathymetry of the area; only two TDL points showed depth greater than 25 meters with the deepest point at 46 m. GPS transmitter data showed inter-nesting locations within the Bay of Kyparissia, with turtles remaining within 5 kilometers of shore until post nesting began. In summary, the loggerhead turtles of Kyparissia Bay spend the majority of their inter-nesting period close to the primary nesting area in the upper portion of the water column.

MARINE TURTLE NESTING AT THE ARCHIE CARR NWR: ARE LOGGERHEADS MAKING A COMEBACK?

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The UCF Marine Turtle Research Group has been studying nesting and reproductive success of loggerheads, green turtles and leatherbacks in east central Florida since 1982. On this 21-km beach, loggerhead nest numbers averaged 9,300 during the 1980s. These were the numbers that predicated the formation of the Archie Carr National Wildlife Refuge in 1990. After its inception, nesting jumped by 52% and continued to climb until 1998, culminating in an all time high of 17,629 nests. From 1998 until 2004, nesting dropped in what has been described as a “steep and serious decline”, reaching an all-time low of 6,405 in 2007. Since then nesting has increased with some fluctuation to reach a high of 15,539 nests in the most recent season (2012), just 2,090 nests (11.8%) fewer than the all time high in 1998. Florida green turtles laid fewer than 50 nests annually for the first three years that UCF worked on the Carr Refuge beach. With a few exceptions, green turtles exhibited a biennial pattern of high and low years through about 2005, when low years began to increase as rapidly as high years and the pattern became more obscured, reaching an all time high of 5,505 in 2011. Several tag recoveries from a 1980s Florida head start program confirm that at least some green turtles are nesting at 15 to 18 years of age. The number of nests laid by Florida green turtles ended at 3,023. Green turtle nesting continues to rise exponentially at the Carr Refuge. Leatherback nesting ranged from zero to one throughout the decade of the 1980s and the first half of the 1990s. In 1996, however, there were 10 nests in the Car Refuge. Nesting dropped to 4 in 1997 but bounced back in 1998, setting up a biennial pattern similar to that of green turtles. Low years remained at about 11 nests while high years continued to increase until 2008, when low years also began to increase. The high years of 2007 and 2011 each produced 52 nests. The 2012 season was expected to be a low year and finished with 37 nests. Leatherback nesting also continues to rise exponentially at the Carr Refuge.

LONG-TERM MONITORING AND CONSERVATION OF LOGGERHEAD SEA TURTLE NESTS ON DALYAN BEACH, TURKEY: RESULTS OF THE RECENT CONSERVATION AFFORDS

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Dalyan Beach is one of the most important nesting sites of loggerhead turtles (*Caretta caretta*) in Turkey. Dalyan Beach was designated as a Specially Protected Area by the Turkish Ministry of Environment and Forestry in 1988. Nesting activity and conservation actions were started from 1988 breeding season and generally performed between 1 June and 30 September for subsequent years. The mean nest count was found as 230 nests for each year and the nest density was calculated as 49 nests per kilometer. The minimum nest number occurred in 1994 nesting season with 86 nests and the maximum nest was observed in 2010 nesting season with 354 nests. Nesting and non-nesting emergences were distributed 10-25m distance from the sea during breeding period. The majority of nesting activities by females occurred in June but started in the second half of May. These results show similarities in all years. The main predator was red foxes, badgers and ghost crabs. Approximately 60% of nests were screened against predation each year, with the screens being fixed with long metal hooks from the corners for additional safety. As a result of protection efforts, the last 5 year period (2008-2012 breeding seasons) the average number of nests was calculated as 308 nests per year. The mean hatching success was calculated as 51.9% (range from 33.52% to 69.17%). The recent increase in recorded nesting numbers can be explained by either the result of the first conservation efforts started nearly 20 years ago or better record of nesting activities especially early in the nesting season or a combination of both. While the observed predation rate seems to be higher than that documented in the literature, Dalyan Beach demonstrates a very good example of coexistence of turtles and tourists.

EXAMINING HERITABILITY IN NEST-SITE SELECTION FOR LOGGERHEAD TURTLES (*CARETTA CARETTA*) USING ADVANCED GENETIC AND SPATIAL TECHNIQUES

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Deposition of eggs into a suitable environment for embryonic development is the final parental obligation for many oviparous species and nest-site selection is critical to offspring survival. For marine turtles, the elevation of a nest relative to the spring tide line is of particular importance as nests laid below the high water mark are vulnerable to tidal inundation, which can lead to developmental arrest of incubating embryos. The correlation between incubation environment and offspring viability suggests the potential for evolutionary pressures to act on marine turtle nest-site preferences. Specifically, if some females consistently nest at elevations prone to inundation and this trait is passed to their surviving female offspring, the frequency of females nesting at low elevations should eventually decrease through natural selection.

There are concerns that management strategies, such as clutch relocation, may impose artificial selection on marine turtle populations and unwittingly propagate an undesirable trait (i.e. poor nest-site selection) that would have otherwise been selected against. However, variation between individuals and heritability in nest-site selection must be established before the potential evolutionary consequences of clutch relocation on marine turtle populations can be examined. The objective of this study is to investigate evidence for individual variation and heritability in nest-site selection for loggerheads (*Caretta caretta*) nesting on the Georgia coast. Elevational variation in nest-sites among females will indicate the potential for selection to act on individuals within the nesting population and individual repeatability in nest elevations will suggest a genetic basis for the behavior. We are estimating intra- and inter-seasonal repeatability and variation in nest elevations for individual, genetically tagged females from the 2008, 2009, 2011, and 2012 nesting seasons. Our data includes elevations for over 900 nests laid on Wassaw, Ossabaw, St. Catherines, Blackbeard, and Sapelo islands. Examining nest elevation data from multiple seasons allows us to test for inter-annual repeatability in nest-site selection for females that nested in 2008 or 2009 and re-migrated in 2011 or 2012. Each nest is matched to an individual female using multi-locus genotypes (DNA fingerprinting) as a genetic tag, and a precision RTK GNSS receiver with a vertical accuracy of ± 3 cm is used to quantify nest and tide-line elevations. The difficulties associated with estimating heritability in quantitative behavioral traits can hinder the ability to make appropriate management decisions concerning the protection of threatened species. A comprehensive analysis of variation and heritability in nest-site selection in terms of inundation risk will provide quantitative data to evaluate the potential evolutionary consequences of clutch relocation on marine turtle populations.

IMPLICATIONS OF HATCHLING SEX RATIOS AND SURVIVAL IN THE RECOVERY PROGRAM FOR THE ENDANGERED KEMP'S RIDLEY SEA TURTLE

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The Kemp's ridley sea turtle was on the verge of extinction during the mid 1980's, but due to intense conservation efforts, its population is now gradually recovering. As part of that recovery program, we have been monitoring the production of hatchling sex ratios produced at Rancho Nuevo, Mexico, in an effort to optimize the recovery rate of this species. In the current study, sand and nest temperatures were evaluated during the 2010, 2011, and 2012 nesting seasons. Beach and egg corral temperatures were monitored at nest depth using temperature data loggers. Incubation temperatures were also monitored in a subset of nests in egg corrals and on the natural nesting beach from each season. General trends in temperature were evident during all nesting seasons. Temperatures were relatively cool during the start of the nesting seasons (i.e. below pivotal temperature), but gradually rose and were at, or above, pivotal temperatures by mid May. Temperatures then remained relatively high for the remainder of the nesting seasons, except during periods when tropical weather systems moved through the area and lowered incubation temperatures to near or below the pivotal temperature. Thus, although an overall female bias would be predicted for each nesting season, some nests early in the nesting season or those subjected to tropical weather systems were predicted to produce males. The nesting beach was also relatively warm (suggesting a female bias) but it was cooler than the egg corrals. Collectively, the data suggest that female-biased sex ratios were produced during the 2010, 2011, and 2012 nesting seasons at Rancho Nuevo. Subsets of in situ nests from arribadas during the 2011 and 2012 nesting seasons were monitored for predation throughout their period of incubation. These data suggest that the predation rate on in situ nests was relatively low. Additionally, survival of hatchlings from the nest to the surf is being evaluated for both low and high density in situ nesting areas from the 2012 nesting season. The results have ecological and conservation implications for the Kemp's ridley. For example, the production of a female bias in the Kemp's Ridley Recovery Program may be accelerating the recovery rate of this endangered sea turtle. Additionally, the evaluation of predation data supports the concept that arribadas may result in predator satiation, thus enhancing nest and hatching survival. Therefore, leaving arribada nests in situ, may be an effective conservation strategy. The sex ratio and predation studies are providing data which are helping to facilitate an effective transition from the use of egg corrals back to the use of the natural nesting beach as the Kemp's ridley recovers.

AIR-DAM ENTRAPMENT OF EMERGING LOGGERHEAD HATCHLINGS, ST. CATHERINES ISLAND, GEORGIA: A CASE OF OBSTRUCTED EMERGENCE

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Loggerhead sea turtles (*Caretta caretta* (Linnaeus, 1758)) nest on the sandy beaches of the Georgia coast, depositing clutches averaging 113 eggs in the backbeach sand where they incubate for approximately 50 - 60 days (average of 56 days in 2008 and 54 days in 2009) prior to emergence during the night. Nestlings mine their way from the top of the egg chamber from a depth of about 30 - 50 cm to the surface by a process similar to shrinkage stoping, i.e. bumping sand loose above them, which falls onto and through the mass of nestlings forming a floor on top of the hatched egg shells at the bottom of the egg chamber (approximately 50 cm deep). The stope thus formed allows the turtles to mine their way to the surface, where they emerge under the cover of darkness. Rain and wind storms may increase the cohesion of the surface layer of sand during incubation while trampling compacts the underlying floor, opening an air chamber above the hatchlings that is higher than their heads will reach, stopping the stoping process by formation of an "air-dam." This process, first observed in 1996 in Nest 96-108a, was documented by observations made on two loggerhead sea turtle nests, 07-042a and 08-097a, on St. Catherines Island, Georgia, investigated by trenching techniques and documented by sketching, photography, and videography and has been documented in six additional nests and often observed, but not documented in numerous other nests, both *in situ* and relocated over 22 years. Clutches of nestlings trapped by air-dammed stoping are vulnerable to desiccation, depredation, and drowning. It was found that: 1. air-dammed stopes form during every nesting season; 2. air-dammed stopes form in both in insitu and relocated nests; 3. hatchlings trapped by air-dammed stopes may die due to subsequent flooding, desiccation, or depredation; 4. air-dammed stopes may be anticipated by identifying "late-nests," i.e. those that don't emerge on time; and 5. nests may be checked by careful excavation straight down into the egg chamber; checking for a "collapsing domed roof" (an air-dam) when penetrated by one's finger. The common development of air-dammed stopes should be anticipated by the conservationist. When indicated by late emergence, the conservationist should carefully dig vertically using his/her hand excavating as small a vertical tunnel as possible to ascertain whether or not an air-dammed stope exists. Further treatment may involve backfilling the excavation tunnel or removal and release of hatchings. Development of air-dammed stopes is thought to be encouraged by over-tamping sand backfill in relocated egg chamber necks at the time of their relocation or by intense, local rainfall or deposition of wind blown sand near the time of the nest's anticipated emergence. This phenomenon, documented in modern nesting loggerhead sea turtles, is represented as a trace fossil in the Cretaceous Fox Hills Sandstone of Colorado.

EFFECTS OF HABITAT VARIABILITY ON *ERETMOCHELYS IMBRICATA* INCUBATION TEMPERATURES: A PILOT STUDY ON LONG ISLAND, ANTIGUA

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Incubation temperature strongly affects sea turtle physiological development, especially through temperature-dependent sex determination (TSD). However, field experiments have demonstrated significant inter and intra-nest temperature variability across all sea turtle species. Further, previous work has shown that *E. imbricata* nest habitats are particularly vulnerable to deforestation, which could result in sex ratio distortion toward a more female-biased population as average nest temperatures increase. TSD and natural nest temperature variation, in addition to increased habitat change from vegetation loss, climate change, and beach stochasticity, make it extremely relevant to better document and understand nest temperature variation of understudied organisms such as hawksbill sea turtles. During late July through early November, 2012, we conducted a pilot study on Pasture Bay, Long Island, Antigua to evaluate temperature variability between nesting habitat types. We placed HOBO Water Temperature Pro v2 data loggers at various heights within egg chambers and control data loggers 0.5 m from the egg chamber at the same depth. Egg chamber loggers remained in situ for the entirety of incubation, while controls were removed and used to determine the temperature gradient with regards to depth within each habitat type. We obtained soil cores from each nest post-hatch and performed ash free dry mass analysis of the sediment to investigate differences in soil organic matter between habitats. Using a marked square meter, we also quantified percentage shade cover at each nest to help classify the habitat gradient. Finally, we measured nest distance to high tide line and distance to nearest vegetation edge. We used an ANOVA test to determine if temperatures significantly varied between nesting habitats and regression analysis to evaluate relationships of other environmental factors to nest chamber temperature. Based on this preliminary work, soil moisture, distance to high tide, soil organic matter content, nest minimum and maximum depth, nest egg count, shade/vegetation cover, and major storm activity all appear relevant to consider when looking at incubation nest temperatures. Future research should focus not just on expanding the number of nests sampled, but also more intensive study of secondary environmental factors affecting nest temperature. Where possible, management of these factors could aid in buffering against further sex ratio distortion.

FIFTEEN YEARS OF RESEARCH ON GREEN TURTLES AT GUANAHACABIBES PENINSULA: A RETROSPECTIVE OF COMMUNITY BASED TURTLE CONSERVATION AND RESEARCH IN WESTERN CUBA

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The objective of this presentation is to provide a retrospective of data and experiences obtained over 15 years on an important green sea turtle (*Chelonia mydas*) population in extreme western Cuba. The Proyecto Universitario para estudiar y conservar las tortugas marinas de la peninsula de Guanahacabibes is a project of the Centro de Investigaciones Marinas de la Universidad de la Habana with support from The Ocean

Foundation and WWF-Cuba. Since 1999 scientists and students have collected beach nesting data on a population of up to 1,000 female green turtles. Female turtles lay their eggs along seven nesting beaches at Guanahacabibes National Park and UNESCO Biosphere Reserve, a wild, relatively uninhabited coastal area. The Project has accumulated continuous annual data on nest size, nesting frequency, environmental impacts such as sand temperature and the impact of hurricanes for almost a decade and a half. Monitoring data is helping piece together the life history patterns of the broader Western Atlantic green turtle population and informing policy decisions by Cuban and regional governments to protect sea turtle populations from poaching, incidental catch in fishing nets and egg collection by coastal communities. Guanahacabibes National Park and UNESCO Biosphere Reserve, located on the westernmost tip of Cuba, is located on the eastern flank of the Yucatan Straits, an important marine pathway for Western Atlantic green turtles. The Project and its partner, The Ocean Foundation began efforts in 2012 to deploy satellite telemetry to further understand the migratory patterns of this population. That year five tags were released and another 5-10 will be released in subsequent years. The Project has also engaged local fishing communities and a historical fishing community of Cocordilo in the Isle of Youth to transition from poaching turtles and eggs to embracing alternative livelihoods. Two community festivals were held in Cocodrilo in 2011 and 2012.

PRELIMINARY RESULTS FROM AKAZUL'S SEA TURTLE TAGGING PROGRAM, LA BARRONA, GUATEMALA

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Akazul: Community, Conservation & Ecology is a UK registered not-for-profit Community Interest Company and has been operating its sea turtle conservation project in La Barrona, Guatemala since 2011. La Barrona is one of Guatemala's key nesting sites utilized primarily by olive ridley (*Lepidochelys olivacea*) sea turtles and infrequently by eastern Pacific green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*) sea turtles. Besides the general human impacts of coastal development, marine pollution, and unselective fishing practices, unsustainable levels of egg-harvesting pose the greatest threat to Guatemala's sea turtles. Key to Akazul's long-term goal is conducting monitoring activities on the turtle nesting beach in order to further our understanding of Guatemala's sea turtle populations. Akazul conducted nightly beach patrols from 1st July-31st December 2011 between the hours of 19:30 and 06:00, across a study area of 7.5 km. All turtles encountered were checked for existing tags and once egg laying was complete, a monel flipper tag was applied to untagged fore flippers. Curved Carapace Length (CCL), Curved Carapace Width (CCW) and clutch size were also recorded. Turtles were observed dring 225 (17.9%) of the 1,119 nesting emergences along the study area. A total of 191 olive ridley turtles and 1 eastern Pacific green sea turtle were tagged during the 2011 nesting season. Fourteen turtles were observed on subsequent occasions returning to the nesting beach and mean interesting interval was 17.2 days (range: 10 days, SD = 3.2). Two of these turtles were observed 18 days later, nesting on beaches 28 and 45km west of La Barrona. Mean CCL for 172 olive ridleys was 65.5 cm (range: 57-74 cm; SD = 2.5) and mean CCW for 171 specimens was 70.2 cm (range 62-77 cm; SD = 2.7) respectively. La Barrona is the first site in Guatemala to implement a standardised tagging program and preliminary results reveal individual variation with regard to nest site fidelity, however, more intensive tagging efforts are required to fully quantify this and other parameters such as clutch frequency and internesting intervals. It is highly recommended to expand tagging studies to other sites across the coast to give a more accurate insight into the nesting biology of Guatemala's olive ridley sea turtles.

A MATHEMATICAL MODEL CONSISTENT WITH THE GEOMAGNETIC IMPRINTING HYPOTHESIS OF NATAL HOMING

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Sea turtles around the world are renowned for their migratory behavior and navigational abilities. Loggerheads hatching in the southeastern United States are a particularly impressive group as they circumnavigate the entire North Atlantic Ocean basin before returning to lay eggs in the same geographic areas they left as hatchlings. This behavior, termed natal homing, is illustrated by a wealth of genetic evidence from many sea turtle species. How turtles are able relocate their natal beach, however, remains enigmatic. While the mechanism behind natal homing is still unknown, the recently proposed geomagnetic imprinting hypothesis notes that the earth's magnetic field varies geographically and that most nesting beaches have unique geomagnetic signatures. Furthermore, loggerheads are known to detect the two magnetic parameters that define these signatures: field intensity and inclination angle (the angle at which magnetic field lines intersect the earth's surface). The geomagnetic imprinting hypothesis proposes that hatchling turtles imprint on the magnetic characteristics of their natal beaches and use this information to return years later. One potential problem for animals using the Earth's field to return to a specific area during natal homing is that the field gradually shifts spatially over time. That is to say, a given geographic location will not carry the same magnetic signature from year to year. Moreover, field intensity and inclination angle change at different rates in different geographic areas. In principle, if the geomagnetic imprinting hypothesis is correct, then changes in the earth's field might cause shifts in nesting distributions. Specifically, in areas where the magnetic signatures associated with turtle nesting beaches converge over time we expect to see an increase in nest density; conversely areas characterized by a divergence of magnetic signatures should experience a decrease in nest density. To investigate this novel hypothesis we used the International Geomagnetic Reference Field (IGRF) model to calculate the distance magnetic fields drifted along the eastern coast of Florida. With these data we described a mathematical function relating position along the coast to spatial changes of the earth's magnetic field at these positions. From this function we generated a quantitative measure for the convergence or divergence of magnetic signatures at various locations along the Florida coastline. We then modeled the relationship between this measure of convergence or divergence and the corresponding change in loggerhead nest density. Using a linear model to correlate these two variables, we found a highly significant slope in the appropriate direction, which implies that areas with a high level of geomagnetic convergence also experienced greater increases in loggerhead nest density. We do not claim to show that movement of the earth's magnetic field is sufficient to predict changes in nesting distribution. Rather, this study provides evidence consistent with the hypothesis that turtles may be using information from the Earth's magnetic field to locate nesting beaches. Thus, we propose that further research into the geomagnetic imprinting hypothesis is greatly warranted.

MODELING INTRAGUILD PREDATION AND PREDATOR FACILITATION ON SHARED PREY

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Interactions between raccoons (*Procyon lotor*), ghost crabs (*Ocypode quadrata*), and loggerheads (*Caretta caretta*) are complex. Some of these interactions have negative consequences on hatching success of

loggerhead eggs. To reduce nest depredation by raccoons, managers at Canaveral National Seashore (Florida, USA) install cages around clutches. Although this has had a positive effect on hatching success, predation still accounts for a large percentage of pre-hatchling mortalities. Previous studies have shown that in addition to intraguild predation (IGP) of ghost crabs by raccoons over marine turtle eggs, there is also a facilitative interaction by ghost crabs to raccoons. When a ghost crab burrows into a sea turtle nest, chemical cues signal foraging raccoons towards the nest's location. Although experimental work has been done on this topic, further research is needed in order to better understand the dynamics of this system and the net effect on threatened marine turtles. We propose a mathematical model that explores the effects of intraguild predation and predator facilitation on shared prey. The model attempts to mimic the interactions among raccoons (intraguild predator), ghost crabs (intraguild prey) and federally threatened loggerhead eggs (shared prey). The model is an extension of the Holt and Polis IGP model in which we add further complexity, predator facilitation. Once established, we will assess the sensitivity of parameter values, e.g., functional responses and conversion efficiencies, to the general behavior of the model. We predict that increasing intraguild prey numbers and decreasing intraguild predator numbers will have a negative effect on shared prey population. This model can help influence predation management techniques by allowing officials to view several consequences of this particular system. In this way, managers will be better informed to develop and implement appropriate methods for predator control and marine turtle conservation.

GREEN TURTLE NESTING ACTIVITIES ON ZABARGAD ISLAND, A MAJOR ROOKERY IN THE SOUTHERN EGYPTIAN RED SEA

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The Red Sea is known to host nesting sites for the endangered green turtles. Known sites are located on the northern coast of Saudi Arabia, in Djibuti, in Sudan and in Egypt. Nesting activities along the Egyptian coast is scattered and low-density with three major concentrations: Tiran Island (Northern Red Sea), Wadi Gimal National Park (Southern Red Sea, in-shore) and Zabargad Island (Southern Red Sea, off-shore). Zabargad is considered the most important nesting site for green turtles in the region. Estimates obtained from irregular surveys from 2001 to 2008 suggested that as many as 610 turtles could nest on the 3.5 km long beach on the island. In order to collect more data on nesting activity on the island, we conducted two 3-day surveys in 2009 and 2010 and one 10-day survey in 2012 during the suspected peak of the nesting season (July – August). In all occasions, during day 1 all turtle tracks were counted and marked to avoid double counting. From day 1 to the last day, night census were conducted on foot along the beach. Only new nesting activities were counted. Nesting success (NS) was calculated as the number of true nests divided by the total number of tracks. The total number of nesting activities per season was calculated using the method published by Girondot *et al*. In 2009, 50 tracks were counted, 5 of which being true nests (NS=10%)(mean number of tracks per night=16.7±3.5). In 2010, 34 tracks were counted, 4 of which being true nests (NS=12%)(mean number of tracks per night=11.3±8.7). In 2012, 127 tracks were counted, 35 of which being true nests (NS=27%)(mean number of tracks per night=12.7±3.7). Assuming that the green turtle nesting season on Zabargad island is bell-shaped, we obtained a total number of counts of 2,262.51 ±531.27 in 2009; of 1,073.90 ±268.80 in 2010 and of 1887.29 ±388.97 in 2012. Assuming that the nesting success was constant every year, and assuming that green turtles lay an average of 2.5 nests per season (based on data from the Arabian Gulf and Oman populations), we obtained the following estimates for the nesting females population: 91 in 2009, 52 in 2010 and 204 in 2012. These results are very far from the estimates obtained from previous data. Effort and timing of data collection can have an effect on the variation from 2009 to 2012 but this could also be related to other factors. As human impact on the island is minimal (access forbidden), causes for such a variation could be related to food availability in the feeding grounds. In 2009 and 2010, floods affected some of the major known feeding grounds along the Egyptian Red Sea coast. Although the number of nesting females on Zabargad island could be considered of secondary importance compared with close nesting sites in Oman and Yemen, this population could be genetically unique and isolated from the other rookeries, thus in need for a total protection. Genetic studies are actually under-going to verify this hypothesis. We would like to acknowledge the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America and the International Sea Turtle Symposium for providing us with a travel grant to participate in this meeting.

VEGETATION AND SUBSTRATE CHARACTERIZATION AT ENSENADA MALIMANSIPA, CASTILLETES: KEY BEACHES FOR NESTING ACTIVITY AT GULF OF VENEZUELA

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The importance of the Gulf of Venezuela (GV) grew after the record of nesting activity at two beaches at Ensenada Malimansipa at the northernmost region of the GV. These beaches presented the basic and essential characteristics for the presence of sea turtles and a potential capacity to support nests from three species of sea turtles: *Dermochelys coriacea*, *Eretmochelys imbricata* and *Caretta caretta*. Five environmental units were classified through satellite photo-interpretation and "in situ" observations during March and May 2011 and July 2012: beach, sparse grasslands, mangrove forests, rocky formations and clay-mud areas. A brief survey of floristic composition was conducted for each unit. Also, beach profiles were conducted to describe the environment at the southern zone of the study area. This region comprises a wide range of environments (terrestrial and aquatic habitats). A total of 8 species were clearly identified, classified into 7 families and 8 genera, and categorized into 3 types of trees and 5 herbs. No species were found in the beach environment. Sparse grassland environments supported mainly succulents and regular grassland species, primarily *Sarcocornia fruticosa* and *Sporobolus virginicus*. Mangroves were dominated by *Rhizophora mangle* but species such as *Laguncularia racemosa* and *Conocarpus erectus* were also present. The southern beach of Ensenada Malimansipa presents a coastal plain and cliffs were observed in only a portion of the beach. A constant problem in this area is the frequent occurrence of solid contaminants (plastics and metals) on the shore deposited by ocean currents and winds. Also, natural erosion due to strong waves and winds might affect the dynamics of the beach, which can result in threats for sea turtle nesting activities.

ACOUSTIC COMMUNICATION BETWEEN HATCHLINGS OF *DERMOCHELYS CORIACEA*

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For a long time it was thought that turtles did not have a well developed system of hearing air or water borne sounds, and that the sounds made during copulation where just a percussion artifact. However, recent studies have now shown that both tortoises and freshwater turtles are vocalizing, and that acoustic communication is an important part of turtle social behavior. Among seaturtles, we know little about acoustic communication and function. There are just a few reports of sounds produced by *Dermochelys coriacea*, which appear to be simply noises made during copulation. The objective of our study was to verify if *Dermochelys coriacea* emit sounds in other parts of their life cycle and describe the repertoire of the sounds they produce. We recorded 12 *Dermochelys coriacea* nests on Barra de la Cruz Beach in Oaxaca, México, in March 2012. The nests were divided into two categories, nests where the hatchlings had emerged from the egg and unhatched eggs and nests with only unhatched eggs. After 12 hours of recording, one hour per nest, we encountered 328 sounds. These sounds had were divided into four groups of sounds based on their spectral and aural characteristics. The mean peak frequency of the vocalizations of the hatchlings was 993.71 Hz (187.5- 2437.5; sd = 440.6). The sound being produced inside the eggs had a mean peak frequency of 1695.37 Hz (187-2343.8) sharper than the nests with hatchlings and unhatched eggs which had a mean peak frequency of 1108.24 Hz (375-2437.5). We hypothesize that the young begin to vocalize to organize a greater number of individuals to help dig out of the nest simultaneously. This may also increase survivorship of hatchlings moving from the nest to the water by swamping potential predators.

A LABORATORY EVALUATION OF HATCHLING LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) PERFORMANCE IN RESPONSE TO CONTROLLED INCUBATION TEMPERATURES

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Incubation temperature has significant developmental effects on oviparous animals, including determining sex for several species. For the Northwest Atlantic loggerhead sea turtle (*Caretta caretta*), apparent population-wide female-biased hatchling sex ratios contrast with observations of juvenile populations, where sex ratios have remained constant at about 2 to 1 female-biased over the past 30 years. It has been suggested that some unknown factor is affecting loggerhead survival, resulting in an unexplained differential loss of ~60% of female hatchlings per year. One theory suggests that incubation temperature affects traits that influence survival. Furthermore, there may be differential survival between male and female hatchlings. We conducted laboratory experiments to test for an effect of incubation temperature on performance of loggerhead hatchlings. Sixty-eight hatchlings were tested in 2011, and 31 in 2012, produced from eggs incubated at 11 different constant temperatures ranging from ~27ºC to ~32.5ºC. Following their emergence from the eggs, we tested righting response and crawl speed, and conducted a 24-hour long hatchling swim test. Data indicate an effect of incubation temperature on survivorship,

righting response time, crawl speed, change in crawl speed, and overall swim activity, with hatchlings incubated at 27ºC showing decreased locomotor abilities. No hatchlings survived when incubated at 32ºC and above. Differences in survivorship of hatchlings incubated at high temperatures are important in light of projected higher sand temperatures due to climate change, and could indicate increased mortality from incubation temperature effects. Acknowledgements: We would like to thank the PADI Foundation, Lerner Gray Memorial Fund, Slocum Lunz Foundation, and the Charleston Scientific and Cultural Society for supporting this research. The help and cooperation of the SC Department of Natural Resources staff and volunteers is greatly appreciated, including Dubose Griffin and the SC-DNR Sea Turtle program staff, Jamie Dozier and SC-DNR Yawkey Wildlife Center staff, and the North Island Sea Turtle Project Team.

