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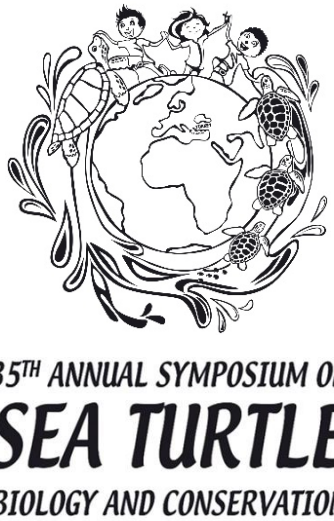
PROCEEDINGS OF THE THIRTY-FIFTH ANNUAL SYMPOSIUM ON SEA TURTLE BIOLOGY AND CONSERVATION



18 to 24 April, 2015
DALAMAN, MUĞLA-TURKEY

Compiled by:
Yakup Kaska, Bektaş Sönmez, Onur Türkecan,
Çisem Sezgin, and Lisa Belskis

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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June 2024

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PREFACE

The Annual Symposium on Sea Turtle Biology and Conservation, hosted every year by the International Sea Turtle Society (ISTS), is a unique event that draws participants from around the world, from across disciplines and cultures to a common interest and objective: the conservation of sea turtles and their environment. The Symposium encourages discussion, debate, and the sharing of knowledge, research techniques and lessons in conservation, to address questions on the biology and conservation of sea turtles and their habitats. The 35th Annual Symposium was held from 18-24 April 2015 at Hilton Hotel- Dalaman, Mugla-Turkey.

Turkish people believe the long life of turtles and their determination to reach the goal even at a slow pace. This historical significance of turtles and tortoises in the Turkish culture influenced the theme of the Symposium. This symposium was decided with the theme of "**Hospitality**"; to host all the turtle people from around the world, bringing everyone together and "**bridging the civilizations**" to reflect Turkey, as a country bridging Europe, Asia and Africa. This is a great opportunity for the people from these continents to participate in the Symposium, as it will be easy for them to travel from their home countries. Besides the regular sessions normally held at past Symposia, specific to the meeting in Turkey, 23rd April is "World Children Day" will be allocated to special sessions for children's activities. Without a doubt, today's children are the future sea turtle researchers and conservationists, and so we need to ensure that we pass our mission on to the younger generation.

35th ISTS includes 14 oral and 35 poster presentations of Anatomy, Physiology, Health; 18 oral and 41 poster presentations of Conservation, Management and Policy; 6 oral and 16 poster presentations of Education, Outreach and Advocacy; 11 oral and 31 poster presentations of Fisheries and Threats; 14 oral and 26 poster presentations of Genetics and Population Biology; 23 oral and 36 poster presentations of In-Water Biology; 11 oral and 36 poster presentations of Nesting Biology; 5 oral and 3 poster presentations of Social, Economic and Cultural Studies Sessions.

Another 13 presentation in Mediterranean Conference, 22 presentations in other workshops and sessions makes 135 oral and 225 posters all together.

We hope these presentations and scientific information helps us to better protect the sea turtles in the world. We believe children involved in this symposium will be future's turtle biologists and conservationalists.

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

35TH ANNUAL SYMPOSIUM ON
SEA TURTLE
BIOLOGY AND CONSERVATION
DALAMAN - SARIGERME- DALYAN (ORTACA)- MUĞLA- TÜRKİYE
18-24 APRIL 2015

PRESIDENT'S REPORT

35th Annual Symposium on Sea Turtle Biology and Conservation
Hospitality
18-24 April 2015, Dalaman, Muğla, TURKEY

President's Report
Yakup Kaska, President, ISTS

The 35th Annual Symposium on Sea Turtle Biology and Conservation was held in Dalaman, Muğla, Turkey on 18-24 of April, 2015. The theme of the symposium is "**Hospitality**". It was chosen as meeting participants will be attending from around the world and hospitality reflects Turkey's friendly and inviting culture. Furthermore, Turkey brought everyone together, "**bridging the civilizations**", bridging Europe, Asia and Africa. This was a great opportunity for the people from these continents to participate in the Symposium, as it was easier for them to travel from their home countries. Besides the regular sessions normally held at past symposia, specific to the meeting in Turkey, we celebrated "**World Children Day**" on April 23rd with special sessions for children's activities. Without a doubt, today's children are the future sea turtle researchers and conservationists, and so we wanted to ensure that we pass our mission on to the younger generation.

A total of 610 people from 80 countries registered for the Symposium. An additional 250 local students and educators attended particular sessions. The venue for the symposium was the Hilton Hotel-Dalaman, Turkey. The program included 4 regional meetings (Africa, IOSEA, Retomala and East Asia), 9 workshops, 2 special sessions (Mediterranean Turtle Conference and Freshwater turtle Session), and a Video Night that showed 12 videos. In addition to the regular sessions, we hosted the 5th Mediterranean Conference on Marine Turtles. A total of 135 oral papers and 230 posters were presented.