PRELIMINARY DATA ON THE OLIVE RIDLEY TAGGING PROGRAM AT NANCITE BEACH, COSTA RICA

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The olive ridley sea turtle exhibits two nesting strategies at Nancite Beach, Costa Rica: arribada nesting (mass synchronized nesting) and solitary nesting. Most studies have focused on the phenomenon of arribada nesting because of the impressive volume of nesting individuals involved, neglecting the less abundant solitary nesting behavior. During the peak nesting seasons of 2010-2013 we studied the internesting intervals and the post-nesting movements of olive ridley females utilizing both nesting strategies. A total of 2,902 turtles were tagged and 445 were recaptured. One hundred and forty one of the 445 recaptures were observed nesting solitarily and during arribadas. The observed overall internesting interval was 30.02 days (SD= 12.50), similar to previously reported data for this population. Additionally, we observed only 17 turtles that laid 3 clutches during the same season, which had not been reported for arribada beaches. We also observed a total of 78 females that nested during two consecutive seasons, exhibiting a remigration period of 348.26 days (SD= 34.88), which suggests that at least part of the population nests annually. Finally, we observed a total of 7 turtles that nested on multiple beaches in the region, including beaches such as Naranjo, Junquillal and Ostional, all of them located south of Nancite Beach. Our results demonstrate that olive ridley females exhibit both solitary and arribada nesting behaviors. This strongly suggests that all olive ridleys have the ability to sense the environmental cues that trigger the phenomenon of arribada. However, our results must be approached with caution given that it is not possible to verify the nesting of every turtle during the arribadas due to the large number of individuals involved. Furthermore, we do not know the level of site fidelity for the Nancite turtles, which might bias our conclusions. Finally, our data demonstrate the importance of including solitary nesting females, as their lower numbers may help us reveal nesting behaviors that would otherwise be missed by arribada-specific tagging programs.

STUDYING BEACH NOURISHMENT TEMPLATES AND MARINE TURTLE NESTING CUES TO LEARN HOW TO ENGINEER MORE "TURTLE FRIENDLY" BEACHES

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Since 1998, ~55% of critically eroded beaches in Florida have been rebuilt through artificial beach nourishment, which is the most common method of combating coastal erosion in the United States. Studies have reported negative impacts on marine turtle nesting success (ratio of nests to non nesting emergences) post-nourishment, indicating that simply the presence of a sandy beach is not enough to guarantee suitable nesting habitat. The first objective of this study was to determine if some nourishment templates are more conducive to loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) nesting than others. Since 2005, approximately 35 kilometers of shoreline in southern Brevard County, FL, which supports some of the highest density loggerhead and green turtle nesting worldwide, have undergone 1) full-scale restoration (typically called nourishment), where sand was added above and below the mean high tide line (2005, 2010) or 2) dune restoration, where sand was placed on the dune (2005, 2006, 2008, 2009). To quantify the effects of these two types of restoration, we used a Before-After-Control-Impact-Paired Series (BACIPS) model, which tests for significance between the difference in nesting success rates at the impact (engineered) and control (natural beach) sites before and after restoration (Δ). After full-scale restoration, there were significant differences in Δ for loggerheads during the seasons immediately following restoration (year of construction) and one year post-construction while green turtles were significantly affected for five years. After dune restoration, loggerheads were significantly impacted each year of construction and one year post-construction while the significant effect for green turtles occurred during half of the years of- and one year post-construction seasons. The significant difference in Δ was consistently the result of a decreased nesting success rate at the engineered sites, although the extent of the decline varied between species and restoration types. The second objective was to determine which beach characteristics serve as loggerhead nesting cues. During the 2010 nesting season, we examined beach elevation, slope, and width and sand moisture content and grain size between loggerhead nesting (n=49) and non-nesting crawls (n=25) on natural beaches (n=2), beaches with full-scale restoration (n=2), and beaches with dune restoration (n=2). When we divided each crawl into quarters, we found that in unsuccessful nesting attempts, the beach slope was flatter in the final quarter of the crawl compared to the one previous (in all study sites except one). Conversely, in successful nesting emergences, the beach slope in the final quarter of the crawl was steeper than the slope in the third quarter. These results indicate that changes in beach slope during the last half of the crawl were important in determining if a turtle nested. This study provides insight into changes in marine turtle nesting patterns post-nourishment. The first study shows that varied design templates affect nesting success rates differently and that gravid loggerheads and green turtles respond differently to altered beaches. The second study illustrates the importance of beach slope as a loggerhead nesting cue, which provides data necessary to engineer beaches in a more "turtle friendly" manner.

TO RELOCATE OR NOT

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In this study we aimed to compare the original and relocated nests in terms of hatchling sizes (SCL and SCW), weight, hatching succcess and carapacial scute deviations. With this aim we randomly selected 22 (11 original, 11 relocated) green turtle (*Chelonia mydas*) nests consisting of 430 hatchlings. From each nest 50 eggs were relocated 1m away from the original nests. During the hatching season, hatchlings coming out of these nests were measured with a dial caliper with an accuracy range of 0.2 mm and weighted with a digital scale nearest to 1g. Furthermore, carapacial scute counts were done. In conclusion, the hatchlings from the original nests were lighter ($t = -4.76$ $p<0.001$) and narrower ($t = 4.387$ $p<0.001$) than the hatchlings from relocated nests. There was no difference in terms of hatching success (Mann-Whitney U test $p>0.005$). Acknowledgment: This study is supported by a cooperative protocol between WWF-Turkey and the Ministry of Forestry and Waters. The senior author would like to thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America and the International Sea Turtle Symposium for their generous support, which supported our participation in the symposium.

POSSIBLE EFFECT OF RELOCATION ON SEX RATIO OF HATCHLINGS: SPATIAL AND TEMPORAL DIFFERENCES IN NEST TEMPERATURES AND SEX OF HATCHLINGS AND EMBRYOS OF LOGGERHEAD TURTLES ON DALAMAN AND DALYAN BEACHES, TURKEY

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This sex ratio study was conducted on Dalyan and Dalaman Beaches, Turkey. Sex ratios of dead hatchlings and embryos were determined by gonadal observation. Sex ratios of live hatchlings were estimated by measuring the temperatures during the middle third of the incubation period. Sex ratios differed between the two beaches, however ratios were similar temporally. More males were usually produced early (May) and late (August) in the season when compared to the middle part of the nesting season (June and July). Sex ratios differed significantly between years and also between the beach zones perpendicular to the sea. Nests deposited close to the sea are usually relocated further inland, which may also affect hatchling sex ratios. Relocation guidelines according to the sand and nest temperatures were applied during the relocation of nests.

DECLINE OF LOGGERHEAD TURTLE NESTS ON FETHIYE BEACH, TURKEY

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Decline and loss of sea turtle populations are increasingly becoming an international concern. In this respect conservation efforts are carried out on most of the nesting beaches in the world. Fethiye Beach is one of the most important nesting sites of loggerhead turtles (*Caretta caretta*) in Turkey. Previous studies showed a negative population trend of the loggerhead turtle population at Fethiye Beach based on nesting data. The nesting biology of loggerhead turtles, *Caretta caretta*, on Fethiye Beach was studied in this work during the 2011 and 2012 nesting seasons. In addition, we analyzed nesting trends over 20 consecutive years, from 1993 to 2012. As a result, we recorded a total of 145 emergences in 2011 and 247 emergences in 2012, of which 60 (41.4%) and 89 (36 %) resulted in nests respectively. 3854 hatchlings emerged (76.03%) from 5015 eggs and 3813 hatchlings reached the sea in 2011 nesting season. For the 2012 nesting season, a total of 7223 eggs were laid, 5238 (72.5%) of them hatched and 4835 (92.4%) hatchlings were able to reach the sea. On the other hand, we recorded a total of 1978 nests on Fethiye Beach during 20 consecutive years with a mean of 99 nests per year. There were also strong annual fluctuations in the number of nests, which ranged from a minimum of 58 nests (in 1994) to a maximum of 158 (in 2004). Linear regression analyses showed that there is a statistically significant negative relationship between years and nest numbers at the 99% confidence level ($r2=0.39$; $p<0.01$). This result has lead to the interpretation that the number of nesting turtles is still in decline at Fethiye Beach. The main reasons of the decrease can be excessive use of the beach by the people, lights from the back side of the beach, and boat traffic on the shore. With such a potential negative trend at a key Turkish nesting beach shows a need for more sharp effective conservation programs.

INVERTEBRATE INFESTATION IN LOGGERHEAD SEA TURTLE NESTS ON DALYAN BEACH, TURKEY

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Sea turtle nests face many dangers during the two month incubation period. It is not yet clear whether certain invertebrates found in the nests are predators or parasites to the eggs or hatchlings. The damage caused by some invertebrates to the eggs of loggerhead turtles, *Caretta caretta*, was investigated during the summer of 2010 on Dalyan Beach, Turkey. The specimens were identified to family or species: *Pimelia* sp. (Coleoptera: Tenebrionidae), Muscidae (Diptera), Myrmeleonidae (Neuroptera), Isopoda (Crustaceae) and Enchytridae (Oligochaeta). The specimens of Enchytridae, *Pimelia* sp. and Muscidae were observed on empty eggshells and in eggs. Samples of Myrmeleonidae and Isopoda were observed in the sand columns of nests. The heaviest impacts of these invertebrates on loggerhead turtle nests were Enchytridae (Oligochaeta). Seventeen (32 %) of the randomly selected 53 loggerhead hatched nests were effected by this group. The damage of Oligochaeta was recorded in 188 (5.1 %) out of 3,253 eggs. However it was determined that Oligochaeta individuals were encountered in the sand columns of nests. The damage in one nest of Muscidae and *Pimelia* sp. was recorded in 4 and 7 eggs, respectively. Although no statistical comparison was possible due to the small sample size, the nests containing these invertebrate were also near the vegetation line.

EXTENSIVE MARINE TURTLE NESTING ACTIVITY REVEALED ON REMOTE BEACHES OF ANTIGUA & BARBUDA, WEST INDIES

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Although low levels of marine turtle nesting activity have long been documented across Antigua's and Barbuda’s 153 km of coastline, establishing accurate levels of current species composition and nesting activity across the islands proves difficult. Many nesting beaches are remote and difficult to access by road, particularly on the southern coast of Antigua and most of Barbuda. To better understand the quantity, composition, and distribution of nesting activity across the entire nation, we conducted beach surveys between 16 June and 16 August, 2012, on six Antiguan beaches (previously identified as priority beaches by the Antiguan Sea Turtle Conservation Project) and two Barbudan beaches. Hawksbill turtle nesting activity was most frequently observed and was recorded at each of these key nesting sites. Leatherback nesting activity was documented at seven of the eight monitored nesting beaches, and green turtle nesting activity was observed at four sites. We note that the survey period overlaps the peak hawksbill nesting season, but lies outside of reported regional leatherback and green nesting peaks. We created satellite images of these priority sites using Google Earth to illustrate the distribution of nesting activity. We further summarize nesting activities by species, season, and geographic distribution and discuss the implications of our findings, including recommendations for future nesting surveys on Antigua and Barbuda.

RUNNING INTO THE FIRE: LOGGERHEAD NESTING DENSITY SHIFTS INTO AREAS OF INCREASED EROSION OVER A 20-YEAR PERIOD*

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Global climate change is a major long-term threat to marine turtles. Understanding how marine turtles will respond to climate change is of paramount importance, as it will inform management decisions related to all aspects of marine turtle conservation. In this study, we sought to understand how sea-level rise, erosion, and human land-use have affected loggerheads nesting in the Archie Carr National Wildlife Refuge (ACNWR) in Florida, USA. The ACNWR is the highest density loggerhead nesting beach in the Western Hemisphere, with an average of 740 nests per kilometer in 2012. We used nesting survey data collected from 1986-2006 to quantify how the proportion of annual loggerhead nesting in each half-km in the ACNWR has changed over time. We then used data from coastal aerial surveys to quantify the effect of erosion and sea-level rise on the changes in nesting density. In 1986, the southern portion of the ACNWR was wider; this trend was continued in 2006, as erosion caused the northern portion to decrease in width more than the southern portion over the 20-year period (although most areas experienced a decrease in width). However, counter to our expectation that loggerhead nesting density would mirror this trend, relative nesting density increased significantly in the northern portion of the ACNWR and correspondingly decreased in the southern portion. It is possible that the loggerheads of the ACNWR are moving north in response to climate change, but there are likely other contributing factors, including human modifications to the beach and dune environments (analyses ongoing). Clearly, sea-level rise and other factors have

substantially altered the location of suitable nesting habitat, and the response by loggerheads so far has been to run into the fire instead of away from it. The effects of sea-level rise are likely to accelerate in the future, and this study will provide knowledge necessary for managers to develop a mitigation strategy. Acknowledgments: Thanks to the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America, and the International Sea Turtle Symposium for their generous support.

BAMBOO BAY, MALAKULA ISLAND,VANUATU, AN IMPORTANT NESTING BEACH FOR WESTERN PACIFIC GREEN (*CHELONIA* MIDAS) AND HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*).

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Bamboo Bay, on the west coast of Malekula Island, Vanuatu (16.23o S, 167.24o E), a 12 km long group of black and white sand beaches was identified in 2005 by local Vanua-Tai Turtle Monitors as a potentially important turtle nesting area. A detailed survey combined with training of local monitors on nesting bleach survey methods was carried out in 2006/07 by a combination of local and international turtle researchers. The preliminary results identified about 350 nests of Western Pacific green (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) and one leatherback turtle (*Dermochelys coriacea*) nest. Over 60 nesters, equally distributed between greens and hawksbills were tagged and nesting parameters recorded. The preliminary results indicated that for green turtles the CCL, within season remigration interval and numbers of eggs per clutch are similar to nearby Australian green turtle populations. In the case of hawksbill turtles the CCL and number of eggs per clutch are considerably higher than for adjacent Australian hawksbill populations. In fact the mean CCL was the largest reported for hawksbill turtles in the Pacific with some nesters over 1 m. Bamboo Bay had a high survival rate of hatchlings and appeared to have minimal anthropogenic harvesting, although predation by feral dogs was a problem on hawksbill nests. Since the initial survey the local Vanua-Tai Monitors have followed up with annual nesting beach surveys. This paper will summarize the results of seven years of nesting beach surveys,including a description of the community monitoring effort, the results of flipper and satellite tagging, and conservation efforts on the nesting beach. Additionally descriptions will be given on the geographic distribution of nests, the role and accuracy of local monitors in carrying out nesting beach surveys and some novel methods of data collection and recording, and predator control.This work was initially funded by the Australian Regional Natural Heritage Programme, with follow up funding to Wan SmolBag Theatre Company from Australian and New Zealand Aid.

THE STATUS AND NESTING ECOLOGY OF SEA TURTLES IN KENYA

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The green turtle (*Chelonia mydas*) is the most common sea turtle species to nest in Kenya. Using data gathered from seven different rookery beaches along the Kenyan coast (between -3.775^{o}, 39.843 ^{o} and -

3.911 °, 39.787 °) in 2012, we investigate the status, spatial distribution and nesting ecology of green turtles. Samples of sand were analyzed for grain sizes, moisture content, pH and conductivity. The pH ranged between 9.3 and 9.6 while the percent moisture content ranged between 4.3% and 9.5%. The conductivity on the sampled sites varied between sites with notably higher values being noted in areas which were frequently inundated by sea water. The sand was highly variable in its grain structure with the percentage of large (500µm and 250µm) grains dominating the structure. The nesting success was much lower at all study sites during the study period compared to previous years but varied across the different beaches sampled. The hatching success was zero in clutches that were laid too close to the high tide line and which were inundated by sea water, while in none inundated areas the hatching success was much higher. Predation of eggs was observed on four nests at two of the study sites while one nest was poached. The results of this study give a baseline for the much needed knowledge on green turtle nesting population in Kenya.

EMERGENCE PATTERN OF LOGGERHEAD TURTLE (*CARETTA CARETTA*) HATCHLINGS FROM IZTUZU BEACH, DALYAN, TURKEY

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The loggerhead turtle (*C. caretta*) is a globally endangered species but we understand little about hatchling emergence behaviour. If we are to increase hatchling survivorship then we must understand diurnal emergence patterns, a period when hatchlings are most prone to mortality as a result of desiccation and predation. In this study I investigated hatchling emergence in September 2012 within an area of high-density nesting on Iztuzu beach, Turkey. A total of 573 hatchlings were recorded during the study period, with hatchling emergence predominantly occurring at night between 00:00-03:00 hrs. Emergence duration occurred over periods of 1-6 nights, with some nests displaying a synchronous hatching pattern and most hatchlings emerging on the first night. The number of hatchlings in each emergence group decreased throughout the emergence period. Hatchling emergence was inhibited by increasing sub-surface sand temperatures. Hatchlings from nests with larger thermal variation emerged over a longer duration. Hatchling emergence predominantly occurred at night, perhaps cued by decreasing sub-surface sand temperature. Within-nest thermal variation due to shallow nest depths and shorter distances from sea resulted in a range of hatchling developmental rates and incubation periods, and longer emergence durations. Future studies should focus on within-nest sand temperatures to understand how hatchling metabolic processes impact emergence. Such work might lead to the development of ecological models which might allow prediction of nesting success based upon nest site selection.

DO SEA TURTLES PREFER WHITE SAND BEACHES? IMPLICATIONS OF THE RESPONSE OF ENDANGERED POPULATIONS TO GLOBAL WARMING

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Incubation temperature can affect hatching success and hatchling sex determination. Current incubation temperatures on many important nesting beaches estimate the predominance of female hatchlings, and this

trend may increase with global warming in the future. Increasing sand temperatures can reduce or even prevent male production. Higher temperatures can be lethal for turtle embryos. Environmental factors that can significantly affect incubation temperature include air temperature, sun exposure, vegetation cover and sand texture and color. Incubation temperatures within nests are lower on white sand beaches than on dark sand beaches. Nesting beaches that have areas of different sand color can result in a wide variation of hatchling sex ratios. In extreme cases, the sand color of nesting beaches could influence hatching success. We have studied the influence of sand color on loggerhead nest site selection on a volcanic island (Island of Maio, Republic of Cape Verde) with a wide range of sand color on available beaches for nesting. We have also evaluated the relationships between sand color, hatching success, incubation temperature and estimated hatchling sex-ratio on different beaches of the island. Finally, we have evaluated the sand temperature on many different beaches from different islands of the archipelago of Cape Verde, a very important rookery for loggerheads on the Atlantic. We have also correlated sand color, sand temperature and nest abundance. By quantifying this interaction, we can predict hatching success and hatchling sex ratio as a function of the sand color, in order to assess the importance of different islands and beaches for the conservation of loggerhead nesting in response to future scenarios of global warming. Most loggerhead turtles on Cape Verde, one of the world's main loggerhead rookeries and the most endangered in the Atlantic, are already nesting on the coldest beaches of the Archipelago. Some loggerheads are nesting on the black beaches of islands that have lethal temperatures for embryos. On many other dark beaches, nests are only producing females. On islands where the sand color is highly variable even among close beaches, turtles do not seem to be selecting white sand for nesting. These results have very important implications on loggerhead conservation and nesting dispersal in response to global warming.

CONNECTING RECORD LEVELS OF LOGGERHEAD NESTING IN KYPARISSIA BAY, GREECE, TO LONG-TERM NEST PROTECTION

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The 44 km beach at Kyparissia Bay, western Peloponnese, Greece, hosts the second largest loggerhead turtle nesting aggregation in the Mediterranean. About 84% of nests occur along the southernmost 9.5 km of the Bay, which is considered as the core area. About 7.3 km of the core area (Sectors A, B, C) has been monitored every year since 1984, with seasonal night-time tagging activity (since 1982) in sections of the core area. Turtles with old tags or scars attributed to lost tags are considered as remigrants, and turtles with no tags or scars as neophytes. In-situ nest fencing and relocation to safer sites was applied to a low intensity in the early years of monitoring, depending on human resources. Protection measures were stepped up from 1990, as nests were subject to high rates of mammal predation (about 50%) and inundation by the sea (about 30%) and since 1992 the majority of nests were protected in most of the core area. The minimum age at maturity for Mediterranean loggerheads is calculated to be 15-16 years. Hence, intensive nest protection starting at the start of the 1990s could therefore result in higher numbers of nesting turtles and nests in recent years. Is this the case? Over the 29-year period (1984-2012), nesting effort in sectors A through C ranged from 174 to 741 nests per year. However, in the last seven years (2006-2012) there has been a considerable increase in nest numbers. The two highest nesting levels were recorded in 2010 and 2012 with other years since 2006 also some of the highest on record. Annual population growth rate between 1984 and 2005 is estimated at 0.9%. However, when the most recent years are included it increases to 1.8%. Through the 1980s to 1992 the percentage of neophyte turtles declined from 100% to 50% as existing members of the population were tagged. This level stabilised at about 40% until 2002 when it bottomed-out at just below 30% for two years. Subsequently the levels have increased, and the percentage of neophytes has been over 60% in three of the last 7 years. Further, the average SCL of all turtles has decreased almost 2 cm during this time of increased nesting. Decreased size may be indicative of a younger population and this tallies with the increased proportion of neophytes observed in recent years. Our data tentatively indicate that recent increases in nest numbers may be connected with long-term nest

protection efforts. However, a number of other factors may have also led to these results including the absence of saturation tagging and particular environmental and oceanographic driven conditions. The indicated positive trend, potentially resulting from ARCHELON's conservation efforts in Kyparissia Bay, make us hopeful that similar activities carried out since the early 1990s at Rethymno, Island of Crete, may reverse the population decline that we have recently recorded there. Acknowledgments: We thank all field assistants and the many hundred volunteers without whom the above long-term work would not happen. AFR thanks International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America and the International Sea Turtle Symposium for a travel grant.

EFFECTS OF GRANULAR INCLINE ANGLE ON THE LOCOMOTION OF LOGGERHEAD SEA TURTLE HATCHLINGS (*CARETTA CARETTA*) IN THE FIELD

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Natural environments are complex with animals running over difficult substrates to ensure survival. Animals that traverse on granular substrates can experience slipping, which decreases their performance since granular media can act as a solid or a fluid when stress is applied. Kinematics of loggerhead sea turtle hatchlings (*Caretta caretta*) reveal that limb use varies significantly depending on granular compaction. These studies were done on level ground. However, hatchlings rarely encounter level ground on sandy beaches, having to crawl up and down sandy slopes. As sand is tilted it approaches a critical incline value (angle of repose) at which the material will cease to act as a solid and start to flow. Depending on substrate particle properties, the angle at which flow is induced varies. Little is known how legged-intruders are affected by sandy inclines. We investigated the effects of granular inclines on the locomotor performance of hatchling sea turtles, hypothesizing that as incline angle increased, the animals will adjust limb-ground interactions to prevent slipping, which negatively affects their performance (speed). We captured 25 hatchlings from 5 different nests on our field site on Jekyll Island, GA and tested them on loose and hard packed sand, and on inclines of theta = 0°, theta = 10° and theta = 20°. Using a fluidized bed trackway, we controlled for granular compaction and incline angle, mimicking a natural beach environment. Two infrared high speed cameras (250 fps) were attached to the trackway to film the detailed mechanics of hatchling locomotion. Results showed that the total distance traveled and velocity decreased as incline angle increased, without granular compaction affecting performance. Maximum angular extent of the flipper at the beginning of stance phase in relation to the body remained the same at theta = 0° and theta = 10°(alpha = 128.17°± 12.12°; alpha = 127.80°± 11.40°; $p>0.05$), however at theta = 20°, it significantly increased (alpha = 143.19° ± 12.86°, $P<0.0001$). The duty factor during stance phase, remained unchanged among compaction levels, at 0.69, which is similar to terrestrial turtles that have a duty factor of 0.75 or higher on level ground. On close packed materials the duty factor decreased at the highest incline angle theta = 20° to 0.66. Taking indications of the step interaction effect due to disturbed ground from a bio-inspired sea turtle robot (FBot), the hatchling data was divided into three step distance categories: no interactions between steps, small step interactions, and large step interactions. Results showed that average velocity increased with frequency when turtles utilize adequate step distance to avoid interaction effects for theta = 0° and theta = 10°. However, little effect was seen at theta = 20° suggesting that at higher angular inclines slip dominates performance.

SPATIO-TEMPORAL VARIABILITY IN REPRODUCTIVE SUCCESS OF THE HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) IN JARDINES DE LA REINA, CUBA

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The study covers a period of 14 years (1996-2010) and discusses nesting of hawksbill turtles (*Eretmochelys imbricata*) at nine index beaches; El Guincho, Caballones Este, Caballones Oeste, El Dátiri, Los Pinos, Cachiboca, El Faro, La Ballena and Boca Seca, located in Doce Leguas Labyrinth, Jardines de la Reina Archipelago, Cuba. Nesting at these beaches was characterized considering various indicators of nest success (emerging success, eggs with no apparent development, eggs with dead embryos and dead hatchlings. Only the indicator ‘eggs with dead embryos’ showed a significant difference ($p < 0.01$) between the study beaches; ‘emerging success’, ‘eggs with no apparent development’ and ‘dead hatchlings’ showed no significant difference ($p > 0.05$). Although there were no consistent trends detected during the study period for the four indicators of nest success, when baseline data were incorporated there was a significant decrease ($p < 0.05$) in emerging success, and a significant increase ($p < 0.05$) in the number of eggs with no apparent development; this indicator is important both spatially and temporally for determining nest success. A possible cause for the increase in the number of eggs with no apparent development could be the reduction in the population of adult male hawksbill turtles in the area.

EVIDENCE OF SEA TURTLES NESTING IN LAGOS, SOUTHWESTERN NIGERIA

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Sea turtles are enigmatic, intriguing, marine megafauna. Sea turtles are cosmopolitan in nature, migrating within ocean basins and utilizing multiple marine habitats. Sea turtles are known to nest on several beaches all over the world. Sea turtle nesting has not been documented in Nigeria until recently. Sea turtles have been nesting in Lagos for as long as there has been fishermen, however due to the low awareness of the status of sea turtles in Nigeria, such occurrences have not been monitored on a regular basis. Also theereis a low technical capacity for monitoring marine megafauna in Nigeria. This study is a review of sea turtle nesting data based on historical records, interviews and actual reports of sea turtle nesting at the Nigerian Institute for Oceanography and Marine Research, Victoria Island from 1978 to the present. Sea turtle nesting has been reported in most coastal beaches along the Lagos coast since the 70s, however recent reports related to sea turtle nesting at NIOMR include the collection of 120 green turtle eggs from Marwa Beach (March, 2010), the capture of a female leatherback at Orimedu (February, 2012) and an olive ridley at Onijegi (September, 2012), roasted Sea turtle eggs sighted at Akodo in during PLMR survey (2012), a hatchling emergence at Onijegi Beach (July 2012), and a nest at Ikate Elegushi Beach (September, 2012). All reported nesting events were on Victoria Island/Lekki axis, Westward of Lagos, Nigeria. Unfortunately this region is an area undergoing intensive coastal development and also highly vulnerable to storm surge. Three storm surge and flooding events have been recorded in this area during this year alone. There is a need for more intensive monitoring of sea turtle nesting activity in Lagos and Nigeria, and to protect vital nesting areas in the future.

EFFECT OF CLOSED SEASONS ON NESTING POPULATIONS OF GREEN TURTLES (*CHELONIA MYDAS*) AND LOGGERHEADS (*CARETTA CARETTA*) AT GUANAL BEACH, ISLA DE LA JUVENTUD, CUBA

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The effects of a closed season on populations of green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles nesting at Gunal beach, Isla de la Juventud, Cuba were studied. An analysis of the harvest (trend for the study period, seasonal variation and during the closed season) and nesting (proportion of nests per species for the entire period and for each species during each period) in four stages: PVI (1982 -1987), PV2 (1988-1994), PV3 (1995-2007) and PV4 (2008-2011), representing different closed season periods. Additionally, the size range for both species was analyzed. It was found that the annual variation of the harvest of loggerhead and green turtles for the whole period shows a decrease over time for both species, associated with closed season in place, while the variation of nesting was observed for both species according to closed season, where the proportion of green turtle nests is higher for most of the period indicating that this is the main species nesting at this beach. An analysis of nesting with the monitoring effort applied to the entire study period, showed a statistically significant relationship for loggerheads ($p < 0.05$), but not for green turtles ($p > 0.05$). The analysis of the mean size of individuals of both species over the study period showed no significant changes over time.

SEASONALITY OF GREEN TURTLE (*CHELONIA MYDAS*) REPRODUCTION AT ALDABRA ATOLL, SEYCHELLES

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Seasonal and temporal-spatial distributions of green turtle (*Chelonia mydas*) nesting activity were assessed at Aldabra Atoll Seychelles, the second largest green turtle rookery in the Western Indian Ocean (WIO), based on morning counts of fresh turtle tracks conducted during 1980-2011. The datasets used in the analyses are derived from: an average of 3-4 surveys per month at two index sites representing ~30-42% of total annual nesting during 1980-1989 and ~58% during 1995-2011; and monthly surveys conducted at another two remote sites which accounted for an additional 20% of annual nesting (total ~78%) during 2002-2011. Turtles engaged in year-round nesting during the season defined as December to November and characterized by patterns of high intra- and inter-annual variation. In some seasons nesting peaked primarily during February to May and in others during May to September. However, on average during 1995-2011, a clear uni-modal pattern emerged with nesting activity greatest during February to September, peaking during April to June, and lowest in November-December. The two Primary Index Sites situated 2.2 km apart on the west coast and separated by a lagoon entrance had mean peak nesting dates that consistently differed by more than a month. Possible explanations for the differences are discussed. At Aldabra, the timing of the 1997-98 ENSO event coincided with a disruption in normal nesting cycles during 1998 through 2002 and the highest levels of nesting recorded at Aldabra to date during the 2000-01 season. Comparison of seasonal median peak nesting dates at five green turtle rookeries in the WIO suggests an inverse relationship with latitude among four of them, with those in the lower latitudes peaking during the austral autumn and winter and in the higher latitudes during the austral summer, an indication that temperature may be moderating nesting seasonality in the WIO.

LEATHERBACKS, COMMUNITIES, AND COASTAL CHANGE IN GRANDE RIVIERE, TRINIDAD

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Grande Riviere is a village of 380 people on the remote mountainous north shore of Trinidad, W.I. The community resides on a beach described as the 'Densest Nesting Site Globally' for the leatherback turtle. The beach is a Prohibited Sea Turtle Nesting Site from March 1 to August 31 between the hours of 6 pm to 6am. At night the beach is managed by the Grande Riviere Nature Tour Guides Association (GRNTGA), a community based organization in a co-management agreement with Wildlife Division. The GRNTGA transforms the dark beach into a classroom during the nesting season. On a busy night of nesting, the turtles and turtle-watching visitors often outnumber the population of the village. The group is responsible for protection through beach patrols, beach cleanup, education, leatherback biology tours and lectures, and research through monitoring and other projects. This poster provides the perspective of the GRNTGA and the Grande Riviere community during the internationally-publicized events of 7 July 2012 when an excavator re-directed the Grande Riviere River in an attempt to re-establish a new river mouth and forestall the increased rates of beach erosion experienced since December 2011. The media highlighted only the work and its immediate impact on nests: the community would like to describe the erosion impacts as well as the appeals and conservation efforts made prior to the intervention. We will present data documenting nesting events in the excavation area and clarify the ecological and social impacts of redirecting the river. The outcome of the incident and the implications for future management of this globally important beach that is nested within a small, conservation-oriented community will be discussed.

ASPECTS OF REPRODUCTIVE *ERETMOCHELYS IMBRICATA* (LINNAEUS, 1766), FROM THE SOUTH COAST OF PERNAMBUCO, BRAZIL

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The State of Pernambuco has reproductive records of sea turtles, especially the species *Eretmochelys imbricata* (Linnaeus, 1766), the hawksbill sea turtle, and a lesser number of *Caretta caretta* (Linnaeus, 1758), the loggerhead sea turtle, and also *Lepidochelys olivacea*, the olive ridley, (Eschscholtz, 1829). Nest placement by sea turtles has influence on the embryonic development, impacting on the sex of offspring, the survival of embryos and the rate of nest predation. This study aimed to analyze reproductive aspects of *E. imbricata* including biological variables (clutch size, incubation time and rate of reproductive success). In order to provide information that could assist in the preparation of conservation plans and more effective management of sea turtles in the region. The study covered an area of 12.92 km long coastline of Ipojuca, south of Pernambuco. The data used in the study were from the 2008/2009, 2009/2010 and 2010/2011 sea turtle nesting seasons, collected by the staff of the NGO Ecoassociados. A total of 335 *E. imbricata* nests were recorded between the months of October and April with peak nesting in February, a period that coincides with the high tourist season. The highest occurrence of nests was on Merepe's beach, with 55.7%. Female *E. imbricata*, which had nested, present a mean and standard deviation of curved carapace length and curved carapace width, 92.0 ± 6.1 cm and 83.2 ± 6.3 cm, respectively. The mean clutch size was found to be 142.4 eggs. The average incubation time was found to be 56.6 days on the beaches of the city of

Ipojuca, and appeared similar when compared to other studies in Brazil. Based on the estimated pivotal incubation time of 62.8 days and considering that the average incubation time recorded in the region was 56.6 days, a female skewed sex ratio for *E. imbricata* occurs on the southern coast of Pernambuco. The average reproductive success recorded was 62.9%, was relatively low compared to values shown in studies conducted elsewhere. It is recommended that environmental education campaigns to educate the local community and tourists be undertaken, because the period of sea turtle nesting coincides with the huge influx of tourists. Greater efforts should be allocated to Merepe's beach that proved to be the main nesting site. It is recommended to undertake further research on the physical and chemical characteristics of Ipojuca beaches in order to establish which features are related to the distribution of sea turtle nesting.

FATE AND EMERGENCE SUCCESS OF HAWKSBILL (*ERETMOCHELYS IMBRICATA*) NESTS IN THE COMARCA NGÖBE-BUGLÉ AND BOCAS DEL TORO PROVINCE, PANAMA

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There is a long history of both commercial and subsistence use of hawksbills (*Eretmochelys imbricata*) in Bocas del Toro Province and the Comarca Ngöbe-Buglé, Panama. Extraction of hawksbills from beaches in the area to support the international trade in hawksbills led to a precipitous decline in nesting. In 2003, a consortium of interested individuals and organizations, including the Wildlife Conservation Society and the Sea Turtle Conservancy, established a standardized monitoring and protection program at Playa Chiriquí, Isla Escudo de Veraguas and Cayos Zapatillas in Parque Nacional Marino Isla Bastimentos. Playa Roja and Playa Larga were subsequently added to the program. During the 2009, 2010 and 2011 nesting seasons, daily track surveys were conducted at each of the five study sites. At all localities, the presence of eggs was confirmed and the nest was marked using flagging tapes; triangulation was used to subsequently locate the nest for evaluation. Nests were evaluated using a standardized protocol three days (72 hrs) after signs of emergence were observed or after 70 days if no signs of emergence were reported. Data from the evaluations were used to determine emergence success (hatchlings successfully exiting the nest) using the following formula: ((# egg shells – # hatchlings encountered in the nest) / total # eggs)) * 100 %. During the three-year period, over 3,500 hawksbill nests from five study sites were evaluated. Across the five beaches, the average number of nests that were intact at hatching was 83.8% (68.5 - 92.8%). The lower value (68.5%) at Playa Chiriquí was mostly due to predation (27.1% of nests), primarily by domestic dogs. The average emergence success of intact in situ nests at the five study sites was 76.2% (66.0 - 82.1%). Over the three years, 127 nests at Cayos Zapatillas were relocated because of imminent threat of erosion. These nests had an average emergence success of 61.5% vs. 80.7% for in situ nests (n = 1047). At Playa Chiriquí, predation reduced emergence success to 12.5% for in situ predated nests (n = 377). Buried plastic-coated metal screens (30x30 cm) were used on some nests to reduce predation by dogs. However, the high density of nests and the fact that the application of the screens is very labor-intensive, meant that only a small percentage of nests could be protected. Nests that were protected had an increase in emergence success. As another measure, the communities near the beach were also asked to help control their dogs. Because of the presence of beach monitors, illegal poaching of nests has been largely eliminated on all the study beaches.

IMPACTS OF WRACK DEPOSITION ON ST. CATHERINES ISLAND, GA

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This study addresses the impacts of major beach wrack accumulation events on St. Catherines Island, Georgia, including: obstruction of nesting; development of cryptic nests; and hatchling loss. The compound effect of rising sea level and increasing frequency and height of storm surges flushed *Spartina alterniflora* debris out of nearby salt marshes and deposited it as wide, thick, wrack mats on the beaches of southeastern U.S. barrier islands in 2009 and 2012. On St. Catherines Island, GA, these events appeared to negatively impact loggerhead nesting success. The apparent negative impact observed by similar conditions in 2009 promoted the 2012 effort to document changes in loggerhead nesting behavior, subsequent impacts on hatching success, and hatchling egress into the sea. Wrack accumulation also forced adaption of monitoring procedures and protocols to cope with the new challenge. The ratio of non-nesting to nesting crawls is one proxy for the difficulty of nesting; the normal average is 1:1 on Georgia beaches, and the normal non-nesting/nesting ratio on St. Catherines is 2:1 due to the high proportion of erosional beaches. During the 2012 nesting season, major wrack deposition events on St. Catherines drove this proxy to a 5:1. The loggerheads that nested successfully modified the typical nesting ethogram with sand crawls that gave way to subtle, flattened trails of wrack as the female crossed over it and back to the sea. Nests in the wrack lacked the typical body pit and exhibited little tossed sand to indicate covering activity. These nests within the wrack mat are described as a new class of obstructed nests designated cryptic nests. The attempted egress of hatchlings from nests obstructed or buried by the wrack mats has been observed and documented in several nests. A typical emergence with an unobstructed path to the sea results in a suite of tiny crawlways that diverge from the nest toward the surf with the crawl “fan” usually being less than 30 m wide by the time the hatchlings reach the water line, unless the tide is very low. Hatchlings obstructed by wrack ridges were diverted laterally with some traveling over 200 meters before crossing a low spot in the wrack ridge. Inventories of nests and counts of hatchling crawls behind the wrack line versus crawls on the open beach indicate losses of 45 to 60 % of the emerged hatchlings to predators and/or trapping within the wrack. Negative impacts were also recorded for nests deposited within the wrack, or nests buried by a subsequent ‘wrack event’ at some point during incubation. Nests that incubated beneath wrack mats accumulated additional sand, compacting the wrack mat, and “deepening” the egg chamber beyond the 55cm average depth. The number of ‘stragglers’ in emerging nests significantly increased, as well as the number of corpses found trapped beneath the wrack.

IMPACTS OF A DECLINING BEACH PROFILE ON HAWKSBILL TURTLE NESTING SUCCESS AND SITE CHOICE

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The critically endangered hawksbill sea turtle (*Eretmochelys imbricata*) prefers nesting on beaches with vegetated areas, but anthropogenic alterations, coupled with extreme weather events, often result in

massive alterations to beach profiles. Since intensive saturation tagging efforts began at the nesting rookery on Long Island (Jumby Bay), Antigua in 1987, the Jumby Bay Hawksbill Project (JBHP) has observed extensive changes to the primary beachfront including estate construction, beach extensions, vegetation bed planting, and hurricane-induced sand erosion. Using aerial photography collected since the 1980s, we quantify these changes on a coarse geographic scale. We use transects oriented perpendicularly to the high tide line and spaced at regular 10 m intervals to estimate vegetative cover and species diversity across available nesting habitat and categorize beach zones based upon vegetation and embankment height resultant from storm activity. Observations from 2012 indicate notable increases in unsuccessful nest attempts and encounters with previous nests compared to recent years; therefore, we evaluate the effects of beach embankment height and vegetation cover on nesting success by comparing nest locations, incidences of unsuccessful nesting attempts, and encounters with incubating nests between the 2005 and 2012 nesting seasons. Finally, we address the hypothesis that nesting events occur a shorter distance inland when turtles nest atop embankments. Preliminary results suggest that since 2005, rapid growth of planted vegetation beds of invasive Scaevola sericea and heavy erosion have drastically changed the face of Jumby Bay's nesting beach. An undeveloped beach on mainland Antigua provides a benchmark for recommendations for beach restoration to improve hawksbill nesting habitat on Long Island. With these results, we will evaluate the impacts of the rapidly changing beach profile and vegetation to inform management actions to preserve this rich nesting site.

TIDAL AND BEACH CONFIGURATION INFLUENCES ON THE LANDING OF MARINE TURTLES ON THEIR NESTING BEACH

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The estuarine beach of Yalimapo, located in the western French Guiana (South America) is a major nesting site for Leatherback (*Dermochelys coriacea*) and green (*Chelonia mydas*) turtles in the region. During the nesting season (February to August), turtles come to lay during night all over the beach. Most of the literature papers have been focused on tidal influence, more precisely the temporal repartition of marine turtles in regard to high tide, in order to adjust the beach patrol survey. On Yalimapo beach, marine turtles nesting repartition are not homogenous and spatial nesting patterns seem to be dispatched on the beach. This beach forms part of the highly dynamics shoreline of the Guianas coast due to mudbank migration. Nevertheless, the estuarine position of the beach , on the Maroni river estuary, had held the sustainability of the beach through time, and therefore constitute a stable nesting site for marine turtles. The comprehension of their nesting behavior is a major issue in conservation programs. The hypothesis of these spatial patterns is the beach configuration which could explained this behavior. In this context, we divided the beach into three areas corresponded to three different characteristics zones. In this study, we proposed a combined analysis of the influence of both tidal and the onshore morphological features on the repartition of the leatherback and green turtles. The more western area, located near the mouth of the Maroni river, has typical onshore morphological features such as a sandy bank. This bank constitute an obstacle at low tide, when it is emerge and could be a natural barrier during marine turtle displacement to access the beach. The middle and eastern side of the beach is less influenced by the onshore shoal. Consequently, they are free of any obstacle for the access of the beach by marine turtles. Furthermore, the tidal level influence the onshore configuration which play a role in the marine turtles repartition. The study highlighted a temporal and spatial variable of the turtle's repartition, depending on the species and the localization on the beach. General observation highlighted a more important arrival of the leatherback turtles during the flood whereas green turtles are more present during the ebb. Then, we denoted a highly pronounced arrival of leatherback and green turtles in the western part of the beach during the flood and near the high tide (where the water level is high), when the sand bank is immerged. And then constitute a free area with no obstacle for the turtles to come to lay in this portion. However the middle and eastern part of the beach studied is

more frequented by Green turtles during the ebb. The estuarine position of the beach seems intensify the tidal current during the flood and ebb. Also, during the flood when the level water is high, the turtles could be transported in the western part of the beach but also on the other side of the beach during the ebb.

TOUCHING BASE – THE STATUS OF MARINE TURTLE NESTING AT THE PATRICK AIR FORCE INSTALLATION, FLORIDA (USA)

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Since 1987, extensive surveys of marine turtle nesting at the Patrick Air Force Base (PAFB) in Brevard County FL, USA have been conducted by the University of Central Florida Marine Turtle Research Group (UCFMTRG). These surveys are among the oldest uninterrupted datasets informing the Index Nesting Beach Survey (INBS) program. This program, developed by the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission, documents temporal and spatial distribution of nesting, as well as responses to beach nourishment and recreational activity. The PAFB study area extends seven kilometers north of Pineda Causeway, SR 404, along the beach front parallel to the eastern margin of the Base. Three marine turtle species listed under the Endangered Species Act are found at PAFB – loggerheads (*Caretta caretta*), green turtles (*Chelonia mydas*) and leatherbacks (*Dermochelys coriacea*). The 2012 loggerhead nest total was 1,530, a 44% increase from the 2011 season (1,056) and 22% above the PAFB long-term average (1987-2011). Six leatherbacks nests were also documented in 2012 (high for PAFB) with no observed nests in 2011. Green turtles nested 28 times, tripling 2011 nesting (9), but 24% less than 2010 (37). This represents a moderately-high year for green turtles and confirms the return to a biannual “high-low” nesting oscillation observed at the Base, after deviating from the pattern during 2004 - 2008 (all moderately-high years; mean = 31.8 nests). During the 2012 nesting season, the effects of a 2011 nourishment on the southern-most 3km of the beach (pre-season dune face reformation; UCF km 0.0-3.0), and the long term effects of the 2005 nourishment (UCF km 3.0-7.0) were also evaluated. Nesting success for loggerheads usually declines in the first season after nourishment, with subsequent recovery. However at PAFB, the beach-wide 2005 project saw higher nesting success in the first season post-nourishment than previous projects (46.0%). Subsequently, nesting improved to 53.4% in 2006, and has been basically increasing over the last six years, with 58% nesting success in 2012. During the 2011 season, nesting success in the 2011 nourished area (UCF km 0.0-3.0) was 49%, which is higher than post-nourishment success for the 2005 project (46%), although it represents a 9.9% decrease from 2010 (58.9%). As predicted, 2012 nesting returned to 2010 levels (59%). Similarly, in the 2011 non-nourished areas, nesting success rose to 54.5% in 2011 (an increase of 6.1% from 2010) and further improved in 2012 to 58%. Given that recent nourishment programs did not result in appreciable nesting depression after sand placement, the overall trend may portend that loggerhead nesting success may be generally increasing at PAFB in recent years. Long term continuous surveys of this nature are instrumental in identifying long term nesting trends and informing government policy regarding coastal management and marine turtle protection. The presentation of this data would not have been possible without the generosity of the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America.

CONTINUED DECLINE OF NESTING LEATHERBACK TURTLES AT CULEBRA ISLAND, PUERTO RICO

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The nesting activity of leatherback (*Dermochelys coriacea*) in Culebra Island, Puerto Rico occurs from mid-March to mid-July and it has been studied since 1984. Therefore, was long known as one of the largest nesting rookeries in the eastern of Puerto Rico, is as well as, in previous seasons were counted of between 200 to 400 nests. Throughout all these years, the data collected on Culebra's beaches indicated the importance of these nesting areas at local and Caribbean region level. Nevertheless, since 2004 the nesting trend declined steadily. Surveys conducted during nesting season at Culebra Island, 2012 revealed an extremely low number of leatherback females (5 females) and of nests laid (32 nests) on the island's beaches. Although, in several near-by leatherback nesting areas such as NEC (northeastern ecological corridor), 17 km west off Culebra Island, localized in Fajardo and Luquillo (mainland Puerto Rico) the number of nests has increased steadily, from more or less the date of nesting on Culebra Island has decrease. Then, is possible that nesting females are emigrate Culebra Island and are giving use to other near-by beaches to nest, resulting in a reduction in the number of nests reported during the past eight years in Culebra Island. Evidence it are two females marked in previous seasons in Culebra Island, reported in the season 2012 nesting at Rio Grande (adjacent area to Luquillo), and other female nesting at Piñones (near of San Juan city). Therefore, the leatherback nesting should understand like a dynamic regional, where each individual of the species recognizes numerous nearby beaches as a wide area for nesting. For that reason, is necessary develop monitoring effort in the region for ensure the leatherbacks conservation.

PROFILES OF PROTECTED AREA NESTING BEACHES AT PUMPKIN HILL AND CUERO Y SALADO WILDLIFE REFUGE, HONDURAS

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Pumpkin Hill Beach is the predominant nesting beach for Hawksbill turtles on the Bay Island of Utila, Honduras, and thus is extremely important to the regional conservation of the species. We surveyed both elevation and vegetation profiles for the entirety of Pumpkin Hill Beach (475 m). To measure elevation, transit level points were taken every 5 m for the entirety of each beach length. Vegetation coverage was documented along each section of beach. The beach at the Cuero y Salado Wildlife Refuge, on the north coast of Honduras, is also a potentially important site for sea turtle conservation. An elevation profile was also created for a 1,000 m stretch of beach, and vegetation composition was measured every 20 m along a 1,000 m stretch. At Pumpkin Hill, we found 16 species of plants, and the area in which turtles chose to nest had significantly more tree cover than other beach areas. At Cuero y Salado, 13 species of plants were recorded during vegetation surveys, and this beach had sufficient vegetation to be considered a potential nesting site for turtles. Results of these surveys will be used to calculate future beach erosion on both Pumpkin Hill and Cuero y Salado beaches, as well as monitor changes in beach structure and vegetation over time that may impact turtle nesting activity and egg development. This study will provide valuable information for sea turtle conservation efforts by determining what factors contribute to appropriate nesting beach areas for both Pumpkin Hill Beach and Cuero y Salado Wildlife Refuge.

TEMPORAL VARIATION OF INCUBATION TEMPERATURE OF GREEN TURTLE NESTS IN THE SOUTHWESTERN CUBAN ARCHIPELAGO

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We analysed five years of incubation temperature data for green turtle (*Chelonia mydas*) nests at the westernmost region of the Cuban Archipelago (2004, 2006, 2007, 2011 and 2012). We compared the temperatures of the entire incubation period as well as during the thermosensitive period when sex is determined. There was a significant difference in temperature during this period ($F_{(8,\ 1143)}$=5, p<0.01) although the most interesting result was that the median value of the thermosensitive period was above 29.5^{o}C in four of the five years analyzed. This indicates that a higher proportion of females were most likely produced. However, when the complete incubation period is considered, there was an increase in the median temperature with a significant difference between the two later years and the previous ones ($F_{(4,\ 1153)}$=22.3 p<0.01). We also compared these temperatures (measured in the middle of the nests) with temperatures recorded from the bottom of the nests. There was a significant difference between temperatures from the bottom and middle of the nests during incubation ($F_{(1,\ 3606)}$= 13,0126; p<0.001). However, the median temperature remained over 29.5^{o}C indicating that temperatures remained skewed towards female production for the entire nest. When the nest temperatures were compared with sand temperatures at the same depth, there was a difference that increases throughout incubation, but if we add the sand temperatures to the average difference with nest temperatures, we can determine nest temperatures with 81% certainty (R^2=0.81). If the same analysis is performed with air temperatures, this certainty falls to 55% (R^2=0.55). Finally, it was also possible to detect the influence of a tropical storm on incubation temperature. There was a significant difference in the mean nest temperature when considering the influence of the storm ($F_{(1,\ 3600)}$=54, p<0.01). Nevertheless, this difference will depend on the nest position on the beach since it seems that innundation of the sea has more of an impact than rain and, therefore, nests closer to the sea showed a higher variation in temperature than those further from the sea.
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EFFECTS OF INCREASED CONSTRUCTION ON THE DISTRIBUTION OF LOGGERHEAD NESTS IN SOUTHERN KYPARISSIA BAY, GREECE

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Kyparissia Bay, in the Western Peloponnese in Greece, contains an approximately 44-km long beach, and hosts the second largest nesting population of loggerhead turtles in the Mediterranean. Within this bay approximately 84% of the nesting occurs in the southern 9.5 km, stretching from the Arcadikos river in front of the village of Kalo Nero, to the Neda river near the village of Elaia. The southernmost 2.2 km section in front of Kalo Nero village (Sector O), is differentiated from the rest of the bay by its much narrower, steeper and rockier beach, whereas the majority of the rest of the bay has a wide sandy platform and is backed by dunes, fields and coastal forest. Historically, Sector O has been characterised by little construction (restaurants, street lights, hotels and bars) behind the beach leaving much of the sector undisturbed, quiet and dark. However, gradually over the last 15 years development behind and on the beach has increased. The beach can now be categorised in three ways: undisturbed by artificial light or noise; affected by artificial light only and affected by both artificial light and noise. Since 1999 the beach has been divided into 50-m sections, and nest locations have been recorded accurately; this has allowed changes in nest distribution to be documented. Nest numbers on Sector O have remained fairly constant over the past 15 years, when the rest of the monitored sectors have shown an increasing trend, therefore the proportion of nests on Sector O has actually decreased. Additionally, nest distribution within Sector O has shifted dramatically, with nest numbers negatively correlated to development behind the beach. However, artificial light alone has not caused this distribution shift, as demonstrated by one 100-m section of beach, heavily illuminated by a hotel, which has shown a dramatic increase in nests, 1999 and 2000 had 2 and 4 nests respectively; 2011 and 2012 had 29 and 55. A further section of 800 m which now has many bars, hotels and streetlights (a combination of lights and noise) has seen the biggest decrease in nests from 80 and 61 in 1999 and 2000, to 21 and 16 in 2011 and 2012. Although this shows that the adult females are moving away from the most disturbed areas they are still nesting where there is significant lighting, leading to hatchlings from these nests suffering from serious disorientation, and requiring significant intervention to allow them to safely reach the sea. The changes observed so far indicate what impact further development along the entire bay could have in the area; further areas of the beach may become unsuitable for nesting and the distribution could change even more significantly. Worse still, there is the potential for development to affect overall nest numbers in the bay. Acknowledgments: We thank all field assistants and the many hundred volunteers without whom the above long-term work would not happen. TER wishes to thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics, CLS America and the International Sea Turtle Symposium for a travel grant.

ESTIMATION OF OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) HATCHING RATES OF CHACOCENTE AND LA FLOR BEACHES, NICARAGUA DURING THE 2009 AND 2011 NESTING SEASONS

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The olive ridley (*Lepidochelys olivacea*) is the most abundant sea turtle species along the Pacific coast of Nicaragua. This species is known to nest solitarily all year round, and in massive arribadas at Chacocente and La Flor beaches between July and January. Since the 1980s, studies have been conducted to assess the number of females participating in the arribadas (using a total count methodology) and hatching rates. Since 2008, the instantaneous count method based on transect methodology has been implemented along with a new methodology to study hatching rates based on marking, monitoring and exhumation of nests. Using these methodologies, we took a sample of 744 arribada nests during the 2009 and 2011 nesting seasons to estimate hatchling production at both beaches. We observed that 26.88% of the nests were lost to tidal erosion, other nesting turtles, predation by domestic fauna and poaching. We were able to exhume the rest of the 544 nests (73.11%) to measure hatching rates and study causes of embryo mortality. Chacocente exhibited the highest nest loss (24.46% vs 2.41% of La Flor). The greatest nest loss at Chacocente was due to nests that could not be found (68.13%) followed by poached nests (14.35%). The greatest nests loss at La Flor was due to destruction by nesting conspecifics (24.32%). These differences are likely due to the higher number of turtles that nest at La Flor (~57% more than at Chacocente) which promoted destruction of early nests due to higher nest density. This greater number of nests was also likely responsible for the greater emersion rate (57%) observed in La Flor during 2011. Total hatchling production in 2009 and 2011 for both beaches amounted to 4,146,986, with La Flor contributing a greater percentage (70%) than Chacocente (30%). Analyzing the data by season, 2011 was significantly more productive than 2009, with 86% more hatchlings. This coincides with an increase of 17% more nests reported during 2011 (111,568 nests). It is important to highlight that more than 1,000,000 hatchlings were produced in 2011 for both beaches combined. Generally, emergence rates for both beaches were very high (Chacocente=24.21%, La lor=36.71%) relative to emergence rates reported for other arribada beaches. The emergence rate of 54% for Chacocente and La Flor was slightly higher than the 52% reported for Nancite beach, Costa Rica in 2011. This may be explained by relatively low nesting volume in the Nicaraguan beaches, which does not exceed 86,000 nests. The dynamics of the nest microenvironment at arribada beaches are complex and many variables were not measured in this study (i.e. incubation temperature, humidity, number of clutches per area and substrate) and we recommend including these variables in future studies. However, the present study demonstrates that both beaches are contributing a large number of hatchlings to the marine ecosystem and these are beaches that support an adequate number of clutches.

CONSERVATION OF SEA TURTLES IN PLAYA CEUTA, ELOTA, SINALOA, MEXICO: 2012-2013 SEASON

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The Autonomous University of Sinaloa, through the Faculty of Marine Science and School of Biology and supported by institutions including the Elota City Council, Agricultural Tarriba, Sinaloa Science Center and CONANP, carries out the conservation activities on the olive ridley (*Lepidochelys olivacea*) beach in Ceuta, Elota, Sinaloa, Mexico (40 km). The camp now considered a "Sea Turtle Sanctuary" and has a rustic auditorium and museum which can host environmental education presentations for a large number of visitors, including school groups, professionals, and regional and foreign tourists. Clutches of eggs are transplanted into incubation pens and boxes. To date, 22,500 eggs were protected and over 5,500 hatchlings have been released. Some nests are left "in situ" for research purposes. For the first time in 35 years, a black turtle, *Chelonia agassizii*, nested on this beach.

EFFECTS OF DIFFERENT LIGHT INTENSITIES ON HATCHLING LEATHERBACK (DEMOCHELYS CORICEA) SEA TURTLES

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Upon emergence from the nest, sea turtle hatchlings are able to direct themselves towards the ocean. There are two visual cues used in this sea finding behavior; light intensity and horizon elevation. Hatchlings have a visual cone of acceptance that is 180 degrees wide and 30 degrees vertical. They use this visual cone to orient themselves towards the brightest horizon, as they are positively attracted to light. Natural light and artificial light influence a turtle's orientation. Natural light supplied by celestial bodies helps hatchlings orient themselves towards the ocean while artificial light disorients and may lead them in the opposite direction of the ocean. It has been concluded that most sea turtles are attracted to wavelengths below 525 nm. The purpose of this study was to observe the change in speed and directional orientation when testing different artificial light (red and blue light) and natural light sources on hatchling leatherback turtles. We collected 5 hatchlings for each of the three experiments conducted each night for three nights (45 hatchlings total). We first assigned numbers to each turtle and then measured their straight carapace length ad width and their mass. The hatchlings were then transported to the beach where day, time, light source and weather status were recorded. Three experiments were conducted each night with natural light and artificial light (red and blue). Natural light experiments were conducted at 1800 h and 1900 h, and the red and blue lights were tested at 2000 h. We measured the light intensity using a sky quality meter. After physical characteristics were recorded we placed the turtles in order relative to their number. They were released at a starting point facing the ocean. After a one minute interval, a flag was placed at the location of each hatchling to mark their trails, for a total of six minutes. Once all five hatchlings in a single experiment reached the ocean, the distance and angles of each turtle's track was measured starting from their specific starting point. These tests showed that leatherback hatchlings moved more efficiently under natural light settings. During the natural light tests at 1800 h and 1900 h the hatchlings' tracks were direct and oriented towards the brightest horizon, however some wandering did occur. When tested with artificial light, the

hatchlings either moved much slower and oriented themselves directly towards the light source or moved in circles around the starting point. Hatchlings were more disoriented when red light was used than under a natural light setting. This information can help us in future leatherback research because many scientists use red light when working with leatherback hatchlings. However, based on our study, the use of red lights significantly disoriented the hatchlings. We found that less light of any source, artificial or natural, will aid leatherback hatchlings in their orientation and speed towards the ocean.

SPATIAL ANALYSIS OF SEA TURTLE NESTING FREQUENCY ON TWO BARRIER ISLANDS IN NORTH CAROLINA

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Despite falling in the northern area of the loggerhead (*Caretta caretta*) nesting range, North Carolina beaches still receive a large number of sea turtle nests during the summer nesting season. Although the numbers are significantly fewer than Florida, which can see up to 10,000 nesting females in a single season, the dedication put forth towards protecting this smaller population nesting in North Carolina is essential due to their endangered status. This study investigated the effects of environmental and anthropogenic variables (elevation, beach angle, distance between nests to shoreline, and proximity to piers, houses and jetties) on the frequency of sea turtle nesting on two North Carolina barrier islands, Masonboro Island and Topsail Island. Masonboro is uninhabited and managed by the National Estuarine Research Reserve and Topsail Island contains large residential areas and some commercial development. Topsail has a long history of land use development that is predominantly single-family residential areas including oceanfront housing stretched along the entire 20km length of the island. The commercial areas are largely focused in the towns of Surf City and to a lesser extent in the town of Topsail Beach and include piers with nighttime fishing. Multiple GIS spatial analysis techniques were used in this study to determine which variables most influence nesting distribution and to construct an overall predictive model for sea turtle nesting. The variables that are most correlated with sea turtle nesting distribution, in both study areas, were proximity to piers and jetties and the angle of the beachfront. The results obtained from this study document how GIS can provide beneficial spatial analysis techniques when researching sea turtle nesting information. Data from this project is available as a resource for sea turtle conservation programs already in place in North Carolina as well as other programs that have an interest in utilizing GIS to study spatial patterns.

MARINE TURTLES NESTS IN DYNAMIC ENVIRONMENTS IMPACTED IN THE NATURAL RESERVES OF MONA AND CULEBRA ISLANDS, PUERTO RICO

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The perpetuity and conservation of marine turtles in the Caribbean Islands depends on the dynamic of the beaches. Two of the most critically endangered marine turtle species nest in Puerto Rico’s shores; these are the hawksbill turtle (*Eretmochelys imbricata*) and the leatherback turtle (*Dermochelys coriacea*). With the goal of understanding the dynamic environments and the impact on marine turtle nests, we selected two remote islands adjacent to Puerto Rico. The beaches in Mona Island and Culebra Island represent a

dynamic shore exposed to swells from cold fronts, tropical storms, and flash floods. Recent studies on beach profiles indicate a dramatic pattern of changes in beach slopes and lengths. The Amny Method for measuring beach profiles helped to determine vulnerable zones of erosion, accretion, and sand banks transported and deposited offshore to inshore. The Island of Mona is known for its high number of hawksbill nests, while Culebra for its high number of leatherback nests. However, in the past years nesting numbers in Mona Island have increased considerable (>70%), and in Culebra Island the leatherback nests have decreased significantly (<70%). The factors attributed to these changes in nesting numbers could be a combinations of biotic and management. Understanding the dynamic of these beaches could have an important impact on the success and productivity of sea turtles.