Workshops: A total of 9 workshops were offered the weekend before the symposium started. These were the Fourth Workshop on Stabile Isotope Techniques in Sea Turtle Research: Lessons Learned and Future Steps, Temperature-dependent Sex Determination, Sea Turtle Rehabilitation and Health, GIS, Tourism and Turtles, Biologging For Sea Turtles, Fisheries Observer Programs: Key to Successful Fisheries Management, Children Activities and New Techniques. The first parts of two of the workshops were held on Thursday, 23rd April 2015. Unfortunately, the Novel techniques for Environmental Campaigning Workshop that was scheduled cancelled. The attachment of four satellite devices and releasing of sea turtles within the Biologging For Sea Turtles Workshops II and Children workshop activities were carried out at DEKAMER Sea Turtle rescue center. This event attracted many local people and authorities as well as the children. A 3D printed Jaw was attached to an injured turtle on 23rd of April, attracting many local and international media. These activities are very overlapped with ISTS' mission that ISTS brings people together to promote the exchange of information that advances the global knowledge of sea turtle biology and conservation.

Pre-symposium Meetings: The 5th Mediterranean Conference on Marine Turtles and the Terrapin, Tortoise & Freshwater Meetings were two main pre-symposium meetings. The regional meetings for Africa, Latin America, East Asia, and Indian Ocean South East Asia were also held. The Marine Turtle Specialist Group meeting was set on Wednesday 22nd of April, 2015.

Key Note Speakers: Three keynote speakers delivered three 30 minutes addresses to symposium participants. Richard Reina's presentation gave the audience a comprehensive overview of the topic *Climate Change and Sea Turtles: What It is, What it isn't and What we need to do about it*, which nicely served after the opening ceremony to all of the symposium participants. Mohd Uzair Rusli gave his keynote speech on *Synchronous Activity Lowers: The Energetic Cost of Nest Escape by Green Turtle Hatchlings* in the Nesting Biology-I session on Tuesday 21st of April, 2015. On Wednesday, 22nd of April 2015, Kate Mansfield gave her speech at the In-Water Biology-II session on *Out With the Old, in with the New Hypothesis: Swimming behavior and Ontogenetic Habitat Shifts Among Wild-Caught Oceanic Stage Turtles*. All three addresses were excellent and very well received by the audience.

Symposium Sessions: This symposium included traditional sessions held at previous symposia, such as Anatomy, Physiology and Health; In-Water Biology Session (Ecology, Telemetry, Foraging, Behavior); Nesting Biology (Ecology, Behavior, and Reproductive Success), Population Biology and Monitoring (Status, Modeling, Demography, Genetics, Nesting Trends, In-Water Trends), Fisheries and Threats Session; Conservation, Management and Policy; Education, Outreach And Advocacy; and Social, Economic and Cultural Studies. In addition to those sessions, we also scheduled poster discussion hours for each session and these were found very productive to meet with all presenters in one room, and facilitated by chairs.

Business Meeting: Very important issues were addressed during the plenary business meeting conducted the last day of the symposium. The travel committee report, the Treasurer's report and other issues related to our society were discussed.

ISTS Elections: The report of the ISTS Nominations Committee presented the following names of the winners of the 2015 Elections: President Elect- Frank Paladino, Board of Directors- Andrea Phillott and Laura Prosdocimi, and Nominations Committee- Michael Jensen, Thushan Kapurusinghe and Andy Estrades.

Board meeting: The Board meeting was held on Tuesday 21st of April, 2015. The meeting was fruitful and lasted until midnight. The Board received and discussed reports from the Nominations Committee, Student Committee, Travel Committee, Students Awards Committee, Awards Committee, as well as reports from the Treasurer.

Student Committee: Since its inception at the 31st Symposium, the ISTS Student Committee has played an increasingly important role in the meeting. For the meeting in Turkey, the Committee was chaired by Itzel Sifuentes and Adriana Cortez. Student participation in the Symposia is critical to the future of our Society's mission, and we commend and encourage continued productive activity by the Student Committee. They organized around 50 volunteer evaluators to provide valuable presentation feedback for about 100 students that requested it. They actively involved in New Techniques Workshop and organized Student Committee Mixer on Tuesday afternoon.

Travel grants: A total of 162 registrants received a travel grant at ISTS35. This level of travel grant awards represents about 25% of the total registered participants. Travel grants took the form of room and board grants, which was highly advantageous for the awardees and for the Society. Only 16 people who received Travel Grant have to cover their food shares. The Travel Grant Committee was chaired by Alexander Gaos, with Angela Formia, Kelly Stewart, Karen Eckert, Alan Rees, Alejandro Fallabrino, Aliki Panagopolou, Maggie Muurmans, Andrea Phillott and Emma Harrison as members. Participant distribution for Travel Grant was 28 % from Europe, 18 % from America, 14 % from US/Canada and %14 CA/America, 11% from Africa, 7% from Asia-Pacific and 4% from South Asia and 4% from Middle East.

Social Events: Welcome Social, Live and Silent Auctions, Farewell party, Student Awards were some of the social events held during the symposium. A welcome cocktail and Turkish Folk Dance were performed on Sunday evening. Children performed folk dances on Sunday and Monday evenings. The popular "Speed Chatting with the Sea Turtle Experts" session made an appearance on Wednesday afternoon and was enjoyed by the experts as well as the participants that plied them with questions on topics ranging from techniques to career advice. On Tuesday evening, Video Night provided informative entertainment to Symposium participants as they enjoyed 12 video presentations from around the world. On the final day of the Symposium, together with the Gala dinner, the Archie Carr Student Awards and the ISTS Awards were followed. The formal portion of the evening closed with words of appreciation from the President and the ceremonial passing of the ISTS Presidential Trowel to incoming President Joanna Alfaro Shigueto. On Friday, we organized three-tours and participants visited Pamukkale, Ephesus and Dalyan lagoons.

Auctions: The proceeds from the annual Live and Silent auctions contribute to Travel Grant funding for students and international participants. We had the usual fantastic response from the sea turtle community in the way of unique donated items for both auctions. With ISTS promoting a more socially responsible outlook, the Auction Team found themselves pushed to the limits to find creative and fun ways to raise funds. The results of their efforts were brilliant and provided new paying and entertaining activities, including "Jail and Bail" and "A Sea Turtle Beauty Pageant". The live auctioneer Rod Mast did again an excellent job. The dedication of Auction Chairs, Jennifer Homcy and Marina Zucchini, for the success of these important events is appreciated by all.

Awards: During the gala dinner, a series of awards were made to prominent members of our society. Lily Venizelos and Henri Reichart were awarded the *Lifetime Achievement Award* for their extensive and significant contributions to the promotion of sea turtle biology and conservation. Awards were also given to Kutlay Keco for *Ed Drane Award for Volunteerism*, Flegra Bentivegna for *Champions Award*. *President's Awards* were given to Ibrahim Baran and June Haimoff. Congratulations to the all awardees.

Archie Carr Student Awards: There were 41 oral presentations and 67 poster presentations entered by students in the Archie Carr Student Awards. The Program Chairs worked with the Student Award Chairs to minimize conflicting student presentation times, thereby ensuring all student presentations were seen by the judges, but we encourage future Program Chairs to liaise with the Student Award Chairs early in the planning process to minimize the requirement for last minute work by all parties. Judges of the presentations in Turkey were: Ana Barragan, Cynthia Lagueux, Dave Owens, Emma Harrison, Kate Mansfield, Marc Girondot, Mariana Fuentes, Paolo Casale, Ray Carthy, Roldan Valverde, Sara Maxwell, Zoe Meletis. The winner for Best Biology Poster was Abilene Colin Aguilar (CICESE, Mexico). Best Conservation Poster went to Mireia Aguilera Rodà (Univ. Las Palmas de Gran Canaria) and runner up was Aurora Oliver de la Esperanza (Univ. Zaragoza, Spain). The Best Biology Oral was won by Natalie Wildermann (James Cook University, Australia) and Joseph Pfaller (University of Florida, USA) was Runner Up. The Conservation Oral winner was Sarah Nelms (University of Exeter, England), and Aliki Panagopoulou (Drexel University, USA) was Runners-Up.

Grassroots Award: The Grassroots Conservation Award is given for the poster or oral presentation that best demonstrates a positive contribution towards the conservation of marine turtles and/or their habitats. This year the Award went to the Fundação Maio Biodiversidade for "Community-based conservation is a key to successful sea turtle protection in Maio Island, Cape Verde" with the authors of Adilson Passos, Amanda Dutra, Franziska Koenen, Alexandra Morais, and Mafalda Navas. The judges were Alejandro Fallabrino, Angela Formia, Jack Frazier, Manjula Tiwari and Ingrid Yanez.

Funding: Generous funding by many entities made it possible for the ISTS35 to be a success. The organizing committee deeply thanks the donors below for their generosity. At the **Platinum** level ($25,000 and above): Turkish Government (Ministries, Governors and Mayors), Pamukkale University, and Marine Turtle Conservation Fund. At the **Gold** level ($5,000 - $19,999): WWF-Turkey, International Seafood Sustainability Foundation, Regional Activity Center, UNEP-RAC/SPA, Istanbul Aquarium and The Ocean Foundation. At the **Silver** level ($1,000 - $4,999): Hilton-Dalaman, Wildlife Computers, Istanbul SeaLife Aquarium, Sirtrack, Mugla Trade and Commerce Union, BTC Pipeline Company, Disney's Animal Science and the Environment, Telonics, Mersin Municipality, Vaughan W. Brown Charitable Trust, Bern Convention of European Council. At the **Bronze** level ($500 - $999): Sea Turtle Conservancy, MEDASSET, Denizli Trade and Commerce Union, The Leatherback Trust, DOKAY, Mac-ART Design Agency.

Vendors: This year's Vendor tables were Wildlife Computers Inc, Collecte localisation satellite, Wipsea, Kaptan June Sea Turtle Conservation Foundation, Qarapara Sea Turtles Chile NGO, Karumbé, Endangered Wildlife Trust, IUCN Marine Turtle Specialist Group, WWF International, MEDASSET, ARCHELON, Loggerhead Marinelife Center.

Carbon Offsets: A meeting the size of the ISTS Symposium represents a considerable use of resources, primarily for travel, but also for onsite lodging and activities. This year, a coordination and follow-through by Erin Seney and Ray Carthy, the ISTS introduced an initiative to offset the carbon footprint of the meeting. The organization made a donation to Carbonfund.org to offset the full on-site footprint of the meeting. We also gave one flask as a gift for participants to use in the future as a way of reducing plastic usage.

Memorial Tribute: During the opening and closing ceremonies of the symposium we observed one minute of silence in tribute to the lives that were lost since the last symposium especially the recent loss of Prof. Nicholas Mrosovsky.