NESTING ECOLOGY AND REPRODUCTIVE SUCCESS OF OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) SEA TURTLE AT GODAVARI RIVER MOUTH NESTING BEACHES, ANDHRA COAST, BAY OF BENGAL, INDIA

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The Godavari river mouth of Bay of Bengal on East Coast of India is situated between 16°17’ and 18° 30’N latitudes and 81°30’ and 82°37’ E longitudes. The nesting beaches of Godavari River mouth were separated into four distinctive zones (I, II, III and IV) based on their topography and morphological characteristics. The mainland beaches nearer to river mouth of zone-I was high elevated and flat terraced type, while the riverine sand spits, shoals and lagoon fringed beaches of zones II, III and IV were fine sandy beaches. The profile of nesting beaches and grain sizes of Godavari river mouth were analyzed to correlate nesting activity and reproductive success (hatching of eggs and emergence of hatchlings) of olive ridley sea turtle (*Lepidochelys olivacea*). Maximum nesting activity of olive ridley turtles was observed during March (50.15%) and April (22.36%), while lowest was recorded in January (8.28%), February (17.24%) and almost negligible in December (1.97%). Nesting density was recorded highest in zone, III, beaches with 34.0 nests/km-1, followed by zone, I of 4.64 nests/ km-1, zone, IV with 3.14 nests/ km-1 and lowest in zone, II of 2.16 nests/km-1. The reproductive success rate (hatching of eggs and emergence of hatchlings) was highest, 52.50 %, in zone, II beaches where as the remaining zones (I, III, &IV) were recorded with lowest hatching success of 36.20% respectively. Nest survival and hatching success was highest (62.71%) at 20 to 40 meters beach profile distances and beyond 40 and 60 meters the nest survival rate was lowest (20.50 %.) due to presence of lowest moisture content in beach sands resulted in poor hatching success. In view of above findings the Godavari River mouth is considered to be as potential “reproductive patch” to olive ridley turtle after Gahirmatha and Rishikulya nesting beaches on east coast of India. Thus the nesting beaches are recommended for protection as a "sea turtle rookery” by the A.P.Forest Department for conservation of nesting habitats and foraging grounds of olive ridley turtles.

EFFECTS OF INUNDATION ON HATCH SUCCESS OF LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) NESTS*

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Inundation of sea turtle nests typically results in decreased hatching success with repeatedly flooded nests being affected most severely. While nests can tolerate some inundation, it is unclear how the frequency and water level within the egg chamber influences hatching success as embryonic development progresses. Piezometers were installed to determine water levels within the egg chambers over periods ranging from eight to twelve hours. Hatching success was determined by excavating nests and determining the relative proportion of hatched to unhatched eggs. For unhatched eggs, we reported the embryonic stage at which development ceased. In 2012, two tropical storms, Debby and Isaac, severely impacted the hatching success of nearly all the nests on Keewaydin Island. Debby washed away 50.7% of the nests and inundated 98.5% of the remaining nests. Isaac washed away 25.9% of the nests and inundated 79.1% of the remaining nests. Nests were inundated up to 66 cm, which filled the entire egg chamber with water. Debby inundated nests for up to four consecutive days while Isaac flooded some nests for up to 24 h. In the nests impacted by Debby, all the embryos stopped developing at the time the storm hit. These nests had a mean hatching success of 3.63%, while nests inundated by Isaac had a mean hatching success of 67.6%. Nests not inundated by either storm had a mean hatching success of 85.8%. Data from several nests provided insight into how inundation impacts hatching success. Nests 107 and 110 were laid < 5 days before the waves and high tides caused by Debby became evident. In these nests, 100% of the eggs appeared to be undifferentiated; however, it is likely that the eggs stopped developing before the embryos were visible. Nest 53, laid 19 days before Debby arrived, had a hatching success of 16.2%. This nest was completely inundated for approximately 12 hours two days after being laid and intermittently inundated again for up to four days during Debby. Half of the eggs (54.7%) survived the initial inundations but stopped developing later, possibly during Debby. Thirty-three days after it was laid, nest 151 was inundated for approximately 24 h by Isaac. This nest continued to develop and had a hatching success of 92.2%. An additional nest (142) that was not inundated until Isaac passed by, was flooded for less than 12 h two days later. The dead embryos found in this nest stopped developing around the time of the second inundation. The hatching success was 58.1%, which suggested that the second inundation, which filled the bottom 8.3 cm of an egg chamber with a total depth of 17.8 cm, was responsible for the cessation of development for the bottom half of this clutch. Nests not over-washed by tides may still be flooded by tidally induced fluctuations in the water table. Consequently, nests deposited closer to the shore or in swales are more subject to flooding by interstitial water and may therefore have lower hatching success. Acknowledgments: This research would not have been possible without the support of the Conservancy of Southwest Florida, countless hours of piezometer checking by Sarah Moss, Matt Ramirez, and Jamie Fisher, and travel grants from the International Sea Turtle Symposium and Dr. David Die.

DARKER BEACHES, BRIGHTER FUTURE: REDUCING THE IMPACTS OF ARTIFICIAL LIGHTING ON SEA TURTLE NESTING BEACHES

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Each year in Florida tens of thousands of sea turtle hatchlings are disoriented by poorly managed beachfront lights. To address this problem, Sea Turtle Conservancy (STC) applied for and received grant funding to implement a program that increased sea turtle hatchling survivorship on Florida's high-density nesting beaches by correcting problematic lights on private properties with histories of causing sea turtle disorientations. Working with state and local agencies and local turtle monitoring groups, STC identified numerous properties with problematic lights. STC staff, skilled in sea turtle lighting criteria, designed cost-effective lighting plans tailored to each site, which met the safety needs of property owners while ensuring sea turtle lighting compliance. The latest technologies in "sea turtle friendly" lighting were used to effectively reduce and manage exterior lighting at over 60 multi-family properties and businesses, which effectively darkened approximately 7 miles of prime sea turtle nesting habitat. Monitoring of nesting at project sites following lighting retrofits showed significant decreases in sea turtle disorientations, resulting in the safe emergence of thousands of hatchlings each year that otherwise would have been disoriented by lights. Furthermore, STC has documented significant energy cost savings for property owners that converted to using turtle-friendly LED lighting. This project has proven that turtle-friendly lighting can effectively reduce hatchling disorientations and save thousands of newborn sea turtles each year. These results, combined with the financial benefits associated with using energy-efficient LEDs, make this project replicable in other coastal communities where poorly managed artificial lighting degrades nesting habitat.

EVALUATION OF SEX RATIOS OF THE OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) AT AN ARRIBADA NESTING BEACH IN MEXICO: SECOND YEAR FOLLOW-UP

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The olive ridley sea turtle (*L. olivacea*) is the most abundant sea turtle species nesting in Mexico. Although most populations are in recovery, in Mexico the species is still classified as endangered. Despite having a protection status, *L. olivacea* is still potentially exposed to environmental stressors such as climate change. The olive ridley, like all sea turtles, displays temperature-dependent sex determination (TSD), which makes them particularly sensitive to environmental changes. Taking into account the increase in global temperature reported during the last decades and the predicted rapid climate change in the next century, there is an increasing concern about the possible impact of global warming in species with TSD in which climate change may result in a strong sex ratio bias that could affect population dynamics. However and despite this concern, there is little empirical evidence of direct temperature effects on sea turtle sex ratios in nesting beaches in Mexico. La Escobilla is an arribada nesting beach located in the Pacific Coast of Mexico with more than 200,000 nests per year. In an attempt to assess the impact of climate change in sex ratios, we have been conducting a study on this nesting beach since 2010, being this our second report. Samples were obtained from overlapping arribadas during two hatching seasons from 2010 to 2012: summer-fall

(September-November) and winter (January-March), and processed by histology with hematoxylin-eosin staining for sex identification. Main sexing criteria were based on the thickness of the surface epithelium (cortex in females) and development (in males) or fragmentation (in females) of medullar cords. We estimated sand temperatures from air temperature records from the closest beach of Puerto Ángel located 25 km (15.5 miles) from La Escobilla for every sample period. No bias sex ratio (significantly different from 50%) was observed during the 2010-2011 season (which presented a Niña event), whereas sex ratios were female-biased (75% females) during the 2011-2012 season. This trend was observed in all sampled months except February 2012, in which sex ratios were 29% males. Consistent with sex ratios data, sand temperature estimations showed an increment of 0.69°C from summer-fall 2010-2011 to summer-fall 2011-2012, and 0.91°C from winter 2011 to winter 2012. The temperature increment for the whole nesting season was 0.8°C. This is a second year study, samples for the 2012-2013 nesting season are underway, and we plan to continue to sample over several years to collect sufficient data to estimate the real impact of climatic events. So far our results show how subtle temperature changes affect sex ratios in this species, highlighting the vulnerability of sea turtle populations to the contemporary climate change. I would like to thank the International Sea Turtle Symposium for the travel Grant awarded and all the sponsors who made it possible: International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America.

OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) EMBRYO DEVELOPMENT AS A FUNCTION OF BEACH ZONES AND AN ASSESSMENT OF A METHODOLOGY TO DETERMINE EMBRYO DEVELOPMENT

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Ostional beach in northwestern Costa Rica is an arribada rookery that exhibits mass nesting events (arribadas) of up to 500,000 nesting females over a period of one week. Despite the large population, there is concern that the population may not be able to sustain itself due to the low hatching success of ~8%. Although beach zone (distance from the high tide to vegetation line) as well as the proximity of the nest to an estuary are hypothesized to affect hatching success rates, these possible effects have not yet been quantified. The purpose of this study was to compare embryo development across different areas of the beach and to assess the accuracy of current methods which determine embryo development. We analyzed embryo development in clutches laid during the June 2012 arribada. All clutches were exhumed after 55 days from oviposition. Clutches were selected for analysis using quadrat sampling within the section of the beach with the highest concentration of nesting females during the arribada. Ninety 1x1 meter quadrats were randomly placed within four distinct areas of the beach: the high zone of the beach near an estuary, the high zone near the vegetation and away from the estuary, the middle zone near the estuary, and the middle zone away from the estuary. Each quadrat was dug out to a depth of 50cm and the nests laid during the arribada located within the selected quadrats were counted. Eggs laid during the arribada were counted and weighed on a digital scale. Unhatched eggs and embryos were weighed. When possible, embryo development was categorized into four stages: 0= no apparent development; I= embryo occupies 1-25% egg; II= embryo occupies 26-50% egg; III= embryo occupies 51-75% egg; IV= embryo occupies 76-100% egg. We analyzed four clutches of eggs, which contained a total of 324 eggs. Forty nine percent of all eggs exhibited no discernible embryo development. Twenty one percent had a mean embryo mass 0.53g (±0.36), 13% had a mean mass 2.45g (±0.97), and 0.62% had a mean mass of 5.12g (±0.87). Excluded from this data are 56 eggs that were too degraded to determine embryo development. In the clutches deposited in close proximity to the estuary, the maximum embryo development was Stage III, whereas the clutches deposited further from the estuary reached only Stage II development. In clutches deposited away from the estuary, those located in the high zone near the vegetation only reached Stage I, while those located in the middle zone reached Stage II. These preliminary data suggest that studying differential hatchling success rates among different beach zones is an area that deserves further investigation. Our results also show that embryos categorized into earlier development stages weigh less than those in later development stages. Thus, categorizing embryos into development stages could be a useful tool in determining hatchling success rates and embryo development. However, the high standard deviations in the embryo weights within the defined development stages indicate that the methodology may need improvement.

BEACH AND NEST TEMPERATURES, AND ESTIMATES OF LEATHERBACK HATCHLING SEX RATIOS AT BIRD'S HEAD PENINSULA, PAPUA, INDONESIA

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Sex determination and hatching success in sea turtles is temperature dependent. Warmer sand temperatures may skew sea turtle population sex ratios towards predominantly females and high sand temperatures may also decrease hatching success. Therefore, understanding beach and nest temperatures is important for conservation programs, including the evaluation of the long-term impact of temperature changes. We recorded sand temperatures during the boreal and austral summer nesting seasons for eight years (2005 to 2012) to estimate sex ratios and evaluate hatching success at the two primary nesting beaches for the western Pacific leatherback (both located on Bird's Head Peninsula, Papua, Indonesia). We also measured rainfall, sand albedo, and sand particle size at both beaches during the main nesting months in 2009-2010. During the boreal summers (2005-2012), the daily average sand temperatures at nest depth (80cm) ranged from 26.4 to 34.9^{o}C. During the austral summers, sand temperatures ranged from 27.2 to 33.0^{o}C. Typically, the average monthly temperatures at nest depth were relatively warm suggesting the production of female-biased sex ratios. Furthermore, average monthly temperatures were very high during certain months, potentially lowering hatching success. Location, sand color, and vegetation affected sand temperature throughout the boreal and austral summer nesting seasons; the lower-open beach sections with dark grey sand were significantly warmer (0.5-3^{o}C) than the white sandy beach and the upper beach section adjacent to the vegetation. Rainfall occurs throughout the year at Bird's Head and had a significant episodic effect resulting in decreasing sand and nest temperatures. The size distribution of sand particles was similar among beaches with predominantly small particle size (500um or less). Thermal absorbance varied between beaches, with the highest absorbance occurring on beaches with darker sand (Wembrak of Jamursba Medi and Wermon). Nest temperatures were positively correlated with beach temperatures and increased up to 2.9^{o}C above sand temperatures during the later part of incubation due to metabolic heating. Histological examination of dead hatchlings from the boreal and austral summer nesting seasons in 2009-2010 produced a female-biased sex ratio. This finding is consistent with the relatively warm thermal profiles of the majority of the nesting beaches. This also included some extremely warm sand temperatures that were associated with lower hatching success. However, certain areas of the nesting beaches (the white sandy areas and also some vegetated areas in the upper zones of the dark grey beach) were relatively cool, resulting in high hatching success potentially producing both male and female hatchlings. Information from this study provides a foundation for developing conservation strategies for enhancing hatchling production with optimal sex ratios at the most important nesting beaches for the western Pacific leatherbacks. Further, this information represents the initiation of a long-term database that can be used at a local level to develop strategies that could potentially offset the impact of long-term climate change on the Pacific leatherback turtle.

REPRODUCTIVE CHARACTERISTICS OF GREEN TURTLES, *CHELONIA MYDAS*, IN TORTUGUERO, COSTA RICA

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Tortuguero, located on the northern Caribbean coast of Costa Rica, has the largest nesting population of green turtles (*Chelonia mydas*) in the Western Hemisphere. The Sea Turtle Conservancy (STC) is responsible for conducting an on-going long-term sea turtle monitoring and conservation program at the site. This research provides scientific information needed to characterize reproductive aspects of the green turtle. The goals of this study were to evaluate various characteristics of green turtle reproductive biology, specifically to determine if female size is correlated to either clutch size or hatching success. The data was collected during the STC's annual Green Turtle Program between June-October of 2010–2012. During the nesting seasons of 2010, 2011 and 2012, 125, 93 and ~70 nests were marked, respectively, with a total of ~288 nests for three seasons. This study showed that 66.4% and 68.3% (2010 & 2011, respectively) of sea turtles whose nests were marked were newly tagged females, the remaining were previously tagged individuals. The majority of nests were located in the 'border' zone (areas with partial shading), reflecting the nest site selection preference of green turtles. The average clutch size in 2010 was 110.8 eggs (33-167), and 116.7 eggs (65-173) in 2011. The 2012 nesting season is still in progress and data are not available yet. We will present the results from 2010–2012, including female size, hatching success and any significant differences detected between years.

ON-GOING RECOVERY OF THE HAWKSBILL TURTLE POPULATION BREEDING AT MONA ISLAND, PUERTO RICO

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Surveys of the nesting beaches at Mona Island, Puerto Rico, show a continued expansion of the hawksbill population breeding on the island, the largest nesting colony under U.S. jusrisdiction. For 2012, ongoing beach patrols indicate that a record numbers of hawksbill nests will be deposited by the close of the monitoring period in early December. Data on total surveyed nest numbers, false crawl activity, nest loss due to beach erosion, nest density, hatching success and other nest parameters are also presented. Population recovery trends spanning three decades are presented and placed in the context of local and international conservation efforts. Mona Island is an uninhabited island managed as a Natural Reserve by the Puerto Rico Department of Natural and Environmental Resources. Located in the Mona Passage midway between the Dominican Republic and Puerto Rico, this limestone island has approximately 7.2 km of sandy beaches located along its southern coast. In 2012, daytime beach surveys were conducted on the island from mid July until early December. As a subset of the beach monitoring, a nesting activity index was established in 2003, which consists of daily morning surveys of turtle nesting activity on a subset of beaches along the southwest coast during the months of September and October.

ACOUSTIC COMMUNICATION DURING *LEPIDOCHELYS OLIVACEA* ARRIBADA

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Social behavior has been described for a wide range of animals and can be attributed to a series of mechanisms which act as a defense from predators to the dilution effect of numbers. There are few descriptions of social behavior in turtles; gregarious nesting behavior has been noted in a few species such as *Chelonia mydas*, *Lepidochelys olivacea*, *Lepidochelys kempi*, *Podocnemis expansa* and *Carettochelys insculpta*. However the mechanism that these animals utilize to maintain these groups and to stimulate simultaneous group behavior during nesting is unknown. There are a number of hypotheses that attempt to describe the behavior of *Lepidochelys olivacea* during arribadas, such as moon phase, meteorological factors, water temperature and olfaction. With the recent discovery that freshwater turtles, in particular *Podocnemis expansa* and *Chelodina oblonga* are vocally communicating both on land and underwater, we attempted to document the vocalizations of *Lepidochelys olivacea* emitted during nesting. The study was conducted at Escobilla Beach, Oaxaca, México, during an arribada of about 600 turtles. We were able to record one female *Lepidochelys olivacea* as she covered her nest and returned to the sea. From the recording we identified 56 sounds, which, based on their aural and spectral characteristics, we classified into four sound types. The mean peak frequency of the sounds recorded was 6180.42 Hz (281.2- 10593.8). Even though the data from this study are preliminary, we believe that the use of sound during the nesting period is highly appropriate for turtles since these animals live in vast places with low visibility and the propagation of underwater sound is an excellent media for long distance communication. Now that we have verified that these marine turtles are vocalizing, we hope that this will stimulate more people to learn more about this behavior and document whether vocalizations underwater are used to stimulate arribada formation and emergence onto nesting beaches.

GREEN TURTLES NESTING ON ARUBA 2001-2012

Edith van der Wal, Sietske van der Wal, and Richard van der Wal

Turtugaruba Foundation, Aruba

Nesting of *Chelonia mydas* was thought to be extremely rare or non-existent in Aruba for many years. However, green turtle nesting activity has been spotted and confirmed since 2001. A monitoring program was initiated which consists of early morning patrols, *in situ* nest protection and post-emergence excavation. Over 10 years of data from this monitoring project are presented. Twenty different beaches were visited at least once by a green turtle over the last 12 years. One beach, “Dos Playa Grandi”, contributed 61 out of a total of 340 green turtle emergences. The average number of *Chelonia mydas* nests on Aruba over the last 5 years (2008-2012) is 35.2 nests/yr (19-45), with an average of 79.5% hatching success. The nesting habitat of *Chelonia mydas* is vulnerable to three major threats: remote artificial lights, off road driving and beach pollution, and obstruction by marine debris. Although Turtugaruba is unable to resolve all of these threats at their source, they can be mitigated and nests can be protected one nest at a time. Acknowledgements:

The authors thank the Turtugaruba volunteers for help with the monitoring and nest protection during the survey period. Participation at this symposium is co-funded by a travel grant from the generous ISTS sponsors.

GREEN TURTLE NESTING ACTIVITY AT JUANI ISLAND, TANZANIA, DURING THE 2012 PEAK NESTING SEASON

Lindsey West, Boniventure Mchomvu, and Omari Abdallah

Sea Sense, Dar es Salaam, Tanzania

Juani Island is a small island (9 km long and 3.5 km wide) located in the south eastern corner of Mafia Island Marine Park off the coast of Tanzania. There are eight sea turtle nesting beaches on the eastern side of Juani Island that support the largest green turtle (*Chelonia mydas*) rookery in Tanzania. In 2012, the first saturation flipper tagging programme was undertaken during the peak nesting months of April and May. Foot patrols were conducted every night between 19:00 and 06:00 hours on four beaches where most nesting is concentrated. Each female turtle encountered was measured (curved carapace length and width) and examined for the presence of existing tags. If not already tagged, individually numbered titanium tags (TZ series) were applied. Sixty nesting attempts were recorded, 50 (83%) of which were successful. Eighteen individual females nested during the survey period. Females were encountered during 46 (92%) of the nesting events. Six females that did not nest successfully were also encountered. Curved carapace lenghts ranged from 101–118cm with a mean of 107.2 SD± 4.7 cm (n = 18). Curved carapace widths ranged from 90–113cm with a mean of 99.7 SD± 4.8 cm. Three of the females had been tagged in previous years. One was first tagged in 2006 and was observed again in 2009 then again during this survey. The second female was tagged in 2006 and the third was tagged in 2009. Half of the nesting females encountered (n = 9) nested at least three times during the survey period; two females nested at least five times. Inter-nesting intervals ranged from 9 to 20 days (n = 31) with a mean of 13.2 SD± 2.3 days. The observed clutch frequency (OCF) value was 2.5 SD± 1.2 (calculated for each turtle encountered nesting at least once within the survey period). Of the nine individuals nesting at least three times, five used the same beach for each clutch. Three females used two different beaches and one individual used three different beaches. The mean clutch size was 134 SD± 14 eggs. Hatching success was 71%. Prior to the saturation flipper tagging programme in 2012, estimates of the number of green turtles nesting in Juani Island had been calculated using track counts from daily patrols and breeding frequencies quoted in published literature. While track counts are a very useful method of estimating nesting population size, detailed observation of nesting behaviour was essential to begin to build a more accurate and nuanced picture. The survey not only provided accurate information on nest numbers and the number of individual females, but also the first data on clutch frequencies and inter-nesting intervals for any turtle population nesting in Tanzania. Funding for a repeat saturation tagging programme in 2013 has already been secured. Efforts will be made to secure additional funding for future years to build understanding of remigration intervals, which can provide crucial information on recruitment, longevity and survivorship within the population.

GREEN TURTLE (*CHELONIA MYDAS*) NESTING ON AKYATAN BEACH: RESULTS OF SIX YEARS SURVEY

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Akyatan beach, Turkey is the most important green turtle nesting site in the Mediterranean. The beach is 22 km in length and monitored everyday on foot between 1 June to 15 September between 2006-2011. During these periods, nest and non-nesting emergences were determined and nests were excavated after the hatchling emergence was complete. The contents of each nest were recorded. The hatching success, the number of hatchlings reaching the sea and the incubation duration for each nest were calculated. We recorded a total of 5879 emergences with 2171 (37%) resulting in *C. mydas* nests during 6 consecutive years with a mean of 362 nests per year. The mean nesting density was 16 nests km-1. Of the overall *C. mydas* nests on Akyatan beach, 1348 (62%) were excavated and 151976 eggs were counted. Of these eggs 116309 (76.5%) hatchlings had come out and 88673 (76%) of them were able to reach the sea. There were strong annual fluctuations in the number of nests ranging from 170 (in 2007) to 562 (in 2006). Six years of nest numbers showed a slightly decreasing but statistically insignificant trend ($r = -0.34$, $p>0.05$).
Acknowledgments: This study was carried out with a cooperative protocol between WWF-Turkey and the Ministry of Waters and Forestry. The authors would like to thank the volunteers.

HATCHING AND EMERGENCE SUCCESS OF GREEN TURTLE (*CHELONIA MYDAS*) IN THE GALAPAGOS ISLANDS*

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In sea turtles, the interaction of numerous abiotic and biotic factors experienced by eggs during incubation affects embryonic survival. In this study, we determine hatching and emergence success of green turtle nests and evaluate the effects of site, year, day of oviposition, carapace length and width of female, nest position and nest habitat, chamber depth and depredation. We compare the relative success of key nesting beaches on the Galapagos Islands, one of the most important rookeries for the green turtle *Chelonia mydas* in the Eastern Pacific Ocean. To evaluate the extent to which parameters affected hatching and emergence success, a binomial generalized additive model (GAM) with fixed effects was used. We found variation in hatching and emergence success to be significant among years and beaches, with the day of oviposition and with nest habitat. Mean hatching and emergence success (S.D.) for the 1039 nests examined was 46.0%(33.4) and 45.6% (33.4), respectively. These values are relatively low compared to other green turtle populations. Nest predation by feral pigs and beetles and nest destruction by turtle digging were the most important causes of embryo mortality. Results from our study will be useful for managers in the Galapagos National Park Service when formulating management strategies to protect green turtle critical habitats.

Other

ARCHELON VOLUNTEERS: AN ARMY OF HOPE

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ARCHELON, a nation-wide non-profit organisation working for the protection of sea turtles and their habitats in Greece, conducts sea turtle projects since its foundation in 1983. Several nesting areas were discovered in the course of ARCHELON projects, and the most important of these are now included in its annual mandate. As years passed by and data were accumulated, the core areas of these sites were well defined and today ARCHELON concentrates its work in seven high nesting-density areas, totaling 54 km. Further, ARCHELON operates a Rescue Centre for rehabilitation of injured turtles and for environmental education activities, as well as an in-water tagging project in Amvrakikos Gulf. Field work differs from area to area depending on the threats that adult turtles, eggs and hatchlings face. The daily work runs from end of May until the middle of October and in general it includes the location, protection and post-hatch excavation of nests, tagging at night, and public awareness activities in the form of information kiosks and slide shows in local hotels. In some areas, field work is very demanding, e.g., in Kyparissia Bay all nests (average 709 in the last 6 years) should be fenced against predators, and the fences should be checked and maintained everyday! Further, there are several data sheets to be filled and entered in databases. In total, during a nesting season an average of 2,350 nests are protected and monitored until hatching, 345 nesting turtles are tagged or checked for old tags, and about 170,000 hatchlings enter safely the sea. Volunteers of diverse skills and backgrounds are welcome in ARCHELON projects; everybody can find his/her position in a wholehearted team working for a common objective. ARCHELON provides to its volunteers very little in material things: a campsite with basic facilities, including gas stoves, cooking utensils and makeshift toilets and showers. The camp is set by the volunteers themselves, who under a well-built team spirit organize their everyday life depending on the particularities of each project. On the other hand, volunteers get the opportunity to work in nature, to materialize their environmental ideas and dreams, and to build up the virtues of responsibility, of endurance, of persistence and of tolerance; all very important for their future careers. Moreover, these multinational teams create a sensation to local communities. Local people start to wonder what has brought these enthusiasts from far-away countries to this particular site and as a result they soon begin to consider sea turtles an important local asset. Volunteers with their dedicated work and selfless camaraderie help a lot to pass this notion to the local community. With their tangible example they promote a more humane model of development which gradually influences local attitudes.

THE PROTECTOR – GHI - SIMS PARTNERSHIP: A MULTIDISCIPLINARY APPROACH; SAVING TURTLES, HELPING PEOPLE

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A secondary goal of sea turtle conservation is the development of programs within communities which will introduce economic and educational benefits as alternatives to the consumptive use of sea turtle species. Such programs may introduce ecotourism and handicraft development as means of persistent economic income for members within the community. While economic stimulation is an important factor in assisting conservation efforts in developing nations, there is great need for other forms of direct community assistance. The ProTECTOR – GHI – SIMS partnership is unique in the field of wildlife conservation in that it approaches sea turtle conservation and community assistance from a multidisciplinary perspective. The partnership takes into consideration the whole person, the environment, and the rich natural resources of the local community and region in a manner that develops a stewardship framework. This approach rests on the concept of holistic care, which is concerned with caring for the integrated health and welfare of both the environment and the person. Supported by the Global Health Institute at Loma Linda University, the first ProTECTOR – GHI – SIMS volunteer project took place from August 19 – 29, 2012 in the community of El Venado, in the Golf of Fonseca, Honduras. The volunteer group accomplished medical, dental, and nutrition education outreach, as well as health screening and treatment. Furthermore, the partnership has provided funding and logistical support for the installation of a much-needed water catchment system to facilitate running water for visitors to the turtle center. These first steps in meeting health, social, and development needs of the community were accomplished with a unique, multidisciplinary approach, all within the context of sea turtle research and conservation undertaken by ProTECTOR working together with the community of El Venado.

GRASSROOTS VOLUNTEERING OFFERS GREATER OPPORTUNITY TO MAKE CONSERVATION IMPACT FOR SEA TURTLES IN CHINA

Laura Gross and Frederick Yeh

Sea Turtles 911, Hainan, China

China is rarely the first country prospective volunteers consider during the quest for the ideal sea turtle volunteer opportunity. However, their contribution to sea turtle conservation is perhaps amplified on Hainan Island, where nesting populations are extinct and the illegal sea turtle trade is thriving. Volunteers for the only sea turtle NGO operating in China get experiences unlike any others in the world, and assist in many aspects of conservation, including rescue, rehabilitation, research, education, and ecotourism. In the floating fishing village of Xincun, a central waypoint for sea turtles held illegally for the Chinese market, sea turtle rehabilitation and research is based on the floating sea turtle hospital: a classic Chinese fishing home and deck, with free-flowing ocean water netted enclosures, floating in Xincun Bay. Volunteers assist in a unique rehabilitation setting where most green and hawksbill sea turtle patients were raised in captivity from hatchlings by local poachers, neighbors to the sea turtle hospital. These circumstances result in illnesses and injuries that generally differ from those seen at traditional sea turtle hospitals, whose main patient core is composed of stranded or wild caught turtles. Volunteers also maintain good relations with fishermen and poachers, working hard to encourage an environment of sea turtle respect and camaraderie through education and community building. Upon release of rehabilitated patients, volunteers contribute to sea turtle research by assisting in the application of metal flipper and PIT tags, only recently starting to be used in the waters of southern China, and by collecting tissue samples for DNA testing. Volunteers also lead children's educational programs at partner resorts, and are an integral part of extending conservation knowledge to the tourists that visit Hainan, many of which would otherwise readily seek out sea turtle meat and products. Volunteers are integral to any good conservation program, and those that choose to volunteer on Hainan Island have become a vital life-force to the survival of sea turtles in China.

VOLUNTEER PROGRAMS OF THE GEORGIA SEA TURTLE CENTER

Jeannie Miller Martin and Caitlin Sampson

Georgia Sea Turtle Center, Jekyll Island, Georgia, USA

The Georgia Sea Turtle Center (GSTC) is a hospital for ill and injured sea turtles located on Jekyll Island, Georgia. It is the only sea turtle facility in the state of Georgia. The facility is open to the general public with an interactive Exhibit Gallery and Rehabilitation Pavilion with viewable turtle patients. The center also focuses on environmental education and research in the fields of ecology and wildlife health. Volunteers help in every aspect of our conservation organization including our Education, Gift Shop, Husbandry and Research departments. Education volunteers devote their time to interpretation within our gallery, pavilion, assist with groups and attend outreach events. Education volunteers also play a large role in night time Turtle Walks and Nest Walks. Gift Shop volunteers dedicate their time to answering phone calls and questions, providing customer service and organizing merchandise. Volunteers working in our Husbandry department assist with food preparation, water changes, patient treatments and all aspects of the daily maintenance of our rehabilitation pavilion. The GSTC collaborates with the St. Kitts Sea Turtle Monitoring Network by allowing volunteers to travel to St. Kitts during leatherback nesting season and help with their monitoring and tagging program. GSTC Volunteer Gary Buckles won the International Sea Turtle Society's Ed Drane Award in 2011 for his dedication to the research and rehabilitation departments of the GSTC as well as his participation in international opportunities. Gary Buckles has spent two or more months in St. Kitts collaborating with their program for the last five years on behalf of the GSTC, while spending the rest of the year volunteering with the center in Georgia. Our citizen science volunteer endeavors include our Marine Debris Initiative and our endangered shorebird nesting patrol. Research volunteers help monitor human impacts and lighting on Jekyll Island's nesting beaches. These volunteers patrol the beach by foot during the nesting season, monitoring lighting from buildings while educating the public and handing out red cellophane to cover flashlights that may disturb nesting females. As the nesting season comes to an end, human impact Volunteers transition into a nest monitoring role so as to prevent sea turtle hatchlings from becoming misoriented or disoriented due to lighting and to mitigate their interactions with public beachgoers. Research volunteers also have opportunities to advance towards working with our sea turtle nesting patrol after dedicating a season to our Human Impacts Team. The GSTC has over 100 active volunteers that have dedicated over 28,000 hours in the five years the center has been open.

DISMANTLING OLD WALLS AND BUILDING NEW BRIDGES: SEA TURTLE ADVOCACY IN THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS, WESTERN PACIFIC

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In these challenging economic times, government agencies are encouraged to pursue creative means by which to get the job done with limited funds and staff. One of the means that has allowed many sea turtle programs to survive and thrive throughout the years has been through the assistance of volunteer organizations. Volunteerism is old concept in many regions; however, in the Commonwealth of the Northern Mariana Islands (CNMI) it is one which has only recently been adopted. In 2009, the CNMI Department of Lands and Natural Resources (DLNR) Division of Fish and Wildlife (DFW) Sea Turtle Program (STP) experienced the resignation of two full-time staff members and needed to find a way to fulfill project goals and objectives with half the staff. Although sea turtles are protected by federal and local laws in the CNMI, illegal hunting still occurs at unknown levels. In the past, the poaching problem fueled the hesitation for volunteers to be utilized by the DLNR-DFW STP; staff perceptions were such that to protect turtle's lives there must be absolute confidentiality in disclosing nearshore survey and beach nesting locations. This trepidation also hindered other outreach efforts such as providing sea turtle data in local media or mentioning research locations in classroom presentations. As a result, little to no information was shared resulting in feelings of disconnection, lack of ownership, and misconceptions between the community and their sea turtle natural resources. Our goal was two-fold, to engage the community in volunteer activities which would allow DLNR-DFW STP to continue their research by filling staffing gaps and more importantly, to open up the lines of communication to allow community connections with and informed conversations about their sea turtle population. We solicited volunteer assistance from several venues including non-profit organizations, college and high school groups, local dive guides, the general public, and sometimes even family members. Opportunistic volunteer solicitations occur during classroom presentations, community workshops, conversations with fellow scientists, or beach patrols. While a more permanent volunteer pool was founded in 2010 by the Turtle Advocate and Guardian Society (TAGS), a non-profit organization whose mission is to help protect endangered sea turtles and their nesting sites as well as help educate the public about the current state of sea turtle populations in the CNMI. Since the inception of TAGS, the DLNR-DFW STP staff has worked closely with the non-profit to coordinate efforts in projects such as beach clean-ups, volunteer training workshops, and camera monitoring of nests. TAGS has also provided DLNR-DFW STP permitted staff volunteer assistance during nearshore surveys, morning nesting beach surveys, night tagging surveys, and nest inventories. Thanks, in part, to the DLNR-DFW

STP's many volunteers we have been able to not only continue but enhance our research, monitoring, and education outreach efforts within the CNMI community.

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900 HOURS ON NESTING BEACHES: PROTECTOR VOLUNTEER EFFORTS IN HONDURAS

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The work of volunteers in sea turtle conservation is indispensable, whether their contribution is over the short or long term. Participants working with ProTECTOR aid in a variety of research projects throughout the country of Honduras. During July - November 2012, five individuals donated their time to assisting graduate students and professors through the ProTECTOR Volunteer Program. Three of these worked in Honduras for only a few weeks, while two served as interns for up to five months. Although some volunteers were undergraduates or recent graduates in biology, others were individuals with professional careers in areas outside the realm of science. Volunteers worked at the Cuero y Salado Wildlife Refuge, on the Bay Island of Utila, and in the communities of Punta Ratón and El Venado, on the Pacific coast of Honduras. In all, volunteers assisted in patrolling beaches for nesting females, tagging adult turtles, monitoring nests, and collecting hatchling data. A related project involved profiling the terrain, slope, vegetation, and pollution cover of nesting beaches in Cuero y Salado and Utila. Altogether, volunteers spent over 180 man-hours working in Cuero y Salado, over 500 hours in Utila, over 150 hours at Punta Ratón, and over 40 hours in El Venado for a total effort of over 900 hours. While working alongside professionals in the field of biology, individuals gained hands-on experience in the roles and duties of sea turtle biologists. ProTECTOR Volunteers provide assistance to each researcher that might otherwise be unavailable at a study site in Honduras. Furthermore, citizen scientists like these continue to help educate people in both the United States and Honduras about the importance of sea turtles, as well as the conservation and research efforts of ProTECTOR, through both word of mouth and social media platforms.

COMMUNITY-BASED SEA TURTLE CONSERVATION IN NORTH QUEENSLAND

Julie Traweek

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North Queensland, has six of the world's seven sea turtle species, with greens, flatbacks, and hawksbills being most abundant. North Queensland also has one of the fastest-growing populations in Australia and one of the highest rates of coastal development. Sea turtles are being affected by water quality, development of nesting beaches, predation by introduced feral pest species, and extreme weather events like cyclones. In 2011, over 1800 green turtles were reported dead or stranded on Queensland coasts. Sea

Turtle Foundation works in partnership with multiple community groups, government agencies, university researchers, and individual volunteers to mitigate the effects of these issues on sea turtle populations. Our volunteers are part of a Sea Turtle Stranding Response Team, which assists state park rangers in responding to stranding calls when we have high stranding rates. We work collaboratively with conservation groups such as the Magnetic Island Network for Turtles, James Cook University, Cairns Turtle Rehabilitation Centre, and Reef HQ's Turtle Hospital to rehabilitate turtles. In Bowen, Queensland, where there is a high rate of fibropapilloma in the green turtle population, groups including STF, James Cook University, Gudjuda and Girringun Traditional Owners, Queens Beach Action Group, and WWF are working together to monitor turtle health and gather data to research the disease. Our volunteers also conduct beach clean-ups and send our marine debris data to Tangaroa Blue, who keep a national marine debris database and work to find solutions with manufacturers and retailers before their products end up in the ocean. In addition, STF works with Reef Guardian schools to educate students about sea turtles and train them to know what to do with a stranded turtle. Thanks to the efforts of all these groups working together, we have seen an increase in the general public's knowledge about sea turtles and the threats facing them. A particular challenge for north Queensland is that we do have so much remote beach that is difficult to patrol without expensive flyovers; these collaborations between community groups and efforts from our volunteers are making a real difference in spreading the word about sea turtles and what we can all do to protect them.

Population Biology and Monitoring

ASSESSMENT OF SEX RATIO AND REPRODUCTIVE STATUS OF A FORAGING GREEN TURTLE POPULATION IN SAN DIEGO BAY, CALIFORNIA

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There has been increased interest in demographic modeling of marine turtle populations to provide context about conservation priorities. Though, such studies are commonly limited by lack of information on key demographic parameters of most populations. Few research projects have examined the population sex ratio or reproductive status of adult turtles at foraging grounds, particularly males, as the majority of studies examining turtle reproduction occur at the nesting beach where females are easy to access. The green sea turtle (*Chelonia mydas*) nesting populations in Pacific Mexico are considered Endangered under the U.S. Endangered Species Act and IUCN Red List. The San Diego Bay (SDB) is home to a foraging population of adult and juvenile green turtles that are believed to be primarily of Mexican stock origin. However, population sex ratio and reproductive state of adult turtles have not been examined and this information could be influential for the management of this local foraging aggregation in a broad regional context. In the early 90s, Dutton and colleagues used a previously published technique to determine the sex ratio of the SDB green turtle population through quantifying the testosterone concentration in blood serum and used adults of known sex (identified through physical characteristics, i.e. tail length) as the controls. A 6:10 male to female sex ratio was found for the 1990-1993 field seasons. Following up on this research, we utilized a commercially available enzyme immunoassay to quantify the population sex ratio through analysis of testosterone concentration of archived serum samples obtained during field seasons since 1993, many of which have physical confirmations of sex in more recent capture years. In addition, we compared the sex ratio of the SDB green turtles to those known for other foraging populations in the Pacific. We also incorporated information on adult reproductive status through ultrasound of gonads and body fat (body condition), female cloacal cytology, male plastron softness, and confirmation of spermatozoa presence in urine (from opportunistic collection). The reproductive assessments provide a more holistic approach to assessing reproductive ecology of the SDB green turtle foraging aggregation and establishes a convenient tool for the rapid assessment of sex ratios.

AN EFFECTIVE AND SAFE TECHNIQUE TO PIT TAG HATCHLING GREEN TURTLES CAPTIVE BRED AT SEA LIFE PARK HAWAII

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An effective, safe, and humane technique has been developed, evaluated, approved, and utilized to microchip hatchling green turtles born and released into the wild by Sea Life Park Hawaii. Since 1976, Sea Life Park has released over 13,000 hatchling Hawaiian-stock green turtles as a conservation and research effort secondary to the Park's principal objective of educational outreach focused on their captive breeding display lagoon and nesting beach. From 2010-2012, 866 hatchlings born at Sea Life Park have been PIT tagged with the Destron Sterilized TX1460L 11 x 2 mm microchip, using the one-time use applicator system. Fifteen hatchlings each year have been retained for captive rearing comparative evaluation of health, growth rates, tag retention, and any movement of the microchip as shown through x-ray imaging. Turtles have been reared up to 40 cm for 2.5 years with no negative effects. PIT tags are inserted into soft proximal tissue of the dorsal left hind flipper after injecting 1% Lidocaine HCL USP pain block. The puncture at the tag injection site is sealed using a drop of Vetbond 3M Tissue Adhesive. The hind flipper PIT tagging of juvenile through adult wild-captured green turtles in the Hawaiian Islands has been carried out since 1995 with significant success and safety, extremely low tag loss, and no movement of the tag within the flipper. Photographic illustrations with step-by-step descriptions of the hatchling PIT tagging technique are presented in this poster.

GLOBAL PHYLOGEOGRAPHY OF HAWKSBILL TURTLES, *ERETMOCHELYS IMBRICATA* BASED ON MTDNA

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Of the seven species of sea turtles, the hawksbill is the one presented by the most anthropogenic pressures. Many studies have determined the genetic structure of populations of *Eretmochelys imbricata* throughout the world. However, to date, there has been no study analyzing the abundance of mitochondrial DNA haplotypes of nesting populations worldwide, to estimate both their genetic interactions and their possible dispersal patterns over time. This meta-analysis, used fragments of 891 bp of the mitochondrial control region, for a total of 125 haplotypes represented in 22 publications, which were grouped into 2 regions by origin. We constructed a tree using Bayesian analysis, which revealed multiple sources of regional populations, for which we identified two independent clades: Atlantic and Indo-Pacific, with a divergence time of ca. 4.3 MYA and showing that lifting Isthmus of Panama makes 3.6 MYA is one of the forces that have been effective as a barrier to tropical species giving rise to allopatric speciation, and finally, that the genetic structure of this species as for other marine organisms reflects different historical and contemporary forces between complex ecological, demographic, genetic, ethological, oceanographic, climatic and tectonic.

THRESHOLD TO MATURITY IN GREEN TURTLES: INTERACTIONS OF AGE, SIZE AND GROWTH

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Age at sexual maturity is a critical demographic parameter that is difficult to determine in long-lived species with cryptic juvenile stages, such as sea turtles. We analyze data from a 34-year study of a captive population of green turtles at Cayman Turtle Farm to evaluate relationships among age, length, and mass at sexual maturity, and pre- and post-maturity growth rates. Although age at maturity is much younger in captive populations compared to wild populations, evaluating thresholds to maturity in a captive population of green turtles provided an opportunity to assess variation in age and size at maturity and growth rates prior to and after maturity in a long-lived species. Maturity is not attained at a given size or age in green turtles, nor is there the expected trade-off between size and age at maturity. There is considerable variation in age, length and mass at maturity even when turtles are held under similar conditions. Although there is no clear threshold for maturity, of the three parameters (age, body length and mass at maturity) length is most similar to that of wild green turtle populations and thus apparently most closely approximates a threshold to maturity. The best predictor for age at maturity is average pre-maturity linear growth rate, and the best predictor for size at sexual maturity (both length and mass) is average pre-maturity mass growth rate. At sexual maturity, resource allocation shifts almost completely away from somatic growth to reproductive output in green turtles, regardless of level of nutrition or size at maturity. Incorporating appropriate levels of variation for age and size at maturity will improve assessments of status of populations and effectiveness of management programs.

PREDICTING THE IMPACTS OF GLOBAL WARMING ON SEA TURTLE POPULATIONS IN VIETNAM

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One of the greatest threats to sea turtles populations in Vietnam is global warming, besides sea-level rise, loss of nesting and foraging habitats, incidental capture and illegal trading of sea turtles and their products. Since incubation temperature of clutches determine the sex ratios, performances of hatchlings and hatching success rates, higher temperature in the future may produce weaker female hatchlings and more egg failures. In order to understand these influences of temperature and predict the problem of sea turtle populations in Vietnam, from 2010 to 2012 we use regression analyses to correlate air temperature, sand temperature and incubation temperature at 8 remained nesting beaches in Vietnam. At the same time, we studied the hatching success, quality of hatchlings and running performances of 40 clutches, which burred

in different time and locations. The results from 2010-2012 seasons show that the sex ratios of hatchling at 8 nesting beaches varying from 72.5% to 80%. However, the regression models suggest by 2050, all nesting beaches of Vietnam will produce a skew towards females (85 to 100%); it is even worse by 2100, when the sex ratios of hatchlings will be from 96 to 100% females and about 50% of clutches will be exceed thermal mortality thresholds. The incubation temperature does not impact the quality and running performances of hatchlings but it clearly impacts the hatching success, the number of un-hatched eggs in hot clutches is much higher than that in cooler ones. Therefore, it is necessary to implement the management strategies to reduce the impacts of global warming on sea turtle populations in Vietnam.

MICROSATELLITE ANALYSES SHOW RESTRICTED MALE-MEDIATED GENE FLOW BETWEEN MEDITERRANEAN ROOKERIES FOR LOGGERHEAD TURTLES

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The population structure of loggerhead turtles (*Caretta caretta*) in the Mediterranean has been widely studied through the use of genetic analyses. Mitochondrial DNA has been traditionally used to analyse the genetic structure of populations but this is a maternally inherited marker. We have reanalysed the genetic structure of Mediterranean loggerheads by amplifying an extended set of 19 microsatellite loci. Tissue samples of 152 hatchlings from Cyprus, Greece (Crete and western Greece), Israel, Lebanon, Libya and Turkey were genotyped. Overall, the number of alleles per microsatellite locus ranged from three to 14 with a total mean of 5.58 alleles per locus. Libya was the nesting area with the highest number of alleles (6.688 ± 2.301). However, the allelic richness did not differ between nesting areas (Kruskal-Wallis, $P = 0.423$). Independence of loci can be assumed as no linkage disequilibrium was found between loci pairs (Chi-square, $P < 0.05$). Three loci presented departure from Hardy-Weinberg equilibrium (Chi-square, $P < 0.05$) and thus, these were not included in further analyses to avoid bias. Significant pairwise genetic differences were found in the majority of comparisons (Fst, FDR $P < 0.014$) except among Greek nesting areas and among the easternmost part of the basin (Cyprus, Israel and Lebanon). Isolation by distance is a likely explanation to the differences seen as indicated by the Mantel test relating geographic and genetic distances (Mantel test, $P = 0.027$). Thus, an eastwards genetic gradient with populations partially connected by male-mediated gene flow along the coastline might exist. A PCA plot revealed four regional units genetically distinct: Greece, Libya, Turkey and eastern Mediterranean. According to these results, future management plans should consider the importance of the specific genetic diversity in each rookery to ensure the conservation of this species in the Mediterranean basin.

PREDICTED SEX RATIO OF IMMATURE KEMP'S RIDLEYS INCIDENTALLY CAPTURED AT MISSISSIPPI FISHING PIERS

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The Kemp's ridley sea turtle (*Lepidochelys kempii*) was historically the most endangered sea turtle in the world and came to the brink of extinction in the mid 1980's. Due to intense conservation efforts, this species is now gradually recovering. Although the majority of Kemp's ridley nesting occurs near Rancho Nuevo, Mexico, they are known to forage throughout the coastal waters of the Gulf of Mexico. It has been suggested that the north central Gulf of Mexico may be an important foraging ground and developmental habitat for this species, but few studies have attempted to survey sea turtles in that region. In 2012, approximately 200 immature Kemp's ridleys were incidentally captured at fishing piers along the coast of Mississippi, and the majority of these received care and rehabilitation at the Institute for Marine Mammal Studies (Gulfport, MS). In the current study, the sex ratio of these immature turtles was examined using a testosterone radioimmunoassay (RIA) that was validated for use with Kemp's ridleys. This subject is of particular interest since this species has temperature-dependent sex determination which can produce highly biased sex ratios. Other studies have detected a significant female bias in other aggregations of immature Kemp's ridleys, and studies at the nesting beach suggest female biased hatchling sex ratios. The ability to examine a relatively large number of immature Kemp's ridleys inhabiting the Mississippi Sound provides an unprecedented opportunity to investigate population sex ratio in the Kemp's ridley sea turtle. The results of the current study provide insight on the population sex ratio which will affect the future reproductive success in this Critically Endangered sea turtle. Further, the sex ratio of these turtles reflects many years of hatchling sex ratios produced in the Kemp's Ridley Conservation Program.

GENETIC CHARACTERIZATION OF OLIVE RIDLEY AGGREGATIONS OFF THE MEXICAN CENTRAL PACIFIC COAST- PRELIMINARY RESULTS

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The olive ridley turtle is a pantropical species and the most abundant in the world. Mitochondrial DNA studies based on nesting habitats suggest four major lineages in the world. This study is one of the first to analyze marine aggregations from the Mexican Central Pacific to evaluate genetic composition with the aim of determining possible origins converging on this area of study. Out of a total of 100 turtles caught, 52 have been analyzed so far (16 adult females, 18 adult males and 18 juvenile/sub adults) from skin samples from right anterior flipper. Genomic DNA was extracted using standard techniques and 880 bp fragments of the mitochondrial DNA control region were amplified using LTEi9agc/H950 primer pair. Sequencing was carried out by Macrogen in Korea. From the 52 samples sequenced in our study, a total of 15 haplotypes were observed with 21 variable sites. One haplotype was predominant accounting for 66% of samples. Haplotypes were trimmed to 384 bp for comparisons with reported haplotypes. Observed sequences were compared to the reported haplotypes to infer their phylogenetic relationships. Although individual sources for the studied aggregation cannot be identified from current results, the presence of the sequence from M60-PCM which clearly nests within the East Indian clade suggests a surprising, albeit infrequent, link between East Pacific (EP) olive ridleys in Mexican Central Pacific waters and central or western Pacific populations. While Shanker *et al* found EP haplotypes in eastern India reflects low frequency westward transoceanic transport for the species; the current results are the first to indicate that the reverse is also possible. Modeling of oceanic currents will be necessary to explain an eastward transport from the Indian-West Pacific to western Mexico and greater genetic coverage of SE Asian rookeries will be needed to locate origins for this unusual olive ridley. Thanks to all sponsors: International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America, CONACYT, Universidad de Colima, UNAM.

MULTIPLE PATERNITY OF THE GREEN TURTLE POPULATION AT KOSGODA TURTLE ROOKERY, SRI LANKA ASSESSED USING MICROSATELLITE* MARKERS

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Adult sea turtles have multiple mates, but the frequency of multiple paternity varies between rookeries and among species. Multiple mating can influence the strength of sexual selection, the effective population size, genetic variability and introgression within a population. Paternity in the offspring of 19 female green sea turtles (*Chelonia mydas*) nesting at Kosgoda rookery in Sri Lanka was determined using microsatellite markers at six loci. Tissue samples were collected from the nesting female and ten hatchlings from each clutch. A total of 24 clutches including single clutches of 17 females and three or four successive clutches of two females were examined. Clutches of 47% of the females were sired by two (62.5%) or three (37.5%) fathers. The successive clutch analysis showed that the dominant father sired 50.0% of the total offspring followed by 33.3% by the second male. The same paternal alleles were observed at all six loci in all the successive clutches. This suggests that the male or males that sired the first clutch also sired the other clutches for a given female. This provides evidence for multiple mating with the same male during a nesting season and/or sperm storage. Although the size of the females that laid clutches with multiple paternity were typically smaller than the females with single paternity clutches, this difference was not statistically significant (Student's t-test; $p = 0.24$). There was no evidence that the same male had fathered offspring with multiple females. Although green turtles are highly promiscuous in their mating behavior and known to store sperm, fewer than half of the females at Kosgoda rookery laid clutches with multiple paternity. In populations where multiple matings occur, knowledge of its prevalence and effects on paternity distribution within a natural assemblage is critical to comprehend population structure. This information can therefore be of great importance to the management and conservation of threatened species such as sea turtles. Acknowledgments: We would like to acknowledge the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics and CLS America, the International Sea Turtle Symposium and National Science Foundation, Sri Lanka for their support to attend to the symposium.

MORTALITY RATES OF KEMP'S RIDLEY SEA TURTLES IN THE NERITIC WATERS OF THE UNITED STATES

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We conducted a catch curve analysis of Kemp's ridleys strandings in the USA, 1986-2009, to estimate instantaneous mortality rates. The methods were similar to those used previously to estimate mortality rates prior to 1990 (Heppell *et al*. 2005). Carapace length data were used to estimate the age structure of the strandings using region-specific von-Bertalanffy curves, assuming a July 1 birthdate. While we had size data from all states, we were unable to obatin permission to use the morphometric data from South Carolina for this purpose. The size distribution of Kemp's ridleys stranded in Georgia is not significantly different than those stranding in South Carolina (Kolmogorov-Smirnoff Test, KSa=0.9420, Pr>KSA=0.3774). Thus, we used the Georgia size data as surrogate for the South Carolina size data, and applied the distribution to the numbers reported stranding in South Carolina (http://www.sefsc.noaa.gov/species /turtles/ strandings.htm). Our ridley year-based model (July 1-June 30) included several cohorts in a given year; we assumed that the reduction in strandings-at-age within a year reflected a constant annual mortality rate for all cohorts within the year. To account for an exponentially growing population, each cohort was weighted by an index of its cohort's strength: the number of hatchlings released during the birth year in the 3 core camps in Tamaulipas (Barra del Tordo, Rancho Nuevo, and Tepehuajes) was divided by the size of smallest cohort represented in the time series (11,100 hatchings in 1975) to form the index. Annual plots of the ln transformed weighted size-at-age numbers indicated that during most years, Kemp's ridleys were fully recruited to the neritic waters by age 2. Unlike the previous catch curve analysis, we did not find that the plots deteriorated until after 10 years. Thus, the rate of decline from age 2 through age 10 was used to estimate the instantaneous rate of mortality for a given year.

CLIMATE CHANGE POTENTIAL EFFECTS OVER SEA TURTLE POPULATION ON FORAGING GROUNDS: VENEZUELAN GULF, A CASE STUDY

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Sea turtle populations are facing several kinds of threats, from single plastic bags to huge climate catastrophes that swap away entire nesting beaches jeopardizing their survival. From the last 3 decades sea

turtle biology, ecology and conservation issues have increasingly captured the interest of many researchers, trying to explain and predict how sea turtle populations will develop worldwide. Climate Change threats (like sea level rise, sea surface and sand temperature increase, increase in cyclonic activity, among others) are a growing interest of study due to the potential vulnerability of sea turtles to those pressures. However, these studies have been focused mainly on sea turtle nesting beaches and how a single climate process will affect them. Here, we use a vulnerability assessment framework to assess the cumulative impact of various climate processes on foraging grounds used by sea turtles at the Gulf of Venezuela (GV). This assessment framework was modified in order to investigate different climate processes presented in the GV. Our assessment indicates that this foraging ground have a relative large vulnerability to climate change, being the potential increment of annual precipitation and a thermocline variability the main climate processes that might affect negatively sea turtle populations at the GV. Temperature and precipitation projections in the Caribbean for a conservative and medium-high scenario of carbon emissions indicates that this region may present a warm and dry climate, with high variations among localities. These alterations will negatively impact habitats, feeding opportunities and migration routes that in long term will considerable decrease sea turtle populations. Few countries understand and know how to respond to climate change, Venezuela isn't one of those. In recent years we have witnessed a potential effect due to climate change, where notable changes in sea surface temperatures and high runoff impacts have altered the habitats of sea turtles in the GV. This framework might allow users to investigate how mitigate different climatic processes individually or simultaneously by manipulating variables from this assessment. Nonetheless, further research and investigations are needed in order to provide a greater mosaic of possible adaptation responses by sea turtles and successful mitigation actions, so sea turtle conservation programs, management and decision makers could help reduce these threats in the long term.

EXPLORING SOUTHERN WATERS: THE PRESENCE OF HAWKSBILL TURTLES IN URUGUAY

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Hawksbill turtles (*Eretmochelys imbricata*) occur globally in tropical waters, mainly associated with tropical reefs. Their distribution in the South Western Atlantic ocean is limited mostly to the northern coast of Brazil and adjacent waters. Regular nesting occurs mostly in the state of Bahia, although its distribution area ranges from Ceará to São Paulo (Brazil). Hawksbill turtles may travel considerable distances between their nesting areas and their feeding habitats. Immature individuals tagged in Brazil were recaptured in the African coast of Senegal and Gabon. In rare cases, juvenile turtles are known to occur as far south as Rio Grande do Sul (South Brazil).However, in recent years, a total of ten hawksbill turtles have been reported in Uruguayan coast. This species was previously unrecorded in this region of the South Atlantic Ocean. Only one hawksbill has been registered in more southern areas, correspond to a juvenile captured in Bahia de Samborombon (Argentina). Therefore, these records are the southernmost strandings reports in the Western Atlantic for this species. The stranding network run by Karumbé registered all the stranded hawksbills in the department of Rocha, in the North-East of Uruguay. All of them are considered as juveniles (mean curved carapace length, notch to tip [CCLn-t]= 35.01 ± 7.96 cm, range: 27.6-56.5; n=10). In 2007, 2009 and 2010 were registered just one hawksbill turtle each year, but in 2011 were registered seven alive hawksbills, but their physical condition was critical. They were moved to the Karumbé Rehabilitation Center in Montevideo, but all of them died. The cause of dead was associated to digestive tract obstruction due to marine debris ingestion. To identify the natal origin tissue sample was collected for ongoing genetic analysis. The presence of the above reported individuals can be correlated with the

occurrence of a positive sea surface temperature anomaly registered in the area. During the strandings events high positive anomalies (0.5 - 1.5) were observed along the Uruguayan and southern Brazil continental shelf and oceanic region. This sustained temperature anomaly is associated with a strong influence of Tropical and Subtropical waters, advected southward by the Brazil Current. Probably these turtles reached the Uruguayan coast owing the favorable thermal conditions during the austral summer where an intrusion of warm oceanic waters is expected. The strandings reported above are of specially interest, since the hawksbill turtle is not frequently reported for temperate waters. Our records extend the geographic range of this species almost 250 km southward. The sporadic occurrence of this critically endangered species in Uruguayan waters implies a fifth species of marine turtle for this zone and reinforces the importance of continue monitoring the Uruguayan coast. This evidence altogether affords a new evaluation of the distribution of this species in the South Western Atlantic ocean.