Acknowledgments: Organizing the symposium took a significant number of hours and effort. The successful organization strongly benefit from the selfless work of a large number of volunteers. My personal thanks go to all organizing committee members. My deepest thanks go out to every single one of them for their hard work, friendship, and their dedication to the International Sea Turtle Society. Without the vision and generosity of our Sponsors this Symposium would not have been possible, and I thank them all for embracing our interests and cause as their own. The ISTS Board of Directors and its Executive Committee for their guidance and support. Every single one of the various Committees' chairs. My Program Officer Ingrid Yanez did a great job of fund raising under trying conditions.

Thanks to: The Program Staff- Oğuz Türkozan, Brian Shamblin and Wayne Fuller and program coordinator Eyüp Başkale and Event Coordinator Dogan Sözbilen and all of the outstanding Session Chairs.

The Logistics Staff- Registrar Serdar Düşen and Olcay Düşen, Volunteer Co-Chairs Natalie E. Wildermann and Can Yılmaz, Onur Candan, Alejandro Fallabrino and Karla G. Barrientos-Muñoz. Exhibitor/Vendor Chair Çisem Sezgin and Nilüfer Araç. Speed Chatting Coordinators; Emma Harrison and Zoe Meletis; Internet Guru Doğukan Mutlu, Logo Designers Yıldız Duman Ercan and Mümin İnan. Nominations Committee Chair Nancy Fitzsimmons and members Shaleyla Kelez, Edward Aruna, Milagros Lopez-Mendilaharsu and Alberto Abreu Grobois. ISTS Awards Committee Chair Sally Murphy and members Dean Bagley, Jim Spotila, Brad Nahill and Blair Witherington. Student Committee members Itzel Sifuentes and Adriana Cortez.

Student Judging Committee Andrea Phillott and Matthew Godfrey. (Judges of the presentations in Turkey were: Ana Barragan, Cynthia Lageux, Dave Owens, Emma Harrison, Kate Mansfield, Marc Girondot, Mariana Fuentes, Paolo Casale, Ray Carthy, RoldanValverde, Sara Maxwell, Zoe Meletis) Video Night Co-Chairs Anna Stamatiou and Kerem Yekta Atatunç. Poster Chairs Yusuf Katılmış and Serap Ergene Book of Abstract Compilers Yakup Kaska, Bektaş Sönmez, Onur Türkecan and Çisem Sezgin. Chuck Shaffer and Dincer Ayaz for planning the Terrapin, Tortoise, and Freshwater Turtle Meeting. Erin Seney and Ray Carthy for a brilliant effort with the carbon offsets for the Symposium. Robin Snape for English-proof reading.

Workshop organizers Daniela Freggi, Andrew DiMatteo, Sandra Hochscheid, Kate L. Mansfield, Yonat Swimmer, Marc Girondot, Şükran Yalçın Özdilek, Simona Ceriani, Kim Reich, Jeffrey Seminoff, Emine Dinç, Jane Akalay, Fikri Türkeş, Ayşe Oruç and Konstantina Kostoula for helping to organize the workshops.

I also thank Luis Cardona Pascual and his organizing committee for organizing 5th Mediterranean Conference on Marine Turtles within the ISTS35.

Additional gratitude goes to: The schoolchildren and teachers of Muğla Province for their participation in our outreach program. **ALL OF THE VOLUNTEERS FROM ISTS AND THE PAMUKKALE UNIVERSITY!** Those of you un-named here, but who gave freely of your time, toil, and enthusiasm when I called you.

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Regional Meetings - Indian Ocean & Southeast Asia, IOSEA	Lalith Ekanayake
Regional Meetings - East Asia	Yoshimasa Matsuzawa
Regional Meetings - Mediterranean	Paolo Casale
Freshwater Turtle and Tortoise Session	Chuck Shaffer, Asghar Mobaraki, Dinçer Ayaz
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5th Mediterranean Conference on Marine Turtles	Luis Cardona Pascual
Sea Turtle Medicine Workshop	Daniela Freggi
GIS Workshop	Andrew DiMatteo
Biologging for Sea Turtles Workshop	Sandra Hochscheid, Kate L. Mansfield
Novel Technologies for Environmental Campaigning Workshop	Paul Tennent, Nadia Pantidi
Fisheries Observer Programs Workshop	Yonat Swimmer
Temperature-Dependent Sex Determination Workshop	Marc Girondot
Fourth Workshop on Stable Isotope Techniques in Sea Turtle Research	Şükran Yalçın Özdilek, Kim Reich, Jeffrey Seminoff, Simona Ceriani
New Techniques-Recent Developments for Young Scientists Workshop	Emine Dinç
Tourism and Turtles Workshop	Jane Akatay
Children's Workshop	İbrahim Gök, Ayşe Oruç, Konstantina Kostoula

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Henri Reichart, Lily Venizelos, Flegra Bentivegna, and Kutlay Keco who is pictured on the right. Photos provided by Sally Murphy.

STUDENT AWARDS

There were 41 oral presentations and 67 poster presentations entered by students in the Archie Carr Student Awards. The Program Chairs worked with the Student Award Chairs to minimize conflicting student presentation times, thereby ensuring all student presentations were seen by the judges, but we encourage future Program Chairs to liaise with the Student Award Chairs early in the planning process to minimize the requirement for last minute work by all parties.