USING CUSTOM-DESIGNED CAPTURE ARRAYS AND NEXT-GENERATION SEQUENCING FOR SNP DISCOVERY IN LEATHERBACKS (*DERMOCHELYS CORIACEA*)

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We describe an approach that combines custom micro-array capture technology and next-generation sequencing to discover SNPs for use in population structure analyses. The samples were chosen primarily as part of an ongoing study of fine scale population structure of leatherbacks nesting in the western Pacific, with a few additional samples representing the global distribution of the species. Nuclear loci sequences were compiled from a variety of sources, including Genbank, as well as flanking regions from microsatellites developed for either loggerheads or green turtles. Additionally some fragments were characterized during SNP discovery for green turtles using AFLP fragments. Genomic library enrichment was completed using tiled complimentary sequence probes designed specifically for the Agilent custom micro-array. Probes were designed to cover the entire mitochondrial genome as well as eighty nuclear loci. In order to multiplex 100 turtles in the array, the individual turtle genomes were fragmented and labeled with short a unique sequence or index tag. The indexed libraries were then pooled in equal concentrations. The pooled library was then hybridized to the capture array and subsequently eluted and amplified for sequencing on an Illumina genome analyzer. This is a streamlined method for collecting large amounts of nuclear and mitochondrial sequence data for SNP discovery as well as population genetic studies of wild populations.

CONSERVATION OF SANDY BEACHES: HOW ANTHROPOGENIC AND NATURAL FACTORS IMPACT SEA TURTLE NESTING ON A REGIONAL SCALE

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Coastal areas provide critical habitats for a variety of wildlife species which helps maintain high biodiversity in this scarce habitat. Although conservation of this habitat is a priority, it is challenging due to

both anthropogenic and natural forces. Rapidly expanding human populations and intense coastal development have resulted in heavy modification of coastal areas. Increasing levels of recreational beach activities have resulted in more human-wildlife encounters, increases in artificial lighting, and pollution. Management actions aimed at reducing these problems, such as beach nourishment, grooming, and coastal armoring, often create additional issues by reshaping sandy beaches. Although sea turtles spend most of their lives at sea, they rely on sandy beaches for one critical stage in their life-history, reproduction. Therefore, alterations to the sandy beach habitat may greatly affect sea turtle populations. Given that threats to sandy beaches are predicted to further intensify in the coming decades, beach management policies that protect biodiversity and maintain ecological processes, including nesting sea turtles, are required. Understanding how the anthropogenic- and natural-factors impact nesting turtles using the sandy beach is essential for success of such conservation efforts. We examined temporal trends in nest density and false crawl rate of loggerhead sea turtles and the association between these parameters and the characteristics of 16 nesting beaches in northwest Florida using log-term nesting and shoreline survey data. We found a decreasing trend in nest density and an increasing trend in false crawl rate over years. Human population growth rate and past nourishment operation were inversely associated with nest density, while erosion rate was positively associated with nest density. Erosion rate and past nourishment operation were positively associated with false crawl rate. False crawl rate also varied by shoreline morphology of nesting beaches. Compared to continuously linear beaches, false crawl rate was higher on beaches located on islands and peninsula tips, which are typically more dynamic. Our study highlights the complexity involved in conserving coastal habitats. We quantitatively showed that human activities, management actions and natural forces combine to influence nesting behaviors of sea turtles in one nesting group in the southeastern U.S. Modifications of coastal systems are accelerating by increasing human footprints and the amplification of natural forces. The Deepwater Horizon oil spill in the Gulf of Mexico is one example of an acute and potentially long-lasting threat to coastal habitats. Shoreline alterations due to climate change and associated sea-level rise are also becoming a global concern. These factors could lead to further degradation of shoreline habitats, therefore there is an urgent need to develop effective conservation policies that address multiple and broad-scale issues to maintain the coastal ecosystems and allow for continued co-existence of humans and wildlife in coastal systems.

POPULATION TRENDS AND SURVIVORSHIP OF NESTING GREEN SEA TURTLES ON ISLA DE AVES, VENEZUELA

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One of the greatest challenges facing the conservation of threatened species is to understand the life-history effects of specific threats and to document population trends, in order to reduce threat impacts and evaluate recovery efforts. Analyses of a species' demographic parameters are essential for setting such goals and can also suggest directions for future research. Here we analyze 26 years of capture-recapture data available for the nesting population of green turtles (*Chelonia mydas*) on Isla de Aves. This population is numerically important in the Caribbean, and has been effectively protected from human impacts since 1979. We analyzed 6,414 encounter histories using an open robust design model with multiple strata (ORDMS), which allowed unbiased survival estimates in the presence of temporary emigration. Using Akaike information criteria, we compared 28 models to estimate survival, recruitment, and remigration rates of adult females, and to test alternative hypotheses about the effects of time, age class and hurricane patterns on these parameters. We also obtained estimates of the population size of nesting turtles each year on Isla

de Aves and their average residence time. The best-fitting model indicated that adult survival was lower for turtles arriving for the first time than for those returning in successive years, probably due to a high rate of tag loss during the first year. Survival varied considerably among years, with a mean annual probability of 0.83 for returning turtles (95% CI 0.51–0.98). This value is similar to survival estimated in Tortuguero, Costa Rica (0.85; 95% CI 0.83–0.87), the only other population in the Caribbean that has demographic estimates based on long-term capture histories, but is much lower than estimates in Australia (0.95; 95% CI 0.92-0.98). Also, Isla de Aves had a remigration interval of 1-3 years, (X: 2.37, SD: 1,10), which was similar to the interval estimated for Tortuguero, Costa Rica (X: 2.95, SD 0,88), but shorter than estimates from Australia (5-7 years). Fluctuations in adult annual survival may be due to turtle fishing in Nicaragua, the Dominican Republic, the Lesser Antilles and the Gulf of Venezuela, where females from Isla de Aves are known to feed. Such fishing pressures do not exist in Australia. The frequency of hurricanes across the Caribbean also explained a small but significant proportion of variation in adult survival ($F = 4.638$; $p=0.04508$ $R2=0.16$). However, although population size varied among years (100-1,453 females), we observed an apparent increase between 1979 and 2008. Thus, although we were able to document the effect of threats on adult survivorship, it appears that the Isla de Aves population may be stable at present or even growing. Management actions to grow this population further will need to be tailored not only to local nesting trends but also to regional climatic cycles and distributed anthropogenic threats and natural conditions in foraging grounds.

GENETIC STOCK STRUCTURE OF HAWKSBILL NESTING POPULATIONS IN THE EASTERN PACIFIC

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The use of molecular genetic techniques plays a critical role in the understanding and management of global sea turtles populations. Due to strong philopatry demonstrated by the taxon, mitochondrial DNA (mtDNA) continues to provide a useful genetic marker for evaluating population structure and phylogeography. We used mtDNA to conduct the first-ever genetic survey of hawksbill nesting stocks in the eastern Pacific Ocean. We analyzed a total of 61 tissue samples collected between 2008 and 2011 from four rookeries across the region. Despite small sample sizes for some rookeries, our initial findings provide novel insights into population structuring and the evolutionary origins of hawksbill turtles in the eastern Pacific. Three previously identified haplotypes and two new ones were found with overall frequencies of 78.7% and 21.3%, respectively, the latter only evident in Central American nesting stocks. Significant differentiation was found between rookeries in Central and South America, providing evidence for stock structuring in the eastern Pacific. One haplotype predominated at all four nesting sites. This and the other two previously identified haplotypes occur in the Indo-Pacific. From a phylogeographic perspective, the prevalence of Indo-Pacific derived haplotypes in eastern Pacific nesting stocks suggests eastern Pacific populations radiated out of the western Pacific, an assertion previously postulated, but which has remained unconfirmed until now. Furthermore, the existence of new haplotypes exclusive to the eastern Pacific suggests the populations have been separated sufficiently long to accumulate new mutations in the mtDNA control region at the regional population level. We also found potential evidence for fine scale genetic

segregation between nesting habitat types, possibly maintained by behavioral differences. Nonetheless, additional studies are needed to confirm this hypothesis. Our findings have important implications for hawksbill management strategies on both regional and global scales. Additional research with larger sample sizes and variable markers will prove crucial to gaining further understanding of hawksbill stock structuring and genetic diversity in the eastern Pacific.

LAGUNA MADRE RECRUITING CLASS OF 2012

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Endangered sea turtle conservation efforts share the common and very vital goal of increasing populations to self-sustainable numbers. With a large effort being carried out towards all species of sea turtles in the Gulf of Mexico, a better understanding of nesting grounds, their relationship to juvenile foraging grounds and population trends can bolster or increase conservation efforts. The Laguna Madre is and has been a viable and flourishing marine ecosystem for many decades. It is an area that provides great foraging grounds for Atlantic green sea turtles (*Chelonia mydas*) of all sizes. Many nearby beaches in Northern Mexico have reported increases in Atlantic green nesting. Looking at nesting data totals from Mexico and straight carapace length from stranding reports in the Laguna Madre, collected over the past 6 years, will allow for the analysis of possible shifts in the average size of the Lower Laguna Madre Population. A shift to a smaller average size in the Lower Laguna Madre green sea turtles' population, coupled with an increase in Northern Mexico nesting, could represent more recruitment in the Lower Laguna Madre population and may represent a growing population of green sea turtles in the Western Gulf of Mexico. Results show a noticeable increase in the number of nesting green sea turtles along with a decrease in the average carapace length of Lower Laguna Madre juvenile green sea turtles. This decrease in the average carapace length is a great indicator of positive recruitment. This recruitment of juvenile green sea turtles is a positive step in the recovery of the threatened Atlantic Green population in the Western Gulf of Mexico.

BAYESIAN FRAMEWORK TO INTEGRATE TRADITIONAL ECOLOGICAL KNOWLEDGE INTO ECOLOGICAL MODELING: A CASE STUDY WITH SEASONALITY OF MARINE TURTLES IN FRENCH GUIANA

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Indigenous groups offer alternative knowledge and perspectives based on their own locally developed practices of resource use. This Traditional Ecological Knowledge (TEK) has been acquired from long-term observations and uses of natural systems. Some promote the use of TEK in scientific research, however the methodology to integrate such knowledge in ecological models is not straightforward. We advocate the use of Bayesian framework to integrate TEK as a prior for analysis. We exemplified such a use of TEK to analyze the seasonality of marine turtles in French Guiana. We show that TEK can resolve some situations in which the parameter fit was not possible. On the other hand, TEK could be biased and it is safer to have data with enough information to prevent this bias to influence strongly the posteriors. The construction of ecological model to be used with TEK will be discussed.

ADVANCES IN SEA TURTLE PHOTO-IDENTIFICATION. A CASE-STUDY CARRIED OUT AT THE MARINE BIOLOGICAL RESERVE OF ARVOREDO, BRAZIL

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Photo-identification is a non-destructive and non-stressing method which uses photographs of natural marks of the animal body to ensure their individual recognition within a population. Photo-ID is also used as a complement to other identification methods such as artificial marks. The present work is focused on the validation of the Photo-ID method developed by the Kelonia Institute (Saint Leu - Reunion Island, France) (www.kelonia.org) for sea turtle Photo-ID for the Cheloniidae family. It uses the specific physical characteristics of animals and procedures are simple and fast. The Program uses simple photographs of the head, taken without any special requirements, from the right and left sides. The Program establishes a set of codes obtained from the analysis of the facial plates (as much as possible), which generates a code sequence of numbers that is the 'ID number' of the individual. The study area is The Marine Biological Reserve of Arvoredo (Santa Catarina, Brazil), which presents an enormous biodiversity of marine wildlife and is an important feeding area for juveniles of the sea turtles species that represent great importance for the local natural heritage. Captures were made by free diving, with a total of 38 individuals of *C. mydas* captured during the summer of 2011/2012, resulting from 136.5 hours of diving effort. Photographs of both sides of the head are needed for photo-identification with the software. A total of 195 turtles were studied (from the present work and from the previous research in the same area). Only one individual was captured by both projects, initially on 19/07/2006 and then recaptured during the present work 06/02/2012. Analyses in the computer program clearly identified that was the same individual, and that there was no observable change in the distribution and geometry of the plates, either from right or left sides, despite almost six years time gap between the captures. Another factor revealed with this turtle was both the right and the left side of the face have the same symmetry and geometry showing the same numbers of codes. This feature occurs in only 5% of the turtles analyzed in the present work, so turtles with only pictures of one side of the head should not be subject to initial registration in order to avoid errors in the database. Previous works using only two post – ocular columns for identification show that may be flaws in their data, for the reason that sea turtles captured in the present study showed that these two columns very similar or equal different individuals. Our final method employed a greater number of columns and scutes thus avoiding possible errors. In conclusion, this work validated the accuracy and reliability of this Photo-ID method. Future work will provide new evaluation of the method and may lead to new management and protection actions for these fantastic animals.

HISTORICAL AND SEASONAL TRENDS IN GREEN TURTLES (*CHELONIA MYDAS*) CAPTURED AT SOUTH HUTCHINSON ISLAND, FLORIDA, USA

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The Florida Power & Light St. Lucie Power Plant is located on South Hutchinson Island, Florida. Since 1976, when power generation first began, sea turtles have become entrained into the plant's intake cooling canal system. A monitoring program was established and sea turtles were routinely removed from the canal.

Morphometric data were taken from each turtle before it was tagged and released, and compiled into a database that has been maintained since the plant went on-line. From 1988 to present (a span of 25 years), green turtle (*Chelonia mydas*) capture data were analyzed to look at historical and seasonal trends in population structure, recapture rates, and fibropapilloma rates. Analysis shows that the percentage of total sea turtle captures at the plant represented by green turtles rose markedly in the late 1980's and early 1990's before leveling off. The percentage of new recruits encountered at the plant has steadily declined since the early 1990's, while the percentage of turtles that have been recaptured at the plant has steadily risen. Green turtles have also exhibited seasonal trends in which the percentage of new recruits rises during winter months and falls during summer months. The data have also shown that fibropapilloma rates are much higher in the winter months than during the remainder of the year. This long-term monitoring project will continue to provide insight into the population structure of turtles utilizing the near-shore waters adjacent to the St. Lucie power plant.

PHYLOGEOGRAPHY OF OLIVE RIDLEY TURTLES

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Phylogeographic studies, which consider the geographic distribution of genetic lineages, provide a powerful method to understand a species' colonization history and the interconnectedness among populations. The olive ridley turtle (*Lepidochelys olivacea*) has a global distribution across tropical and sub-tropical oceans, and is one of the most abundant marine turtle species. It is closely related to the Kemp's ridley (*Lepidochelys kempii*) and the origin of both species is believed to be related to the closure of the Isthmus of Panama during the Pliocene. Subsequently olive ridley would spread from the Pacific Ocean into the Indian, and colonized the Atlantic Ocean most recently; or a remnant population from Indian Ocean would colonized both East Pacific and Atlantic Oceans. In this study we expand our previous work by investigating new aspects of evolutionary processes and demographic history that contributed to current *L. olivacea* distribution. Using Bayesian analyses we analyzed mtDNA control region sequences from 14 rookeries (n =541), as well as fifteen nuclear short tandem repeats (STRs) from 12 rookeries (n = 285). Bayesian analyses with the mtDNA sequences were carried out in Lamarc in two ways: 1) with 9 sets of populations: Surinam (SU), French Guiana (GF), Brazil (BR), India (IN), Sri Lanka (SL), Tiwi Island (Tis), Cape York (CY), Costa Rica (CR), Baja California (BC) and continental Mexico (ME); 2) 4 sets of populations: Indian Ocean (IN and SL), Indo/West Pacific (Australia and Malaysia), Atlantic Ocean (GB, GF, SU and BR) and East Pacific (CR, BC and ME). The results showed that genetic diversity, and consequently the Nef (females effective population size) in olive ridleys varies widely, from Nef ~17,000 for IN to Nef ~1,300 in CY (Australia); all sets of population showed sign of population growth. The unique pairs of populations with Nm values higher than one are those from the East Pacific (ME, CR, and BC) and Sri Lanka into India. Divergence times were estimated using a Bayesian approach and resulted in clade K, found only in India Ocean and the most basal lineages for olive ridley, originated around 1.6 Mya,

the East Pacific clade about 0.61 Mya, and the split between the Indo-Pacific and Atlantic lineages around 0.36 Mya. These results are mostly consistent with the recent colonization of East Pacific and the Atlantic and suggest a model of recurrent extinction/colonization for most ridley nesting sites that may be explained by climatic changes, especially during the Pleistocene. Diversification times within all five clades are very similar, ranging between 221,000 years ago and 342,000. Significant statistics for the STR data and similarly shaped star trees in each of the four major olive ridley clades suggested a population expansion, a scenario partially corroborated by the neutrality tests (Fu's FS and Tajima's D) and the Bayesian Skyline Plot (BSP) analysis which indicate a population expansion for *L. olivacea* after the last glacial maximum. These results suggest that the most recent demographic events (colonization and population expansion) for most oceanic regions may have been concurrent.

GENETIC STRUCTURE OF GREEN TURTLES NESTING IN THE NORTHWESTERN PACIFIC OCEAN*

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Japan is located at the northern limit of the Pacific green turtle breeding area. The Ogasawara Islands and the Ryukyu Archipelago are the two main nesting sites of this species in Japan. Only green turtle nests are found in the Ogasawara Islands, where the number of annual nesting is estimated at more than 1,000 by beach surveys. In contrast, in the Ryukyu Archipelago the nests of three species of sea turtles (loggerheads, green turtles and hawksbills) are found. This archipelago is a long island chain lying more than 1,000 km between Taiwan and Kyushu, and contains scattered nesting rookeries of green turtles. Hence, the available data about nesting sites and the size of nesting populations are limited at several islands of the southern and northern Ryukyus. Although surveys in the central Ryukyus have been started in past years, the genetic population structure in the whole Ryukyu Archipelago is still unknown. The previous studies suggested that there were three genetically differentiated stocks nesting in the Ogasawara Islands and Yaeyama Islands, in the southern Ryukyus. These populations were also differentiated from the two neighboring populations nesting in Taiwan. In the present study we collected samples of nesting green turtles in the central Ryukyus, and analyzed them using mitochondrial DNA (mtDNA) by sequencing approximately 860 base pairs of the control region to understand the extent of genetic connectivity among the green turtle nesting populations in the northwestern Pacific Ocean. Although several haplotypes were shared with other populations, it was suggested that there were two differentiated populations in the central Ryukyus. The haplotypes detected in the central Ryukyus also belonged to three divergent clades, as was previously observed in three other Japanese populations. These clades corresponded to three of five clades detected in the populations through Australasia. Although in many rookeries the haplotypes from two divergent clades were detected sympatrically in the northern Pacific rookeries, mixtures of haplotypes from three divergent clades have been observed only in Japanese populations. Moreover, all regional populations in Japan showed high genetic diversities. These results suggested that the source of Japanese populations had their origin in the emigrations from several common populations in lower latitudes, which might have been geographically distant. Consequently, they could have maintained high genetic diversities even after they were differentiated into the small populations at the periphery of their distribution. Fifteen of 18 haplotypes, including their dominant haplotypes, have been only reported from populations in the northwestern Pacific rookeries. This suggests that the populations in this region have evolved as their own lineages after the historical immigration. Acknowledgments: This research was financially supported in part by the Global COE Program A06 to Kyoto University and the Ocean Exposition commemorative Park management Foundation. We are grateful to the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S.

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THE "HUNT" METHOD FOR ASSESSING RELATIVE ABUNDANCE OF SEA TURTLES IN SHALLOW COASTAL WATERS

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Aerial surveys are used to estimate relative abundance of sea turtles over broad geographic areas. However, detectability of turtles from the air is typically low for coastal waters where water clarity is reduced, the structured bottom conceals turtles, and where juvenile turtles too small to be seen from aircraft are the most common life stage. As an alternative to visual surveys from high-altitude, fast-moving aircraft, we describe the results of surveys using small vessels. Between 2002 and 2012, we conducted vessel-based visual surveys for sea turtles at the Key West National Wildlife Refuge, Florida USA. This area includes an approximately 500 square km area with bottom types varying between seagrass, hard-bottom (sponge and octocoral), and stony coral, with water depths mostly less than 3 m. We used a 7.4 m length skiff with two observers standing atop a 2-m platform and an additional observer viewing the water ahead of the vessel. Our vessel paths were not along predetermined lines and were meant to provide exploratory coverage. We describe these search methods as haphazard, unmarked, non-linear transects, or HUNTs. During HUNTs, a helmsman recorded vessel path and turtle locations with a Garmin Global Positioning System (GPS). The GPS recorded start and end locations of HUNTs as well as continuous vessel tracks at a 20 m resolution. Vessel speed during HUNTs was approximately 9 km per hr. HUNTs were near haphazard with respect to course decisions made during transects and were biased by access opportunity. Access opportunity was influenced by water depths where our vessel could navigate and where subsurface turtles could be observed (0.2 to 6.0 m depth). Perpendicular distance between the transect line and each turtle was estimated by observers on the vessel. We used the program Distance 6.0 to estimate detectability functions, effective transect widths, and turtle densities. Opportunistically, turtles observed during HUNTs were captured by hand. We observed 2,900 turtles of three species (*Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*) and captured 743 turtles with sizes ranging from 21.4 to 108.5 cm straight carapace length. We imported vessel paths and sea turtle locations recorded with GPS into ESRI's ArcGIS 10.0 for analysis and mapping. Using effective transect widths estimated from distance functions and vessel paths across our study area, we developed effort density plots useful in revealing search bias and underexplored locations. We used minimum search effort as a masking criterion for estimates of turtle density and we plotted turtle density against bottom type. Our conclusions are that the HUNT method is a useful way to assess relative abundance of sea turtles on a geographic scale between aerial surveys and single-site sampling.

ORIGIN OF IMMATURE GREEN TURTLES (*CHELONIA MYDAS*) AT TWO FORAGING GROUNDS IN SABAH, MALAYSIA

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Understanding the population dynamics in both breeding and foraging habitats is a vital part of assessing the long-term viability of any species, particularly those that are highly migratory, such as green turtles, *Chelonia mydas*. Monitoring of the populations at the foraging grounds may help detect early signs of population trends that would otherwise take decades to be seen at the nesting beach. Mixed Stock Analysis (MSA) using molecular marker techniques provide an effective tool for estimating the origin of turtles sampled away from their nesting beach. Here we use sequence data from the mitochondrial DNA (mtDNA) of 96 immature green turtles at two foraging grounds at Mantanani Island and Layang Layang Island located northwest of Sabah, Malaysia. We used data from eight Australasian green turtle populations as the baseline data for tracing back the origin of turtles at the two foraging grounds. The origins of the turtles at the two foraging grounds were not different and the majority of these turtles originated from key rookeries at Sarawak in north western Borneo and from the Malaysia and Philippine Turtle Islands in SE Sabah. These same rookeries have a long tradition of using unshaded beach hatcheries that have resulted in mostly female hatchlings being produced. This may have contributed to the 1:4 female biases seen at the foraging grounds. We discuss the implications of hatchery practices at nesting beaches and recommend future research to improve the management of marine turtles in the region.

GREEN TURTLE (*CHELONIA MYDAS*) GENETIC COMPOSITION AT A FEEDING GROUND AND ROOKERIES IN THE WEST ATLANTIC: CONNECTIONS BETWEEN POPULATIONS

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Sea turtles are globally distributed reptiles that exhibit complex life traits, such as long generation time, oceanic habitat of juveniles, female homing and wide-ranging migrations. The migratory behavior outcomes in spatial segregation between breeding and nesting sites, resulting in successive stages of the mixing and isolation of genetic stocks, both spatially and temporally. The green turtle, *Chelonia mydas*, is threatened with extinction worldwide and understanding its history is important to assess population dynamics and make future projections on the population trends. The use of molecular techniques has enabled progresses in species conservation, such as characterization of population structure, genetic diversity and natal origins. Thus, the aim of this study is to characterize the genetic composition of *C. mydas* in a feeding ground (hereafter FG) (at north coast of Rio de Janeiro state, Brazil, n=175) and two rookeries (French Guiana, n=46, and Guadeloupe, n=24) in West Atlantic Ocean, as well as the genetic contribution of rookeries to the FG, based on mitochondrial DNA sequences. The FG is composed so far by 11 haplotypes: CM-A8 (72%), CM-A5 (17%) and the others with a frequency less than 5% (CM-A1, CM-A3, CM-A6, CM-A9, CM-A10, CM-A23, CM-A24, CM-A32 and CM-A42). Besides, two previously undescribed haplotypes were found, CM-A69 and CM-A70. The nesting rookeries are composed so far by CM-A5 (95%) and CM-A3 (5%) in Guadeloupe, and by CM-A5 (93%), CM-A8 (4%) and CM-A22 (3%)

in French Guiana. The mixed stock analyses (MSA) revealed a major genetic contribution to the FG from Ascension Island, an isolated island in South Atlantic; and from French Guiana, in West Atlantic. Given the genetic composition of feeding grounds, and the worldwide distribution of green sea turtles, it is essential to understand the dispersion patterns to establish management plans. These preliminary results contribute to better understand the dynamic of green sea turtle population on West Atlantic Ocean. This study highlights the importance of connecting nesting and feeding areas that can be widely distributed according to ecological opportunities or constraints: conservation initiatives have to focus not only on those areas, but also on corridors between them, where turtles may also be subject to threats. Acknowledgments: University of São Paulo, CAPES, Fapesp, Kwata NGO, Institut Pasteur de la Guyane, International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America, International Sea Turtle Symposium, European funds (PO Amazonie) via the CARET2 project.

ESTIMATING ABUNDANCE AND CLUTCH FREQUENCY FROM TAGGING DATA ON NESTING BEACHES: HOW MUCH EFFORT IS ENOUGH?

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Abundance and clutch frequency are important parameters in studies of nesting sea turtle populations. Interest in these parameters might, for example, stem from the desire to track population status, estimate annual productivity, or study the relationship between clutch frequency and environmental covariates. Regardless, these parameters can be estimated, even in the face of imperfect detection, using modern statistical methods. The question is how much effort is needed to achieve reasonable targets for precision in estimates of abundance and clutch frequency. This question is complicated by lack of fidelity by individuals to an individual study area within a nesting season. Conversely, nest censuses combined with tag recaptures can provide supplemental estimates of detection probability. We use simulated data to evaluate precision of abundance and various clutch frequency estimators, under various levels of capture effort, using scenarios relevant to hawksbill, loggerhead, and leatherback tagging studies. We also discuss how lack of fidelity can be incorporated into estimation models.

ESTIMATING DEMOGRAPHIC PARAMETERS OF LOGGERHEAD TURTLES NESTING IN THE NORTHERN GULF OF MEXICO

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Population dynamics of marine turtles in the Gulf of Mexico are poorly understood. Although loggerhead turtles (*Caretta caretta*) nesting in the northern Gulf are part of one of the world’s largest loggerhead populations, little information exists from this nesting group on basic parameters such as population

abundance and survival probabilities. In this study, we derive the first estimates of key demographic parameters for loggerhead turtles using data from a long-term saturation tagging effort conducted along the St. Joseph Peninsula, Florida from 1998 to 2011. Clutch size, incubation rate, emergence success and turtle length were compared among remigrants, internesters, and neophytes using a single-factor Analysis of Variance and followed by multiple mean comparisons. Temporal trend in turtle size was examined using linear regression with year as an independent variable. Encounter histories were created for each loggerhead female encountered within our original 5-km study site. Survival, encounterability, probability of entry, probability of remaining, and transition probabilities between nesting and foraging states were estimated using a two-state open robust design model, for which females may be in an observable ‘nesting’ state or an unobservable ‘foraging’ state for any given year. This model type uses a combination of primary and secondary timescales to account for temporary emigration during unobservable foraging years. Each parameter may be estimated to vary over time or may be held to a constant value for each primary (year) or secondary (10-day) period. Alternative models were constructed using varying arrangements of time-dependent and constant parameters. The second-order Akaike’s Information Criterion was used to select the most parsimonious model. Parameter estimates were obtained with Program MARK which implements the robust design tagging model. Throughout the study period, 433 turtles were tagged following oviposition. We documented an extremely low (<10%) remigration rate within this population. There were no differences in clutch size, incubation rate or emergence success among remigrants, internesters or single nesters; however remigrants and internesters were larger than single nesters. There was no temporal trend in turtle size. Estimates of survival were high and estimates of abundance indicated a declining trend. Because of the relatively high survival estimates documented in this study for adult loggerheads, we suggest that high mortality in juvenile loggerheads may be the primary factor contributing to the decline in nest abundance reported for this area and other beaches in the Southeastern United States. It is important to continue intensive tagging in the northern Gulf in order to enable detection of changes in demographic parameters, including estimated annual survival probabilities that might signal changes in the magnitude or the appearance of new at-sea impacts such as the Deepwater Horizon oil spill.

NEW MICROSATELLITE DNA ANALYSES MAY CONFOUND CURRENT POPULATION MODELS FOR LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*)

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Mating systems play important roles in shaping life history evolution and population dynamics of a species; as a consequence they should be considered when planning conservation efforts. Specifically, in small populations, mating systems can influence effective population size and direct evolutionary change. Polyandry, a single female mating with multiple males, may result in the multiple paternity of progeny within or among nests. A literature review suggests that multiple paternity occurs in most species of reptiles. Within the Testudines, mating systems vary greatly: 0-100% of nests sampled had multiple fathers. Previous studies on the loggerhead sea turtle (*Caretta caretta*) showed that within large rookeries in Florida, Australia and Greece the occurrence of multiple paternity within nests ranges from 30% (Florida) to 95% (Greece). Our study is the first to assess nests for the presence of multiple paternal contributions within the smaller and more imperiled Northern Management Unit of NW Atlantic loggerheads. On a small beach on Wassaw Island, Georgia, USA, nesting loggerheads and up to 20 offspring were sampled from 72 nests (19.5% of nests laid) over three nesting seasons (2008 – 2010). We determined that 75% of nests sampled had multiple fathers with an average of 2.65 fathers contributing to each nest; the number of fathers per nest did not change over the three-year loggerhead nesting cycle. There was a positive relationship between the number of fathers per nest and female size (SCL), but there was no relationship between number of fathers and hatching success. Finally, 195 individual paternal genotypes were identified over the three years. Each individual male contributed to just one nest throughout the three years of nest sampling. Our findings suggest that there is a large pool of males contributing to the Wassaw nests. The lack of recurrence of males may reflect a sampling artifact, males may be transient and mate with the Wassaw Island females in route to other mating sites, or males may not mate each year.