Judges of the presentations in Turkey were: Ana Barragan, Cynthia Lagueux, Dave Owens, Emma Harrison, Kate Mansfield, Marc Girondot, Mariana Fuentes, Paolo Casale, Ray Carthy, Roldan Valverde, Sara Maxwell, and Zoe Meletis.

The winners of the student awards included two undergrad presenters (noted in the table below). Students receiving awards were from universities in Mexico, Spain, Australia, USA, and England.

Student Awards for Poster Presentations at ISTS35, Dalaman, Turkey

Category	Format	Prize	Student	Institution	Title
Biology	Poster	Winner	Abilene Colin Aguilar	Ensenada Center for Scientific Research and Higher Education, Mexico	Food availability affects the reproductive success of the olive ridley?
Conservation	Poster	Winner	Mireia Aguilera Rodà	Univ. Las Palmas de Gran Canaria, Spain	Assessing the effects of tire ruts on the beach dispersal of hatchling loggerhead sea turtles in Boa Vista Island, Cape Verde
Conservation	Poster	Runner up	Aurora Oliver de la Esperanza	Univ. Zaragoza, Spain	Tourist impacts over the nesting habitat of the threatened loggerhead and green turtle in Kanzul, Riviera Maya-Tulum (Mexico)

Student Awards for Oral Presentations at ISTS35, Dalaman, Turkey

Category	Format	Prize	Student	Institution	Title
Biology	Oral	Winner	Natalie Wildermann	James Cook University, Australia	Offshore dispersal of flatback (Natator Depressus) hatchlings: insights into the world's only oceanic turtle
Biology	Oral	Runner up	Joseph Pfaller	University of Florida, USA	Global phylogenomincs of planes crabs, a common symbiont of sea turtles
Conservation	Oral	Winner	Sarah Nelms	University of Exeter, England	Assessing the potential impacts of seismic surveys on marine turtles
Conservation	Oral	Runner up	Aliki Panagopoulou	Drexel University, USA	Hook, line, & thinkers: understanding complex perceptions of fisher-turtle interactions in context (Crete, Greece)

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KEYNOTE SPEAKERS

ANATOMY, PHYSIOLOGY, HEALTH

INNATE IMMUNITY IN SEA TURTLES

Paula Aguilar-Claussell[1], Alan A. Zavala-Norzagaray[1], and Catherine E. Hart[2]

[1] CIIDIR-Instituto Politecnico Nacional unidad Sinaloa
[2] Red Tortuguera A.C.

Immune system in sea turtles is compound with humoral components, cell mediators and innate elements. Immune system components in reptiles are similar to advanced vertebrates but more primitive. So many factors can affect operation of immune system in a sea turtle or any other reptile, some of those includes age, reproductive and nutritional status. Young individuals can get humoral response capacity diminished because innate immunity is quite active and it is possible to still present persistent maternal antibodies. Sexual steroids production in sea turtles has been associated to a low rate of circulating antibodies and it has been demonstrated that light and luminous cycles play a very important role in immune system regulation. There are many elements that can affect the immune response of a sea turtle, for example, the individual capacity to regulate their own body temperature. In wild life, diurnal reptiles as sea turtles, depends on morning sunbathes to increase their body temperature. In captivity, commonly they are not well sunlight provided causing hypothermia, which affects the immunity functions by altering the production of circulating white cells and antibodies. This review has the purpose of concentrate relevant features about innate immune system functions and how immune responses can be affected in sea turtles. It shows how different and not so obvious elements can play a very important role in this kind of physiologic responses. This information can be used in rehabilitation, conservation, handling and researching processes as a support for many other investigation themes and also to get a better understanding of sea turtles functioning.

GEOMETRIC MORPHOMETRICS OF LOGGERHEAD TURTLE (*CARETTA CARETTA*) IN THE CENTRAL MEDITERRANEAN

Rigoli Alessandro[1], Daniela Freggi[2], Amedeo Ciccocioppo[1], Giulia Vagnoli[1], Paolo Luschi[3], and Paolo Casale[4]

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Geometric morphometrics is a relatively recent approach to the study of the form that allows to compare the morphological and anatomical parts of an organism and, to quantify the geometrical information related to the change in shape of various body parts of a body, in order to view the differences between the individuals and describe such changes in shape in a repeatable and objective way. We studied 58 loggerhead sea turtles ranging 17.7-78.8 cm CCL, found in the waters around Lampedusa Island (Itlay) in the period 2012-2013, in order to asses morphological variability in different body structures and their possible allometric changes. Specifically, we studied geometric morphometrics of carapace, plastron, head, and the front flippers. Digital photographs were taken for each anatomical part of each turtle and analyzed through a total of 90 landmarks. The results show that, with growth, the carapace displays a simultaneous restriction in width and a stretching

with a slight modification of the central scutes, while the large scutes remain unchanged. The head stretches and shrinks at the attachment to the neck, and shows an increase in the length of the beak at the level of the rostrum and of the upper jaw, and a displacement of the postocular and supraocular scales. The front flippers show a variation at the level of the positioning of the nails and a narrowing in length and width. The possible adaptive values of such changes are discussed.