GENETIC ANALYSIS OF LOGGERHEAD SEA TURTLE HATCHLINGS FROM THE ALABAMA COAST

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The loggerhead sea turtle is a protected species that inhabits temperate and tropical waters world-wide. One of the largest concentrations of loggerhead nesting in the world is in the southeastern U.S. including the northern Gulf of Mexico. The haplotypes of loggerheads in the southeastern U.S. have been examined in many locations, but have only received scant attention in Alabama. Therefore, it is of importance to evaluate the genetic haplotype of hatchlings from the beaches of Alabama to understand how they fit into the overall population structure of the southeastern U.S. Additionally, the Deepwater Horizon Oil Spill resulted in a wide variety of unprecedented responses implemented to address the impact on ecosystems in the northern Gulf of Mexico. In order to protect the nests, loggerhead sea turtle eggs were relocated from the beaches in Alabama to Cape Canaveral National Seashore where the eggs hatched and the hatchings entered the Atlantic Ocean. A better understanding of the haplotype of loggerheads from Alabama could help facilitate such strategies in the future. The current study seeks to complement previous studies by determining the haplotypes of loggerheads nesting in Alabama, and thus verify that they share the same haplotypes and similar haplotype frequencies as the turtles of the northern Gulf of Mexico recovery unit. Also, this project verifies that the haplotype frequencies occurring Alabama are similar to those in Cape Canaveral where the relocated turtles were released. Determining the haplotypes of hatchling loggerheads from Alabama beaches is valuable to understanding the population structure, movements, and life history of loggerhead sea turtles. Therefore, such information is valuable to an effective management strategy for this species. Tissue samples from forty-three hatchling loggerheads were collected over two nesting seasons as part of a collaborative study with UAB and Bon Secour National Wildlife Refuge. DNA sequence analysis was conducted on a 380bp fragment of the mitochondrial d-loop control region. The sequences were compared to haplotype sequences in the Archie Carr Center for Sea Turtle Research genetics database. The results of this study indicate that haplotypes CCA-1 and CCA-2 occur in hatchlings from Alabama nesting beaches, with CC-A1 occurring in the majority of the hatchlings sampled. Previous studies have shown these haplotypes to occur with similar frequency on the mid-Atlantic and northern Gulf coasts of Florida.

PHOTO-ID AND SNORKELING TRANSECTS: COMPARING TWO METHODS TO ESTIMATE GREEN TURTLE ABUNDANCE IN A MAJOR FEEDING GROUND IN THE SOUTHERN EGYPTIAN RED SEA

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Being able to monitor and assess abundance of marine turtles in their feeding grounds is necessary to understand trends and evaluate the impact of threats on those populations. However in-water monitoring is usually costly and estimates can vary according to the technique used. We compared two methods (photo-identification and snorkeling transects) to estimate seasonal variation in population abundance at Marsa Abu Dabbab, a major feeding ground for green turtles in the Southern Egyptian Red Sea. From September 2011 to August 2012 (excluding December 2011), we conducted monthly snorkeling surveys along fixed transects. While snorkeling, we counted every visible turtle, estimated the visibility and thus the width of the belt transect and collected other data on turtles as species, approximate size and gender. We also took pictures of both sides of the head and the carapace of each turtle observed during each transect. To estimate the abundance of turtles using the belt-transect method, we simply assumed that the density of turtles in the surveyed area is the same as in the total bay. We recorded 196 sightings, all green turtles (mean daily sightings=6.3±2.7, range: 0-11, no of days=31). Mean visibility was 13.0±3.6 m (range: 6-18 m, n=31). We found that there was no significant correlation between the visibility and the number of observed turtles (r=0.3494, df=30, p=0.0540). Using the belt-transect method we obtained an average monthly population of 29.8±15.5 turtles (CI 95%: 24.1-35.5). We also found that the relative abundance of green turtles during the nesting season (n=16, mean=23.7±3.6, CI 95%: 16.4-31.0) is significantly lower than during the non-nesting season (n=15, mean=36.3±3.7, CI 95%: 28.7-43.8)(n=31, df=1, F=5.9818, p=0.0208). As for the photo-identification method, we used the unique design of the lateral scutes as a natural marker to identify each new and recaptured individual. We then used closed and open-population capture-mark-recapture models during the non-nesting season because the population was assumed closed between the months of October and April. Using package Rcapture in R, the best closed-population models based on the AIC criteria were models Mth (Chao, Darroch, Poisson and Gamma): under those models the population was estimated to be between 37.6±2.6 with model Mth Poisson and 46.5±12.4. During the nesting season, an open-population model was used and population size estimates varied between 12.4 ±0.8 in July 2012 and 29.5±4.7 in May. The two methods gave very close results with an increased population during the non-nesting season. This can be explained as 65% of the green turtles in the bay are sexually mature individuals that possibly migrate to the breeding grounds during the nesting season. The belt-transect method has the advantage of being relatively inexpensive and can be used in small areas where turtles are not snorkeler-friendly. The photo-ID method on the other end allows researchers to collect also other information as individual growth and migrations. We are at present using a combination of the two methods on other 11 feeding grounds to estimate the relative abundance of green turtles in the Egyptian Red Sea waters. We would like to thank the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America for providing us with a travel grant to participate in these meeting.

BODY SIZE MINIATURIZATION OF LOGGERHEAD SEA TURTLES NESTING ON MINABE-SENRI BEACH, JAPAN

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We measured carapace length of loggerhead sea turtles nesting on Minabe-Senri Beach, Wakayama, Japan since 1990. The standard straight carapace length (SCL) of the 757 females ranged from 700 to 960 mm. Annual average of SCL was on a declining trend with yearly fluctuations. Considering that the mean SCL of 890 mm for 118 females nesting on Kamoda Beach, the nearest rookery in 1972, body size of loggerhead nesting females in this region seems to decrease consistently in last four decades.

PHYLOGEOGRAPHY OF ATLANTIC GREEN TURTLES: INSIGHTS FROM MULTIPLE GENETIC MARKERS

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The interacting effects of past and current processes on population distribution over time constitute an active research area increasingly central to conservation biology. Despite the species' globally endangered status, historical processes leading to the current distribution of highly migratory green sea turtles are insufficiently understood. Genetic analysis is a powerful tool for uncovering population history and connectivity, and our aim was to address key remaining questions of Atlantic green turtle phylogeography. Fifteen nuclear microsatellite loci were genotyped from six Western Atlantic rookeries (n = 301) and analyzed with respect to published mitochondrial data (n = 1,205) using Bayesian methods. Statistical analyses revealed two Western Atlantic rookery clusters: southern (Brazil) and northern (USA, Costa Rica, Surinam, and Venezuela). Genetic differentiation among and within clusters was low but generally significant, although there was substantive migration between them. Analysis of the two divergent Atlantic/Mediterranean mitochondrial lineages revealed similar clusters except for Aves and Surinam, which grouped instead with southern and central rookeries. Analyses indicated these lineages split about one million years ago. The spatial distribution of multiple genetic markers was consistent with the historical existence of two glacial refugia. Expansion out of the refugia occurred around the time of the Last Glacial Maximum or earlier, and was followed by mixing around the central Aves and Surinam rookeries. This study provides a more complete historical context and refined understanding of population structure, thus enhancing conservation and recovery efforts for this globally endangered species.

COMBINED GENETIC ANALYSIS AND DISPERSAL MODELLING REVEAL DIVERSE NATAL ORIGINS OF GREEN TURTLES FORAGING AT THE PALMYRA ATOLL NATIONAL WILDLIFE REFUGE, CENTRAL PACIFIC

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Population connectivity and spatial distribution are fundamentally related to the ecology, evolution, and behavior of many species including cryptic marine organisms. In the marine realm the life histories of diverse taxa are shaped by movements that vary among stages, such as dispersal primarily driven by ocean currents in younger individuals, and directed migration later in life. Highly migratory and globally endangered green turtles are important elements of diverse and often distant ecosystems that may be connected in unknown and surprising ways. Genetic analysis is a powerful tool for investigating marine turtle connectivity and tracing unknown natal origins of feeding ground populations. However limitations can include high confidence intervals and incomplete sampling. Simulating hatchling dispersal within an ocean circulation model is a technique that allows us to generate spatially explicit predictions based on statistically robust sample sizes (i.e., calculating trajectories for thousands of virtual particles). Our objective was to combine these methods to determine the unknown natal origins of green turtles foraging at the Palmyra Atoll National Wildlife Refuge (PANWR), Central Pacific. We extracted hindcast output from the Global Hybrid Coordinate Ocean Model to examine how surface currents might influence the probability of green turtles from different nesting beaches reaching the PANWR foraging grounds, and used particle-tracking software to identify possible migratory corridors juvenile turtles might use to reach the PANWR. In addition, we used regional analyses of mitochondrial control region sequences from turtles collected at the PANWR during a five-year period (2008-2012). Genetic analysis revealed widespread origins ranging from the distant eastern Pacific to closer central Pacific islands. Our modeling results also indicated that turtles could potentially reach the PANWR via surface currents coming from the eastern, central, and to a lesser extent western Pacific. The emerging story of diverse PANWR origins contrasts with the more localized, self-contained Hawaiian green turtle stock, contributing to a complex model of green turtle dispersal in this region.

INTEGRATING DETECTABILITY AND ABUNDANCE IN ASSESSMENTS OF SEA TURTLE POPULATION TRENDS

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Assessments of population trends based on abundance data alone, without accounting for detectability, can lead to erroneous conclusions. Population trends of threatened and endangered sea turtles worldwide are often based on counts of nests or nesting females. We analyze 39 years (1973 to 2011) of nest-count, female-count, and capture-mark-recapture (CMR) data for nesting loggerhead sea turtles (*Caretta caretta*) on Wassaw Island, Georgia, USA. Annual counts of nests and females, not corrected for detectability, yield significant, positive trends in abundance, suggesting an increasing nesting population of loggerheads. Multistate open robust design modeling of CMR data that accounts for changes in detectability, however, reveals that the annual abundance of nesting females has remained essentially constant throughout the study period. The dichotomy is primarily a result of methodological improvements incorporated over the study period that increased detectability and thus the probability of encountering nesting females and nests. This study is the first comparison of sea turtle population trends that do and do not account for detectability and demonstrates the potential for serious misinterpretations of data. Past assessments of sea turtle population trends based exclusively on abundance data should be interpreted with caution and re-evaluated when possible. These concerns apply equally to a wide range of species, many of which are threatened or endangered, that are currently monitored with count data not corrected for detectability.

DEVELOPING QUANTITATIVE TOOLS TO EVALUATE RECOVERY IN GREEN SEA TURTLES, *CHELONIA MYDAS*: A RESEARCH PROSPECTUS*

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Green sea turtles, *Chelonia mydas*, have increased dramatically in the Hawaiian Islands and Florida. There is a need to determine the best tools and practices for incorporating vital rate information into population models to assess population size and status. These populations provide an opportunity to identify changes in vital rates (survival, growth and reproduction) that are associated with population growth and recovery. For the Hawaiian and Florida populations, we ask three main questions. Do key life history traits vary over time? Which population models are most accurate and reliable? Which management options work best to maintain population recovery? Data from the NOAA Pacific Islands Fisheries Science Center Marine Turtle Research Program and the Florida Fish and Wildlife Research Institute will be used to determine if and how life history parameters change over time. The time-variant life-history estimates can be incorporated into the population models to estimate overall population trajectory and status. We will test a variety of population models, and use model selection metrics, e.g., Akaike's information Criterion, to determine which models are appropriate for each population according to their fit to available data. These new models can be compared to regression models of nests over time to determine if there is an increase in population size. But, model selection will be more powerful if we can compare model output using multiple data sources. These include detectable shifts in demographic variables that are linked to adult recruitment, or size distribution changes in the juvenile population. Recovering populations are useful for model development because they often show shifts in age structure that are related to changes in vital rates, which can themselves be linked to management actions. This can reduce uncertainty in model parameterization. The life-history traits will likely show changes over time, yet the direction of the change may depend on the history of anthropogenic impacts. For example, a population recovering from harvested adults and subadults will likely show expanded length-frequency distributions, overall more individuals in each size class and older size classes. This is a pivotal point in the natural history and conservation of *C. mydas*. Understanding how a population is changing as it recovers provides useful ecological and conservation knowledge that can be applied to other populations and species. By using quantitative methods to examine long-term data sets, we can find answers to questions about how life history traits have changed over time, and also which vital rates best indicate population change. Furthermore, we can derive robust nester population estimates, and ultimately confirm the status of *C. mydas* populations. Finally, we hope to use the best-fitting models to understand how these populations may respond to a changing environment and to identify which management actions will best support the species in the future.

MIGRATION OF GREEN TURTLES (*CHELONIA MYDAS*) BETWEEN NESTING AND FEEDING GROUNDS ACROSS THE CORAL SEA

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A review of the data collected over the last 50 years by different projects on the migration of *Chelonia mydas* to and from New Caledonia (n=94) indicate that 1) females nesting at D'Entrecasteaux atolls (New Caledonia) are found in feeding grounds all along the Queensland coast up to Papua New Guinea but also in New Caledonian waters, and 2) females known to nest in the Great Barrier Reef are found in feeding grounds located in New Caledonia. Most of the tag recoveries belonged to females part of the south Great Barrier Reef genetic stock. These females showed fidelity to foraging sites located 2000 km away from the nesting site located in New Caledonia. Most of the recaptures were done by fishermen that hunt turtles for food. An extended analysis will be presented of the distances and locations travelled by the individuals, their sizes and the likelihood of recoveries. Genetic sampling at d'Entrecasteaux will occur in November 2012 and thus results will be available.

GENDER IN A MIXED STOCK GENETIC ANALYSIS OF SUBADULT LOGGERHEAD SEA TURTLES

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Loggerhead sea turtle mtDNA haplotype data have been used in several previous studies to estimate nesting beach contributions to mixed feeding assemblages. However, given the known life history differences between male and female sea turtles, there may exist gender specific nesting beach contributions. Here we analyze both serum testosterone data and mtDNA haplotype data collected during eight summers spanning a twelve year period (2000, 2001, 2002, 2004, and 2008, 2009, 2010, 2011) to estimate the temporal stability of nesting beach contributions to a mixed stock feeding aggregation of loggerhead sea turtles located along the southeastern coast of the United States. In addition, this unique combination of genetic and serum testosterone data in subadult sea turtles will allow for a gender specific analysis of nesting beach contributions to subadult foraging grounds. This gender based approach to mixed stock analyses is especially critical in sea turtles as nesting rookeries have highly variable sex ratios; not utilizing a gender based approach can mask the importance of rookeries that would be undervalued based on rookery size alone. We anticipate overall findings congruent with a previous single-year analysis that demonstrated a disproportionately large contribution from the nearby nesting populations relative to more distant populations. Further, we anticipate that the uneven nature of nesting beach gender production will increase this disproportionate contribution when gender is considered in the mixed stock analysis. These findings will be discussed in the context of a warming climate further changing the relative importance of nesting

beach contributions to overall reproductive success, particularly as it relates to the smaller loggerhead nesting beaches of the northwest Atlantic ocean.

GENETIC SIGNATURE OF POPULATION BOTTLENECKS IN THE OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) AFTER COMMERCIAL EXPLOITATION IN MEXICO: IMPLICATIONS FOR CONSERVATION

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Information on the demographic and genetic consequences of overexploitation, such as human-induced genetic bottlenecks, are often difficult to detect on ecological time scales. Nesting colonies of *Lepidochelys olivacea* in Mexico were severely impacted by a commercial fishery between 1960 and 1990. Although nesting activity has apparently increased in the last decade, multilocus assessment of the genetic consequences of the commercial fishery on nesting rockeries are needed. Here we analyzed genetic variation from ten microsatellite loci of 365 samples representing 18 nesting sites across the Mexican Pacific coast. We detected population bottlenecks for five nesting areas, providing genetic evidence compatible with the demographic disequilibria produced by their recent over-exploitation. We also report on nuclear DNA support for a genetically differentiated management unit in Baja California Peninsula (FST =0.01, P<0.001) and clarify population structure in other areas. The genetic results reported here are important for management purposes in Mexico and also contribute nuclear DNA data to challenge the generally accepted panmixia hypothesis for Olive ridley in the Eastern Pacific.

PREDICTED SEX RATIOS OF JUVENILE GREEN TURTLES (*CHELONIA MYDAS*) ALONG THE EAST COAST OF FLORIDA, USA

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Temperature-dependent sex determination (TSD) has been a fascinating topic to researchers for decades. Substantial time and effort have been spent on beaches, examining sex ratios of sea turtle hatchlings, in order to understand the effects of TSD and to gain information about baseline sex ratios being produced in various regions. Recently the field has gained greater attention in light of climate change predictions. In addition to hatchling sex ratios, effort has been put into collecting information on juvenile sex ratios. There are several advantages to sampling the juvenile life stage. Since these developmental areas consist of multiple age cohorts, a snapshot of the juvenile sex ratio represents a condensation of many years of hatchling production. Sex ratios of juvenile aggregations will not only provide baseline data on ratios being represented at this life stage, but will also come into conservation importance as the climate changes. The objectives of this study were to 1) characterize the sex ratios of multiple juvenile green turtle aggregations along the coast of Florida, and 2) provide a snapshot comparison of how sex ratios have changed using

historical data from the 1990s. The three juvenile green turtle aggregations used in this study are found on the east, central coast of Florida, at the Trident Submarine Basin at Port Canaveral, in the Indian River Lagoon (IRL) near Sebastian Inlet, and at the Saint Lucie Power Plant on Hutchinson Island. Blood samples were collected over the course of a year at all locations, then were subject to testosterone analysis through radioimmunoassay (RIA). A previous study done from 1995-1997, using RIA, demonstrated extremely female-biased populations at the Trident Basin (5.71 females: 1 male) and in the IRL (5.27 females: 1 male). The IRL has a history of sex ratios going even further back, to 1987, where the calculated ratio was nearly one female to one male. Objective 2 was addressed by comparing the most recent data to these previous results using a G-test. By continuously studying the same population over a long period, we will have a much better understanding of how juvenile sex ratios vary temporally and how they respond to climate change. This information is critical to an effective conservation effort for the green turtle. Attendance to the symposium for C. Sanchez was made possible through the International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Lotek, Sirtrack, Telonics, CLS America, and the International Sea Turtle Symposium through the Travel Grant.

ANNUAL SURVIVAL OF JUVENILE LOGGERHEADS IN THE NORTH ATLANTIC OCEAN

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Understanding the mortality of the various life history stages of sea turtles is key to developing population assessments of protected species. This is especially so for the pelagic stage of juvenile turtles, for which little such information is available. Juvenile loggerhead sea turtles, captured via dip-net in the North Atlantic Ocean, were satellite-tagged to assess annual survival: 24 pop-off archival transmitting tags (PATs) were deployed on 45-60 cm turtles and 13 Mini-PATs were deployed on 30-45 cm turtles. Twenty-four pop-off archival transmitting tags were deployed on 45-60 cm loggerhead turtles and 13 Mini-PATs were deployed on 30-45 cm loggerhead turtles that had been captured via dip-net in the North Atlantic Ocean to assess annual survival. A known fate model with the transmission data was used to estimate annual survival rates and determine if there were differences in survival between the two groups. The best model of the data suggested there was no difference in survival between the groups and time was constant across month for both groups.

CATCH RATES, SPATIAL DISTRIBUTION, AND DEMOGRAPHICS FOR KEMP'S RIDLEY SEA TURTLES (*LEPIDOCHELYS KEMPII*) CAPTURED IN NEARSHORE COASTAL WATERS BETWEEN WINYAH BAY, SC AND ST. AUGUSTINE, FL (2000-2012)

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Since 2000, the National Marine Fisheries Service has funded and permitted a regional sea turtle trawl survey from South Carolina to northern Florida. Key metrics for loggerhead sea turtles (*Caretta caretta*) in this survey have recently been reported. Here, we present temporal and spatial catch rate trends for Kemp's ridley (*Lepidochelys kempii*) sea turtles. Between 2000–2003 and 2008–2012, research trawlers sampled 5,151 stations and captured 164 Kemp's ridley from May-August. A maximum of three Kemp's ridley were captured in a single event and most positive catch events consisted of just one Kemp's ridley. Spatial analysis revealed that 10% of sampling events were associated with hot spots and captured 53% (n = 87) of Kemp's ridley. Three percent of sampling events were associated with cold spots and resulted in no Kemp's ridley captures. Temporal catch trends were examined using a generalized linear model for a subset of sampling events (4,489) with complete environmental data (21 total variables) in which 150 Kemp's ridley were captured. Kemp's ridley catch per sampling event was fit to a negative binomial distribution to examine catch trends. Four model terms accounted for 24% of total data set deviance. Year explained 9% of data set deviance due to 46% of positive catch events and 52% of captured individuals having occurred during 2011-2012. Mean water depth during the trawl and distance from shore accounted for 8% and 3% of data set deviance, respectively. Subregion accounted for 4% of data set deviance. Kemp's ridley were captured across the latitudinal sampling range; however positive catches were greatest south of Savannah, Georgia and decreased northward along the South Carolina coast. Kemp's ridley sea turtles captured in this survey ranged in size from 23.1 to 63.4 cm straight carapace length (SCLmin), but 94% were <60 cm SCLmin. Recent catch increases have also favored smaller Kemp's ridley, with 58% (29 of 50) of individuals ≤35 cm SCLmin captured since 2011, consistent with neritic recruitment following exponentially increased nesting in the Gulf of Mexico in the past five years. Testosterone radioimmunoassay suggests that Kemp's ridley sea turtles captured in this survey are predominantly female; however, validation through laparoscopy has not been conducted. Genetic analyses have documented four distinct haplotypes, but are dominated by the haplotype LK-1. Sex and genetic data for samples collected in 2012 (~one-third of genetic samples collected in this survey to date) are pending, but will be included in this presentation. The long-term trends reported here represent important missing pieces for Kemp's ridley management in the southeast United States. Continued nesting increases at primary nesting beaches in Mexico foreshadow continued Kemp's ridley catch increases along the Atlantic coast. As such, we anticipate further opportunity to monitor catch rates and to develop analytical partnerships for Kemp's ridley on par with those that currently exist for loggerhead sea turtles in our survey. Moreover, concurrent collection of sex ratio and genetic haplotype data will provide crucial insight regarding demographics in this critical habitat for developing juvenile Kemp's ridley.

DEMOGRAPHIC ISOLATION AND COLONIZATION OF SOUTHERN GREATER CARIBBEAN GREEN TURTLE ROOKERIES WITH AN EMPHASIS ON FEMALES NESTING ON BUCK ISLAND, UNITED STATES VIRGIN ISLANDS

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Genetic tools have proven valuable for inferring demographic partitioning among nesting populations as well as estimating rookery contributions to mixed foraging aggregations. However, extensive genetic marker sharing can confound inferences of demographic connectivity and colonization pathway hypotheses as well as introduce uncertainty into rookery contribution estimates for mixed stock analyses when haplotypes are based on short control region sequences. We tested the utility of mitogenomic variable positions combined with mitochondrial microsatellite repeat (mtSTR) sequences to reassess the genetic structure of four green turtle rookeries in the southern Greater Caribbean region that share common 490 base pair haplotype CM-A5 at high frequency: Tortuguero, Costa Rica; Galibi, Suriname; Aves Island, Venezuela; and Buck Island, St. Croix, United States Virgin Islands. We further explored potential colonization scenarios through genotyping nesting females representing the small but increasing Buck Island rookery at 50 microsatellite loci to determine pairwise relatedness. We previously demonstrated through sequencing of mitogenomic variable positions that CM-A5 actually represents at least four distinct lineages partitioned among regional rookeries, with CM-A5.1.2 accounting for nearly all CM-A5 females nesting at Tortuguero, CM-A5.2 occurring primarily in the Aves Island rookery, and CM-A5.1.3 shared at high frequency between Buck Island and Aves Island. Haplotype CM-A5.1.1 was inferred as ancestral based on its central position in the haplotype network incorporating the novel mitogenomic variable positions. CM-A5.1.1 was the only CM-A5 subhaplotype recovered for the Galibi rookery and occurred in the other three rookeries as well, supporting the hypothesis that the CM-A5 lineage has colonized northward and westward from the coast of South America. We revisited the structure of these rookeries through sequencing of mtSTR loci previously shown to be highly polymorphic in the Mediterranean green turtle aggregation. The four mitogenomic CM-A5 haplotypes were further subdivided into 20 mtSTR haplotypes. CM-A5.1.1 was subdivided into 11 mtSTR haplotypes that were strongly partitioned among rookeries. Two mtSTR haplotypes were shared between Suriname and Buck Island that were not detected among the sampled Aves Island females, evoking the possibility of colonization from quite distant rather than proximal rookeries. Over 60% of the CM-A5.1.1 Buck Island nesters carried an mtSTR haplotype unique to this rookery. CM-A5.1.3 was subdivided into three haplotypes, with 66% of the Buck Island nesters carrying a haplotype not detected in the Aves Island sample. The mtSTR results reinforce inferences of pairwise relatedness generated from 50 microsatellite loci for the Buck Island nesting females. Nearly half of all tagged nesting females were assigned to just two maternal clusters, each of which carried an STR haplotype unique to Buck Island. These results suggest that colonization of novel nesting habitats may occur from close and distant source rookeries, and that rookeries can increase rapidly through recruitment of daughters from a small number of successful nesting females. Although genetic studies typically focus on large rookeries, deep sampling of recovering and nascent rookeries may yield additional insights into the colonization process and how marine turtles will adapt in the face of global climate change.

CLUTCH FREQUENCY AND NUMBER OF NESTING LOGGERHEADS (*CARETTA CARETTA*) AT THE ARCHIE CARR NATIONAL WILDLIFE SANCTUARY DURING THE 2010, 2011 AND 2012 SEASONS*

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Concerns over the status of loggerhead sea turtle (*Caretta caretta*) populations in the United States have been raised due to a dramatic decrease in nest production between 1998 and 2004. These concerns generated renewed interest in vital demographic rates on nesting beaches (clutch frequency, number of nesting females, annual survival, remigration interval, etc.) that drive nest production but to date have not been well understood. Many of these values can be generated through the analysis of mark-recapture data from nesting females on beaches such as the Archie Carr National Wildlife Refuge using modern mark-recapture statistical methods. Data for this presentation were collected during the 2010, 2011 (completed) and 2012 (ongoing) loggerhead nesting seasons at the Archie Carr National Wildlife Refuge, Florida, USA. Analysis of the 2010 and 2011 loggerhead nesting data has been completed using Open Robust Design (ORD) models in program MARK. Each annual data set was formatted as a single season and run through a basic set of models created by manipulating three sets of parameters (pent, phi and p). These three elements are informative in their own right (indicating the structure of arrivals: pent; probability of renesting: phi;

and detection probability: p) but they can also be used to derive estimates of residence time (number of clutches per female) and N (number of nesting females) during each of the two seasons in question. Detection probabilities (p) for both seasons were low (~15-20%), leading to uncertainty as to whether such analysis would produce viable results. Program Release was run through program MARK for both years and indicated good fit of the models to the data. The model-averaged estimate of population size (N) for the 2010 season is 2,167 (95% CI: 1,558-2,775) and it is 2,515 for the 2011 season (95% CI: 935-4,097). Model-averaged residence time (number of nesting attempts per female) is 5.53 for the 2010 (95% CI: 5.2-5.9) data and 3.69 for 2011(95% CI: 1.85-5.54). Analysis of the 2012 data is forthcoming and will be included in the presentation. Results of these analyses show that important variation in number of clutches per female exists between years at the Archie Carr National Wildlife Refuge. Acknowledgments: I would like to thank all of the sponsors of the travel grant (International Sea Turtle Society, U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, Ecoteach, Defenders of Wildlife, Sea Turtle Conservancy, Defenders of Wildlife, Lotek, Sirtrack, Telonics and CLS America) and the International Sea Turtle Society for their support in providing my lodging while in Baltimore making it possible for me to attend the meeting.

VARIATIONS IN THE OPERATIONAL SEX RATIO FOR BREEDING LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*) OVER THREE NESTING SEASONS AT ST. CROIX, USVI.

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For marine turtles, the adult breeding sex ratio, or the operational sex ratio (OSR) is important to know for population modeling purposes as well as for monitoring the status of a population. Previously we demonstrated that for leatherback turtles in St. Croix (USVI), there were as many males as females in a given year that were actively breeding. In 2010, we found that for 46 females (a subset of the nesting females that year), there were 47 males that had been actively breeding with those turtles. We expanded this study to look at OSR over multiple years to A) determine if operational sex ratios changed from year to year, B) to identify males that may have been breeding yearly and C) to complete a male census for this nesting population. Since we had already evaluated male turtles for the 2010 nesting season, we looked at the OSR for 2009 and 2011 at St. Croix. To do so, we genetically fingerprinted nesting females and their hatchlings using 7 polymorphic microsatellite markers. Then with GERUD1.0, we were able to identify fathers for each of the hatchlings and infer male genetic fingerprints. In 2009, we evaluated 1051 hatchlings from 99 females and in 2011 we fingerprinted 755 hatchlings belonging to 65 females. Over the 3 years of the study we found that the male to female ratio remained fairly stable at nearly 1:1 and changed only marginally over the time frame. We found that a few males that had mated in all 3 years, some that mated in 2 years and more commonly, we found that most males had mated in just one year. It should be noted that just because a male was not identified in the genotypes of the hatchlings, it should not be inferred that the male was not at the nesting grounds attempting to mate. We have now identified 190 individual males at this nesting rookery, thus providing a census of the breeding males in this population. It is now possible to monitor the breeding activity of male turtles at any nesting ground and this work shows the potential for evaluating male reproductive success or fitness, as well as quantifying the annual nesting population of males and females.