CRANIOPLASTY APPLICATIONS AND EVALUATIONS WITH COMPUTED TOMOGRAPHY OF SKULL FRACTURE AND BRAIN INJURIES IN SEA TURTLES (BETWEEN 2008-2014 YEARS)

Muhammed Enes Altug[1], Cafer Tayer Isler[1], and Ramazan Davran[2]

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[2] Mustafa Kemal University, Faculty of Medicine, Department of Radiology, 31040, Antakya, Hatay/TURKEY

The material of study created totally 26 sea turtles (23 *Caretta caretta* and 3 *Chelonia mydas*) with the head trauma brought to the Mustafa Kemal University, Faculty of Veterinary Medicine or Sea Turtle First Aid, Treatment and Rescue Center (DEKIYM) for emergency first aid and surgical intervention. Clinical, radiographic, neurological examinations and treatment outcomes were evaluated in the sea turtles. The severity of skull fractures and brain trauma were assessed by computed tomography records. In X-ray and computed tomography records were determined multi-part linear and depressed fractures in 25 cases, cranium fractures in 22 cases, sinking into the brain of cranium fracture in 15 cases and a sink sharp object penetrating into the brain in one case. Six of the depression fractures in the skull were closed and also 19 were open. In oral cavity, esophagus or gastrointestinal tract of 8 cases with head injuries were identified fishing injury. The cases were primarily treated with medical treatment against infection and the impaired general condition, and than the skull fractures in 16 cases were underwent with cranioplasty. Cranioplasty was caried out with poly-methyl methacrylate in 15 cases, while one patient was achieved with a skin graft. Thirteen of the patients that underwent cranioplasty were *C. caretta*, 3 were *C. mydas*. Treatment outcomes shown that 5 *C. caretta* completely healed with cranioplasty administration, and also one *C. mydas* and two *C. caretta* with medical treatment. One *C. caretta* and one *C. mydas* recovered after the cranioplasty, but these died one year after rehabilitation because diving reflex absence. Survival time in 6 of the remaining cases were between 31-60 days, while 12 cases had between 1-30 days. As a result, 8 of 26 sea turtles with head trauma were sent back to their natural habitat.

EVALUATION OF DIFFERENCES IN THE BLOOD GASES AND CARDIOPULMONARY PARAMETERS IN SEA TURTLES WITH FISHING AND SEVERE HEAD INJURY IN THE TURKEY'S EASTERN MEDITERRANEAN COAST

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In this study was evaluated the differences between blood gases and cardiopulmonary parameters in four *C. mydas* sea turtles with severe head or carapace injury, five *C. caretta* with fishing injury in the forearm or mount and twenty five *C. caretta* sea turtles with severe head or carapace injuries. The cases were brought from in the Turkey's Eastern Mediterranean Hatay coast in last eight years. The weights of the loggerhead sea turtles (mean±SE) were determined as 39.5±4.94 kg in the fishing injuries and 32.6±2.21 kg in the severe head or carapace injuries, and also 43.2±6.83 kg in green turtles with the severe head and carapace injury. Cardio-pulmonary functions were monitered with ECG. The differences in the respiration rate (RR/min) between the examined turtle groups were found non-significantly ($p<0.05$), but the differences in the heart rate (HR/min) and the cloacal temperatures (Temp, 0C) between the loggerhead sea turtles with fishing injury and head or carapace injury were found statistically significant ($p<0.05$). In the venous blood samples were analyzed pH, pCO2 (mmHg), pO2 (mmHg), Hct (%), Na+ (mM), K+ (mM), iCa++ (mM), HCO3 (mM), TCO2 (mM), O2 sat (%) and tHb (g/dL) values. The differences in pCO2 (mmHg), pO2 (mmHg), TCO2 (mM) and O2Sat (%) values between the loggerhead sea turtles with fishing injury, and the green and loggerhead sea turtles with severe head or carapace injury were found significantly ($p<0.05$). Blood gases analaysis shown that the values of pO2 (mmHg) and O2Sat (%) of the green sea turtles with head and carapace injuries were significantly found lower than the loggerhead sea turtles with fishing injury and severe head or carapace injury ($p<0.05$). And also the values of pCO2 (mmHg) and TCO2 (mM) of the green sea turtles with head and carapace injuries were significantly found higher than the loggerhead sea turtles with head or fishing injury ($p<0.05$). As a result, blood gas analysis can be used as an important parameter in urgent clinical evaluation in the sea turtle medicine.

A FIRST APPROXIMATION TO CONGENITAL MALFORMATION RATES IN EMBRYOS AND HATCHLINGS OF SEA TURTLES

Annelisse Bárcenas-Ibarra[1], Horacio de la Cueva[2], Isaias Rojas-Lleonart[3], Alberto Abreu-Grobois[4], Rogelio Lozano-Guzmán[5], Eduardo Cuevas[6], and Alejandra García-Gasca[7]

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[4.] Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Mazatlán, Sinaloa, Mexico
[5.] Instituto Tecnológico de Ciudad. Victoria, Ciudad Victoria, Tamaulipas, Mexico
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[7.] Centro de Investigacion en Alimentacion y Desarrollo, Mazatlan, Sinaloa, Mexico