ESTIMATES OF LOGGERHEAD CLUTCH FREQUENCY AT MASIRAH, OMAN DERIVED FROM SATELLITE TRACKING

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Oman hosts the largest loggerhead nesting aggregations in the Indian Ocean. The historical track-count surveys for reliable estimates of loggerhead abundance date from 1977-79 and 1991. Based on these surveys, an estimated 20 to 40 thousand females have nested annually on Masirah Island. An untested but key assumption to interpret the Masirah track counts was adoption of a clutch frequency value of 4.0 nests per female a year. Particularly at remote rookeries, for animals with unknown site fidelity, or for high density nesting sites, it may be impractical to determine clutch frequency from verified observations of all nesting events such as attempted during saturation tagging projects. Estimates of annual nesting numbers at Masirah depended upon extrapolations from limited counts of nesting attempts and upon tagging of nesting turtles, with corrections for partial effort. More recent efforts have developed interagency partnerships to better quantify the status of the Masirah rookery, recognized as one of two significant loggerhead rookeries at an international level. With up to 80 nesting attempts per km / night at the peak of the nesting season and over 60 km of nesting habitat involved, it was not feasible to reliably distinguish remigrants from newly tagged females at this population, despite a tagging program using flipper tags and PIT tags. We therefore attempted to derive estimates of site fidelity and clutch frequencies for females sampled by satellite telemetry at Masirah. Satellite transmitters were applied to females early in the 2010 to 2012 seasons to catch the first nesting females of the season and account for inter-annual variability in nest production. Masirah females during the internesting period are often sedentary near the island which complicates the identification of subsequent nesting emergences from characteristics of the satellite transmissions. Even so, preliminary estimates derived by satellite telemetry yielded a mean annual clutch frequency of 5.5 (n=4), 5.2 (n=18), and 5.8 (n=12) clutches per female from those seasons. An overall mean was 5.5. nests (SD = 0.87, range of 4-7 nests). Satellite telemetry provided improved measurements of site fidelity and suggests a need for revised fecundity estimates. A review of track count data from standardized surveys of recent nesting seasons on Masirah (2008-2012) is currently in progress. It is intended that a combination of new surveys augmented by satellite telemetry would yield a more accurate interpretation of recent and historical records to yield crucial population trends. A revised status assessment would be based upon new data from current nesting activity and recent clutch frequency data. The Masirah loggerhead population will soon be re-evaluated from comparisons of the early and recent surveys (taking into account differences in methodological approaches), and whether overall trends are apparent for the nesting population (a temporal difference).

IS THE MAJOR FLORIDA LOGGERHEAD ROOKERY IN THE GULF OF MEXICO EXPERIENCING DECADAL POPULATION OSCILLATIONS?

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The Southwest Florida rookery is a unique genetic entity within the Northwest Atlantic loggerhead regional management unit. Six barrier islands of Sarasota County in Southwest Florida collectively host the highest density (peaks of 100-200 nests/km) of loggerhead nesting within the Gulf of Mexico. Monitoring of these islands (Longboat Key, Lido Key, Siesta Key, Casey Key, Venice Beach, and Manasota Key) has been conducted systematically over three decades, revealing strong annual fluctuations in nest counts. The 2012 season concluded with the highest level of recorded activities since systematic monitoring began. Preliminary totals of 4616 loggerhead nests and 42 green nests are both new records. Each island has its own unique features and history. Several of the islands have had a series of beach nourishments and the extent of coastal development varies, with the least developed islands having higher nesting densities. However, nest count fluctuations appear unrelated to displacement from erosion hotspots or recently nourished beaches. While green turtle trends have increased steadily from 1994 to 2012, loggerhead nesting has oscillated on the same nesting beaches. Loggerhead numbers increased from 1991 to 1998, declined from 1998 to 2007, and increased from 2007 to 2012. Evidence of alternating periods of population increase, decline, and increase appear at first glance to agree with a hypothesis that North Atlantic Multi-decadal Oscillations are influential as drivers of annual loggerhead nesting activity. However, the present monitoring study found that the most extreme fluctuations had occurred within a five-year time span - less than the predicted time scale, from a low of 1592 nests in 2007 to a record high of 4616 nests in 2012. It is tempting to speculate beyond these data, but future years of monitoring are needed to discriminate whether a predicted decadal period has shortened substantially (a frequency shift), or whether the increasing trend will continue through the remainder of the predicted decade (an amplitude shift). Among the associated factors that warrant further study are shifts of immigration among rookeries, generational time lags associated with fluctuations in hatchling productivity or primary sex ratios, changes in female remigration periods, variability in female per capita reproductive output, and variable time frames for mortality and recruitment.

EVIDENCE OF RECOVERY OF THE ARRIBADA OLIVE RIDLEY POPULATION AT NANCITE BEACH, COSTA RICA

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Nancite beach, located on the northwest Pacific coast of Costa Rica, was one of the first two olive ridley arribada rookeries to be discovered in 1970. Since then, various studies have monitored the abundance of ridley turtles in each of the arribada events over the years. Early data showed a robust population with individual arribadas amounting to an average of 194,250 individuals for the period 1981-84. Since the early 1980s, however, the population has undergone a significant decline with more recent numbers indicating a collapse in the population. Early speculations suggested that this population decline was due to the very low hatching rate that this rookery has exhibited since its original discovery, which resulted from the poor incubation microenvironment from many broken eggs when the population is elevated. This gave rise to the hypothesis that arribada rookeries undergo natural population cycles in which, during a crash, nest destruction is significantly reduced thus promoting a healthier incubation microenvironment with a subsequent increase in hatchling production. Greater hatchling input into the marine ecosystem would then result in increased recruitment to the adult population, strengthening the nesting population. We report here preliminary evidence supporting the natural cycles hypothesis based on our long term dataset collected at Nancite beach. To address the hypothesis we have collected data on arribada abundance at this beach for the period 1970 to present, including published accounts and our own data. Our data on arribada abundance was collected mainly using the instantaneous count or transect method, which allows the estimation of the number of effective females that nest during arribadas. In addition to this, we have nearly continuously monitored hatching rates at this beach since 2007. To do this, we marked a number of nests each arribada and tracked the fate of the each after every mass nesting event. We then compared our data with the historical dataset for this beach. With regard to the trend in the arribada population our numbers indicate that since 1970 the population has undergone a reduction of 90%, reaching its lowest point in the mid 1990s and then again around the year 2000. Since then, however, the population has remained stable, exhibiting an average of 23,900 turtles per year since 2007. Along with this, our numbers show that annual hatching rates average 70% since 2007, compared with 17.04% for the period 1981-84. We do not know whether the increased hatching rates will actually result in an increase in the population because life stage-specific mortality is unknown for this population. However, assuming that mortality rates are not significantly detrimental and that these hatching rates will remain elevated for the next 2 or 3 decades, it is conceivable that the Nancite population may rebound within the next few decades after that. Only the long term monitoring of this population will help elucidate the power and appropriateness of the arribada life cycle hypothesis.

MIXED STOCK ANALYSIS OF LEATHERBACK TURTLES FEEDING IN BRAZIL: RECORDS OVER FOUR YEARS

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The population of leatherback turtles (*Dermochelys coriacea*) nesting in Brazil is restricted to very few individuals, regularly nesting on the coast of the Espírito Santo State. However, a larger feeding aggregation occurs throughout Brazilian waters, with higher concentration off the south and southeast coasts. The objectives of this study are to estimate the contribution of source rookeries to a Brazilian feeding ground using population genetic measures and Mixed Stock Analysis (MSA), to describe the haplotypes found for two previously genetic undescribed rookeries: Gabon and Guadeloupe/Martinique, to increase the number of samples from Brazilian and French Guianan rookeries and to compare the data obtained with previous reports. To compare the sequences between leatherbacks from Brazil and elsewhere, we analyzed 496 bp of mitochondrial DNA (mtDNA) control region from leatherbacks stranded on beaches (n=90) and incidentally caught by fisheries in Brazilian waters (n=9) from January 2004 to December 2007. We also analyzed samples of nesting females from a rookery in Gabon (n=23) and from two rookeries in Guadaloupe and Martinica (n=29) and additional samples from rookeries in French Guiana (n=29) and Brazil (n=14). The MSA was run using haplotypes from the pelagic leatherbacks (n=99) and from 15 rookeries found worldwide from previously reports (overall n=386). Information from the literature regarding the number of females nesting per year in each population was used as a prior. An overall of 14 different haplotypes were described using the entire database. The most common haplotype, called A was found in 171 samples (44,30%). This haplotype was spread across all rookeries except for the Pacific coast of Mexico and Costa Rica. The haplotype A2, found for the first time only at the foraging area in Brazil, now was also found in samples in rookeries from Brazil and Gabon. Two new haplotypes (A5 e C3) were found in this study, both in samples from French Guiana. For the MSA, all chains consistently indicated a major contribution to the Brazilian pelagic aggregate from Gabon (77,7%), the largest populations of leatherback in the world. Efforts should be done in order to produce longer mtDNA and nuclear sequences in widespread worldwide samples to improve the confidence of data in phylogeography and MSA. Furthermore, MSA studies provide relevant data connecting nesting and feeding sites, and it is also important information for planning management strategies aiming to enhance conservation efforts worldwide. Acknowledgments: FAPES, Capes, CNPq, Fapemig and ISTS Program Committee

INDIVIDUAL IDENTIFICATION OF GREEN TURTLES (*CHELONIA MYDAS*) USING THE PARIETAL AND INTERPARIETAL SCALE PATTERN

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Individual identification is an important tool in ecological and behavioral studies. Photo-identification techniques have been used to estimate population parameters of aquatic mammals, but have seldom been used in other marine animal groups. In sea turtles, individuals are marked and identified through the use of metal tags, but recent studies indicated that photo-identification of facial scale patterns may be reliable for identifying and marking individuals in a population. This study aimed to validate the identification of individuals of *Chelonia mydas*, using the parietal and interparietal scale pattern. Data were collected by monitoring the beach seine fisheries between August 2008 and May 2012 at Itaipu beach, Niteroi, Rio de Janeiro, Brazil. Green turtles incidentally caught by fishers were measured and photographed in the head, where the parietal and interparietal scales are located. The number of parietal and interparietal scales ranged from one to five scales. Scales also differed in form. These characteristics were used as criteria for assessing whether a photographed individual was a new capture or a recapture. We photographed 163 green turtles, out of which 68 were tagged with metal tags. We recaptured 49 animals, 20 identified with metal tags. To validate the photo-identification method, a double-blind test was applied using volunteers for the study. We selected one capture and one recapture photograph of 12 animals that also received metal tags adding up to 24 pictures. Each picture was assigned a randomly selected number to avoid biased identification either by the test applicator or the volunteer. Photos were randomly grouped into pairs and showed to volunteers to respond whether the photos were of the same individual or not. A total of 56 tests (one test for each volunteer) were applied, totaling 672 samples (responses). Chi-square tests were performed, to look at significant differences between right and wrong answers, types of wrong answers (false positive and false negative) and between right, false positive and false negative answers. In all tests the null hypothesis of equal frequencies was rejected. Correct answers accounted for 92% of the responses. Incorrect answers were 100% false positive. Results of the last Chi-Square test were redundant with 92% of right and 8% of false positive answers. This study indicated that photo-identification of individual *Chelonia mydas* using the distribution pattern of parietal and interparietal scales is a very reliable method not subjected to losses by deterioration, and do not interfere with animal health like artificial marks.

Social, Economic and Cultural Studies

FROM SEA TURTLES TO REEFS: COMMUNITY-BASED MARINE CONSERVATION AND SUSTAINABLE DEVELOPMENT WITH THE COMMUNITY OF FALALOP, ULITHI ATOLL, FEDERATED STATES OF MICRONESIA

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Coral reefs around the world are suffering from multiple stressors, affecting the ecological integrity of coral systems, and the livelihoods of people who rely on them. In the summer of 2012, a reef conservation project was initiated at the request of the community of Falalop, Ulithi Atoll to address a need to work with small autonomously governed communities to strengthen their capacity to manage their coral reefs and associated resources to enhance sustainability during a time of rapid ecological change. This project partnered with and followed the successful efforts of an on-going community-based conservation project, the Ulithi Marine Turtle Program (UMTP), sponsored by The Oceanic Society. As a result of the UMTP, the community wanted to expand their conservation efforts to include reef and resource conservation. Ulithi Atoll, located approximately 185 kilometers northeast of Yap Proper, is home to several "Turtle Islands", of which five are identified as significant green turtle nesting sites by the local people. Nesting turtle monitoring fieldwork has been conducted as part of the UMTP on two of these turtle islands: Gielop Island (1991, 2005 through 2011), and Loosiep Island (2008 through 2011). Community ownership and ongoing support of the UMTP, as well as direct involvement in project management and data collection has led to the success of the project. In line with this effort, the reef survey project worked closely with the community and traditional leaders, and used an approach that included both social science (interview and numerous community meetings) and quantitative ecological assessments (reef surveys and specimen analysis) to develop recommendations to the community. Community members were trained to continue collecting data throughout the year to inform their own management plan. This approach closely followed the model of the UMTP, where community 'field technicians' collect critical sea turtle data. A key part of this approach was to hold educational meetings and explain the ecology of what the science team learned, so community members would understand (for example) the impact of herbivorous fishes on reef ecology and health, and why certain changes to the community's resource extraction methods and patterns may help. Recommendations were provided to resource owners and stakeholders to create their own plan based on what would work best within their cultural and decision making/enforcement framework. The traditional leaders implemented a locally managed marine area (LMMA) that was larger in scope and more comprehensive than what was initially recommended. As a result of the work on Falalop, traditional leaders have requested assistance to develop an atoll-wide plan (fourth largest atoll in the world). In addition, other islands in the Yap neighboring island chain are requesting assistance to create a similar program on their islands. This represents a unique and timely opportunity to advance marine conservation across the western Pacific.

STUDYING SEA TURTLE VOLUNTEERS IN NORTH CAROLINA, USA

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Volunteers participate as monitors and data-collectors in many sea turtle conservation projects in the US and elsewhere. However, there have been few formal studies of sea turtle volunteers, their demographics, motivations and concerns. In 2009, we conducted a survey of 700 people who volunteer with the North Carolina Sea Turtle Project, in collaboration with the state's Wildlife Resources Commission. Volunteer characteristics and motives are described, as are their attitudes to some elements of program management. Results show volunteers share similar demographic characteristics (mostly female, retired, over the age of 60, with higher than average levels of education and income) and are highly motivated to conserve sea turtles and the environment in general. Social goals and contributing to science were less important motives than other categories. Although volunteers are generally positive about the state agency coordinating the work, and believe the data they collect are used, the majority is uncertain about how data are used. We consider what the results imply for volunteer programs in general and for the overall health of the particular project and ways to improve its management.

PERCEPTION OF FISHING COMMUNITIES ON SEA TURTLE POPULATIONS IN THREE NATURAL PROTECTED AREAS SINALOA, MEXICO

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Since ancient times, sea turtles in Mexico have been utilized by humans as a source of protein (meat and eggs), medicine, décor, and ceremonial jewelry. To assess the current state of turtle utilization in Sinaloa, Mexico we surveyed the residents of fishing communities that operate in the waters of three protected natural areas, particularly because there is evidence of mortality caused by anthropogenic activities on turtles from these areas. The results show that 75% had utilized sea turtles recently or in the past, and 25% had never utilized turtles. Turtles are utilized by 41% of consumers because they preferred the meat and by 3% of consumers because they profited from catching turtles.

PERCEPTIONS, PARTICIPATION AND POACHING: IDENTIFYING THE DRIVERS BEHIND ILLEGAL SEA TURTLE USE IN COMMUNITIES ADJACENT TO CAHUITA NATIONAL PARK, COSTA RICA

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The aim of this research was to identify the drivers underpinning illegal harvest of sea turtles and their eggs by residents of communities adjacent to Cahuita National Park on the Caribbean coast of Costa Rica. In 2009, representatives from three adjacent communities at varying geographical distance from the National Park: Cahuita town, Hone Creek and Playa Negra were interviewed using semi-structured face-to-face interviews, designed to obtain information regarding perceptions of sea turtles and management of the National Park. Questions also elicited responses related to use of sea turtles through consumptive and non-consumptive use. Factors identified as influencing poaching behaviour were economic drivers, perceived legitimacy and awareness of regulations, governance, personal morality, and socio-cultural norms. In communities where income levels are variable and unreliable, such as Hone Creek and Playa Negra, economic factors were identified as the major drivers of poaching behaviour. This was due to the consumptive value of illegal trade in sea turtle eggs as a source of income. Conversely, the key driver behind sea turtle use in Cahuita town was found to be non-consumptive through economic gain from turtle-associated tourism and social influence, resulting in high levels of compliance towards National Park regulations. Lack of awareness of sea turtle conservation regulations was recognised as a key factor driving behaviour in all of the communities surveyed, influencing personal morals and perceived legitimacy of regulations. Future management strategies should strive to involve local communities in sea turtle conservation practice as a means of enhancing voluntary compliance towards regulations. Awareness raising campaigns through educational workshops in all communities associated with the National Park is recommended. These should be interactive, enabling open communication and transparency of information between all stakeholder groups and institutional levels, to facilitate change and progress towards both ecological and socio-economic viability of sea turtle conservation within Cahuita National Park.

U.S. SHRIMP INDUSTRY ADOPTION OF TURTLE EXCLUDER DEVICES (TED)—OVER A DECADE LATER: CASE STUDIES FROM TED RESEARCH IN GULF OF MEXICO AND U.S. SOUTH ATLANTIC

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The adoption of Turtle Excluder Devices (TEDs) in the U.S. shrimp trawl fishery in the late 1980s/early 1990s was marred by litigation, civil disobedience as shrimp fishermen blocked harbors, legislative actions by states and the U.S. Congress, and public relations campaigns against the "trawler elimination devices" or TEDs. Sociological studies in the early 1990s identified a suite of socio-economic factors that contributed to the resistance among U.S. Gulf of Mexico shrimp fishermen to TEDs: forced innovation; economic hardship of industry from imported shrimp and loss of catch from TEDs; perception of turtle bycatch problem; perceptions of the TED's effectiveness; interagency conflicts; and uncertainty in enforcement. Nonetheless since the 1990s, existing TED designs and regulations have been improved and a variety of new rigid and soft TEDs introduced. For example, in 1994 a TED modification was approved enabling leatherbacks to escape from small grid TEDs. A 1998 introduction of a new soft-TED, the Parker TED preceded the 2003 release of larger TED escape openings to improve the exclusion of leatherback turtles and adult loggerheads and green turtles. The double-cover escape opening was introduced, consisting of two mesh flaps covering the escape hole, providing enhanced turtle exclusion as well as improved shrimp retention. In this study, we report on preliminary findings from the social, economic and cultural studies component of case studies in collaborative research with U.S. shrimp trawl fishermen in Georgia (South Atlantic), Texas, Louisiana, Alabama and Mississippi (Gulf of Mexico). Interviews were conducted with a dozen captains, crew, NOAA Fisheries scientists, and fisheries extension staff, from April—August, 2012. Interviews were conducted in offices, on fishing docks and buildings, over the phone, and on fishing vessels during collaborative research on new TED designs. Findings are presented in comparison to fishermen attitudes about TED adoption from the early 1990s—while some factors seem less important today (e.g., interagency conflict, uncertainty in enforcement, forced innovation), others have evolved in significant ways. For example, in the summer of 2012 perceptions of TED's effectiveness still plague the industry overall, although loss of catch concerns can be associated with a lack of awareness and capacity in industry of how to install, maintain, and operate TEDs effectively. Additional operational inefficiencies (e.g., fuel costs, regulatory mandates) and market forces (e.g., imports) continue to demand greater productivity from fishing operations and lessen available time to experiment with innovative gear and fishing practices. There have been unintended positive consequences of TED adoption, including removal of other larger, troublesome bycatch species (e.g., rays, sharks) that can reduce the quality of the shrimp catch. Further collaborative research with NOAA scientists directly on fishing vessels and improved visualization and research tools (e.g., underwater video of trawl performance) has increased the credibility of TEDs and the science to develop new TED designs. Thus, while barriers to TED adoption continue to exist and have evolved from the challenges of the late 1980s/early 1990s, additional opportunities have emerged to overcome these barriers.

KNOWLEDGE OF BEACHGOERS TO THE PRESENCE OF AND THREATS TO SEA TURTLES IN THE GULF OF MEXICO; RESULTS OF A SURVEY OF VISITORS TO GALVESTON ISLAND, TEXAS

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Knowledge of Galveston Island residents and visitors regarding the 5 species of sea turtles most commonly found in the Gulf of Mexico is relatively unknown. Our objective was to quantify, through surveys, the public's knowledge of sea turtles on Texas beaches. Specifically, we were interested in: 1) awareness of threats to sea turtles in various life history stages and habitats; 2) understanding of their own role in mitigating threats to sea turtles; and 3) willingness to support programs whose foci include: protection and conservation of sea turtle habitats, outreach and education, and legislation designed to facilitate the conservation of sea turtles in the Gulf of Mexico. A random survey of visitors to public beaches on Galveston Island was conducted during Summer and Fall of 2012 (n = 112). Participants were asked to provide responses to 14 questions. In terms of general demographics, knowledge and interest, results from several survey questions are given below. Responses reveal that 15% of those surveyed were from out of the state, 81% were from areas other than Galveston Island (many from the Greater Houston area) and 4% were residents of Galveston Island. Less than 1% did not have a high school diploma or equivalent, 22% had a high school diploma, 77% had a college degree or are in the process of obtaining one. Of the 112 people surveyed, 51 (46%) were not aware that sea turtles nest on Texas beaches. That percentage varied significantly with level of education. In addition, we quantified the percentage of people surveyed who would support efforts to conserve sea turtles and their habitats; 72% responded in the affirmative. Interestingly, there was no significant difference based on education level in this category. Identifying the demographics of visitors is vital as we refine materials used in outreach efforts. Knowing where participants elect to stay while visiting Galveston Island (hotel or vacation rental home), or if they were day visitors allowed us to determine how and where to reach the largest number of people. By providing location-specific outreach materials (beach signs, hotel door hangers, rental house table tents) to specific lodging destinations we can maximize our outreach "footprint." More importantly, the survey results clarified what visitors and residents are unaware of, thus providing a foundation of topics and concepts for future education and outreach.

CONNECTING INTERNATIONAL CONSERVATION PRIORITIES WITH HUMAN WELFARE IN LOW-INCOME REGIONS: HAWKSBILL TURTLES IN EL SALVADOR

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Hawksbill sea turtles (*Eretmochelys imbricata*) are critically endangered globally and hawksbills in the eastern Pacific Ocean are considered among the most endangered sea turtle populations in the world. Less

than 500 mature female hawksbills remain in the entire eastern Pacific, with nearly 45% of these individuals nesting in El Salvador. Cooperation among countries located within the geographical range of hawksbills in the eastern Pacific is essential for maximizing coordinated conservation actions and to minimize threats. However, management strategies often emerge from international agendas that may conflict with local priorities, particularly in resource-dependent areas of low-income regions. Priorities of the international conservation community often center on the biological aspects and needs of hawksbills, whereas local priorities of coastal residents tend to focus on the socio-economic development and needs of human communities. To evaluate the implications of these differences between international and local priorities and strategies for hawksbill conservation and community development in low-income regions, we reviewed important socio-political developments during the last 130 years in El Salvador and drew from the historical record to describe how sea turtle conservation, particularly hawksbill conservation, emerged along the Salvadoran coast. We then analyzed 34 interviews with local egg collectors to help us understand how they prioritized hawksbills and their perspectives towards hawksbill conservation. Our results demonstrated that among egg collectors and other local residents, the primary value of hawksbills was the economic value attached to egg sales; nests not purchased for protection by conservation initiatives were sold to local markets for consumption. In addition, most respondents desired more involvement in decision-making regarding hawksbill conservation, which they considered to be biased towards elite interests. We concluded that strategies divorced from local realities can discourage stakeholder participation, escalate latent conflict, and hamper the sustainability of conservation outcomes. Recognition of local realities could improve future efforts that connect international conservation priorities with community development to optimize long-term hawksbill recovery efforts in low-income regions of the eastern Pacific. We thank the respondents, Boone & Crockett Club, Texas A&M University, National Fish and Wildlife Foundation, U.S. Fish and Wildlife Service, International Sea Turtle Society, Western Pacific Regional Fishery Management Council, and U.S. National Marine Fisheries Service for invaluable support provided.

CAMINHO MARINHO EXPEDITION: CONNECTING RESEARCH AND COMMUNITY IN A WAY WHICH CONSERVES THE SEA TURTLES WITH AN ECOSYSTEM-BASED APPROACH

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The South of Santa Catarina (Laguna, Imbituba and Garopaba) is characterized by the presence of juvenile green turtles, accompanied by biological diversity, artisanal fishing communities, as well as increasing port services and tourism. The Caminho Marinho Project is an initiative that aims to connect Research and Environmental Education to conserve sea turtles and study the services provided by the oceans. The Caminho Marinho Expedition is the tangible realization of this initiative. One week long, the Expedition connects research in the ecology of marine vertebrates (in-water sea turtle monitoring), with benthical ecology (of fauna and flora), in a socio-economic context. The sample points were indicated by community knowledge about green turtle presence. Points include Farol beach, Galheta beach, Ipoã island and Itapirubá point, located in Laguna and characterized by community fisheries and tourism. Vila beach, Santana de dentro Island, and Santana de fora Island, in Imbituba, are sites close to port activity. And Ibiraquera beach, in Imbituba and a garopaba beaches, have many little artisanal fisheries communities and a growing tourism industry. Two different methods are used to capture the green turtles. For analysis of population structure, only first captures are used. Curved carapace length (CCL) is measured using a flexible tape to the nearest 0.1 cm. Seawater temperature (ST) is measured in situ with thermometer, on all sampling days. The effort units and their Catch per unit efforts (CPUE) are compared with the different ocean services, biodiversity, use of fisheries communities, tourism or port, ST values and effort per day

using general linear model analysis. The results will be disseminated not only in the wider community through social networks and from the base site with photos and videos, but to and through the local community participants in the expedition, (as part of participatory research to management). With the support of a boat from Base Cângulo (a tourism company of Garopaba), children of the coastal communities experience the diversity of services offered by their environment and experience participation alongside the expedition, in-water. The experience enhances the awareness to a participatory management under a marine ecosystem-based approach. In addition, graduate students participated in the Expedition Team, as part of a course of theoretical and practical training. The Expedition is economically viable and self-sustaining economically due to the connection and supports of multiple stakeholders, for environmental, socio-cultural and economical motives, because as Joaquin Torres Garcia said, "Our North is the South” (Nuestro Norte es el Sur).

PRODUCTIVE WORKSHOPS IN COMMUNITIES ASSOCIATED TO SEA TURTLE CONSERVATION PROJECTS IN THE MEXICAN PACIFIC

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In coastal communities which have sea turtles conservation projects, women are not usually involved in activities that are performed, so it is necessary to work to incorporate these activities and unify the community in active participation in these projects. From July 2011 to date has worked with women from different coastal communities of Guerrero (Buena Vista and La Union) and Oaxaca (Ventanilla and Cacalote) that are associated with nesting beaches by developing productive workshops that allow interested women to join to the sea turtle conservation project through alternative work to generate a source of income and a steady food source in their families, in addition in order to minimize plunder of eggs and killing of sea turtles. We developed two productive workshops: (1) sea turtles crochet and (2) backyard gardens, which were given to groups of five women in each community, which in turn are training more women involved in these activities. Each workshop consisted of five sessions of two hours, where the main activities of the training was an introduction to the topic, sharing of materials, preparation of final products as well as the resolution of questions of the group. After completed workshops, we partitioned material to all participants, yarn and polyester fibre stuffing in crochet workshop, and seeds in backyard gardens workshop, in order to start sea turtles and increase their gardens. Weeks after we reviewed the final products of each family to verify that it is being applied correctly learned activities to have good results that benefit the families involved. Actually there are 20 families developing their backyard gardens and 30 women performing activities of crochet in the four coastal communities. Within communities we have seen an increasing interest in learning these activities among women in the communities, and thus greater participation by them in such conservation projects.

MARINE CHELONIAN ILLUSTRATION: PART VIII – THE RISE AND FALL OF TURTLE SOUP

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Pictures tell a thousand words, providing far more than simply an image. They tell a story, although one told in pictures, and in this case, with a few accompanying words. Soup, derived from “sop”, meant bread dipped/soaked before eating and from prehistory also known as pottage - cooked in a communal pot. Green turtles with their greenish fat, have been consumed for thousands of years. Strabo and Pliny chronicled the chelonophagi or turtle eaters. Early texts tout the importance of turtle soup in early Europe and later Colonial America. But most early cookbooks exclude turtle soup recipes due to difficulty of butchering large turtles at home. It was the height of fashion in 1700s England, particularly when made with “calipee” meat. The superior West Indian green turtles survived the journey to England when kept in tanks of fresh water, the same water they were kept in for up to three months to “retain their flavor”. “West Indian” recipes for dressing/cooking of turtles appeared and turtle merchants thrived in England. London’s Ship and Turtle Tavern, known for keeping live turtles in their basement, was established in 1377 was even recommended in Charles Dickens’ correspondence. An 1873 London city guide stated, “A plate of turtle and a grilled fowl done Indian fashion will repay a stranger for going the distance to The Ship and Turtle in Leadenhall Street.” The Tavern in Great Queen-street was also famous for its turtle; keeping the largest stock of living turtles in London. Through the 1800s, it was considered the ultimate luxury, becoming the centerpiece of official functions with single Royal events said to serve over 250 tureens. Entire courses were provided by 60-110 pound turtles. Preparations were complex, belly was boiled, back was baked. Presentations were elaborate, often being served in the shell. Flippers and entrails were strewed in rich sauces as side dishes, with at least one tureen of turtle soup including the head. The taste followed English colonists to America. Philadelphia’s 1700s society began a long tradition of turtle soup with the Philadelphia Gazette advertising a nine-hour turtle soup banquet. French influences in Boston also established turtle as a staple. John Adams ate it several times during the Continental Congress. Cookbook turtle recipes increased sixfold in the next hundred years with turtle available in stoneware crocks. Even the White House had a dinner featuring a 300-pound turtle main course. But preparation was difficult and time consuming. This delicacy would likely have disappeared without the innovation of canned turtle (and terrapin) soup from Campbells, Franco American, Heinz, Ancora, Becas, and others as early as 1882 when it was widely available in grocery stores. Popular in the early 1900s, turtle on menus and in cookbooks began to decline mid-century. Prohibition, turtle population decreases, domestic help costs, and finally, the Endangered Species Act of 1973 brought an end to the turtle soup that was once such an integral part of culinary history and gave a new lease on life to the turtles that made it possible.

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