Congenital malformations in sea turtles have been considered to occur sporadically. Previous research on the Mexican Pacific olive ridley revealed high levels of congenital malformations, but little or no information is available from other sea turtles species. Here we present results from detailed qualitative and quantitative analyses of external congenital malformations in olive ridley, green, and hawskbill sea turtles from Mexican rookeries. We examined 150 green and hawksbill nests, and 209 olive ridley nests during the 2010 and 2012 nesting seasons, respectively. Olive ridley eggs were transferred to a hatchery and incubated in styrofoam boxes. While nests from the other two species were left in situ. For each nest: eggs number, live and dead hatchlings, and eggs with or without embryonic development were registered. Malformation frequency was evaluated with indices of (i) prevalence, as the proportion of eggs and nests with at least one malformation, and (ii) severity, as the number of malformations per organism and nest. Mortality levels, and prevalence and severity were significantly higher in the olive ridley than in hawksbill and green sea turtles. A total of 63 congenital malformation types were observed in embryos, and dead and live hatchlings. Of these, 38 were new reports; 35 for wild sea turtles, three for vertebrates. 31 congenital malformation types were found in hawksbill, 23 in green, and 60 in olive ridley. The head region showed a higher number of congenital malformation types. Congenital malformation levels in the olive ridley were higher than previously reported. The olive ridley seems more prone to the occurrence of congenital malformations than the other two species. Whether the observed malformation levels are normal or represent a health problem cannot be currently ascertained without long-term assessments.

VALIDATION OF BODY CONDITION INDICES IN LOGGERHEAD SEA TURTLES*

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Sea turtles strand for many reasons, and cause of death for fresh dead turtles can be determined through detailed necropsy and histopathology analysis. The Virginia Aquarium & Marine Science Center has conducted necropsies on fresh dead turtles since 2004. One important question for stranding responders is 'what is the turtle's body condition?' To answer this question, we tested two simple body condition indices using mass dissection techniques and lipid extraction. We developed an adipose mass index (AMI) by dividing the mass of the adipose lining the carapace by the carapace mass. We also extracted lipid from loggerhead adipose depots and determined percent lipid in the adipose tissue. Thus we were able to compare both adipose quantity using the AMI and adipose quality using percent lipid for each body condition index. We assessed loggerhead sea turtle body condition using two indices, the Fulton's K (W/L3*10,000), and a qualitative index based on visual assessment of the plastron depth compared with the depth of the ventral marginal scutes and the shape of

the cranial neck. Included in the study were 31 turtles that died from acute vessel or fishery interaction (VI/FI), 14 that died from disease/debilitation and are assumed to be unhealthy and in poorer body condition, and 30 that died from other/unknown causes and could be either robust or in poor body condition. Using a two sample Wilcox rank sum test, Fulton's K scores were significantly higher for VI/FI than non-VI/FI cases (K n=69, W=226, p<0.0001). AMI was also significantly higher for VI/FI cases (n=41, W=120, n=0.027). Percent lipid in adipose was not significantly different between the groups (n=34, W=102, p=0.292). When we eliminated the other/unknown cause of death cases and only compared VI/FI with disease/debilitated turtles, differences in percent lipid were significant (n=11, W=73, p=0.007). These results suggest that the observed decline in Fulton's K body condition scores between presumed healthy VI/FI cases and non-VI/FI cases is due to a loss of adipose quantity, but differences between VI/FI and unhealthy turtles are the result of decline in both adipose quantity and quality. Using the qualitative body condition index, turtles were scored as normal, thin or emaciated. Using a Kruskal-Wallis Rank Sum test, there were significant differences in the three body condition categories in Fulton's K score (n=64, X2=26.467, p<0.0001), percent lipid (n=33, X2=11788, p=0.003) and AMI (n=39, X2=7.364, p=0.025). Pairwise comparison showed differences among all three conditions in Fulton's K scores. For percent lipid, emaciated turtles were lower than normal and thin turtles, and for AMI, normal turtles were higher than thin and emaciated. These data support the use of qualitative and quantitative body condition indices for loggerhead sea turtles and provide stranding responders with new tools to use in assessing stranded turtles. The visual body condition index can only be used with live or fresh dead turtles, but Fulton's K can be used on any turtle for which a mass and length have been collected.

BODY CONDITION INDEX IN RESCUED GREEN TURTLES (*CHELONIA MYDAS*) IN THE GULF OF VENEZUELA: A SEVEN YEARS ASSESSMENT

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This is the first study to investigate the Body Condition Index (BCI) for green turtles (*Chelonia mydas*) in the Gulf of Venezuela (GV). The GV is considered important feeding habitat for green turtles in the southern Caribbean because of the genetic and ontogenetic diversity, year-round and long-term residence. However the resident turtles are under the high pressure of harvesting by the Wayuu people. We analysed curve carapace length (CCL) and body weight of 68 green turtles collected by the NGO "Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)" between 2008 and 2014 in the GV. To calculate the BCI (mass/SCL3), we transformed the CCL to SCL using an equation derived from other green turtle population in the Caribbean. We then categorised BCI of each turtle as "very good-VG" (above 1.20), "good-G" (between 1.19 and 1.10), "average-A" (between 1.09 and 1) or "poor-P" (below 1), following the categories used by other authors. Straight-carapace length and mass ranged from 21.00 to 85.00 cm (mean=34.45cm, sd = 11.018) and 0.70 to 70.00 Kgs (mean=6.184 Kgs, sd = 10.498) respectively. The BCI varied between 0.339 and 2.34 (mean=1.293, sd= 0.387). The percentages of BCI were 20.3% VG, 24.6% G, 26.1% A, and 29.0% P. Although the "poor" condition was the most frequent index, we didn't find a significance difference among the BCI's in the GV ($\chi 2$ (3)=0,824; p=0,844). When comparing with other study sites, the BCI in the GV is the lowest reported so far (mean and range). More evidences about the population status, and the impacts of conservation efforts are required in this important Caribbean region. Acknowledgments: funding and support for this project was provided by: International Sea Turtle Society, Ministry of Environment and Urban Planning, Ministry of Forestry and Water Affairs, Muğla Valiliği, Pamukkale Üniversitesi, Ortaca Belediyesi, TÜBİTAK, International Seafood Sustainability Foundation, WWF, Hilton, Wildlife Computers.

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

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[2] Pamukkale University, Sea Turtle Research Centre (DEKAMER), Denizli-Turkey
[3] Pamukkale University, Vocational School of Acıpayam, Department of Herbal and Animal Breeding, Denizli-Turkey

The first sea turtle rescue centre (DEKAMER) was established in 2008 and its activities during the first six years are explained in these results. A total of 122 injured turtles, 95 (78%) *Caretta caretta*'s, 24 (20%) *Chelonia mydas* and 3 (2%) fresh water turtlesTrionyxtriunguis were admitted to the centre during the years of 2008-2014. Turtles that came for rehabilitation was brought from distances approximately 250 km. (min. 12km., max. 750 km.). The wounded turtles were

brought from Dalyan/Muğla (39%), other parts of Muğla (25%), Antalya (25%), Aydın (4%), İzmir (3%), Mersin (2%) and Balıkesir (2%). Totally 68turtles were recovered and released back to the sea as healthy individuals. The remaining 42 died during their treatments. The mean value of the treatment durations were calculated as 5 months (151 days) ranging from two weeks to two years. There are currently 12sea turtles still undergoing treatment and rehabilitation at the centre. Injured turtles were mainly (64%) found within the Muğla province. In order to determine the true cause of mortality, necropsies 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 speed boat crash or propeller cut (22%), fishing-net or fishing line entanglements (22%), buoyancy problems (14%), intentional injuries (13%), parasite infection (12%), hook ingestion (12%) and others (5%). The treatment process varies depending upon the type of injury, and size of wounds being treated. First of all, all injured turtles are hydrated with either Ringer solution or Isotonic. Vitamins and other supporting medicine were applied IV and/or IM depending on their body condition and state of health. Turtles were cleaned from external contaminants with 5% Betadine solution. Antibiotics, silver containing creams, and powders were used open wounds. If it is necessary intramuscular painkillers and antibioticswere also given for a period of one week. The centre is open to both national and international collaborations.

HEAVY METALS IN BLOOD OF BLACK SEA TURTLE FEMALES IN MICHOACAN, MEXICO

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All life stages of marine turtles, are susceptible to human-induced mortality. Direct human manipulation as the renewal and regeneration of beaches as well as lighting and cleaning thereof, may reduce the survival of eggs and hatchlings on the beaches. The presence of humans on the beaches on foot or in vehicles, may adversely affect buried in the sand nests and hatchlings that emerge from it. Other factors such as erosion and accumulation of the beach, the introduction of exotic species and predators, are indirect human effects, which may be responsible for many deaths of turtles. The pollutants dispersed in the sands of the beaches, involved in embryonic development and hatching eggs from their nests and indirectly influence the loss of sea turtle populations, so it is important to identify the possible contamination of organisms by heavy metals, which cause toxicity problems to react with the sulfur atoms present in proteins. Heavy metals are a fundamental part of the anthropogenic sources from domestic waste is industrial agriculture, which are hazardous to marine biota, man and the environment. Some contaminants found in sea turtles at significant levels, to cause serious damage in these organisms are: Se, Ni, Hg and organochlorines (PCBs and DDT). Among the potential effects these pollutants are found in adults: damage to the endocrine system, results in terms of growth, development and reproduction; including cancer; embryos and hatchlings; change in sex ratio, malformations, increased early mortality and low hatching. This paper presents a qualitative and quantitative assessment of heavy metals in the blood of the population of female black turtle (*Chelonia mydas agassizii* aka *Chelonia agassizii*) that nests in Michoacan, Mexico is made. 10 samples of 5 ml blood black turtle nesting females, and which placed in tubes with lithium heparin as anticoagulant used. Lyophilization of the samples was performed by means of the dehydration process product under low pressure (vacuum) and moderate temperature, for which the samples should be previously and permanently solidified (frozen) during drying. To carry out the lyophilization, samples are frozen at a temperature of 40 ° C - 50 ° C for a fixed time of 40 min. Then we proceeded to digestion of the samples which were gauged in a volumetric flask. A gauged time, the samples were ground in a mortar to be sprayed until a size of less than 100 microns grain. The samples were placed in a fluorescence spectrometer for heavy metals and their concentration. We found 50 traces of heavy metals in blood samples of black sea turtle, some of which were identified potentially toxic because of its concentration: vanadium, manganese, cobalt, nickel, copper, zinc, arsenic, selenium, cadmium, mercury and lead.

FIRST REHABILITATION CASE OF A HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) STRANDED IN EASTER ISLAND, CHILE: THE NEED TO ALLOCATE RESOURCES TO INCREASE THE CHANCES OF SUCCESS

María J. Brain, Carol Medrano, Beatriz Brito, José del Río, and Rocío Álvarez-Varas

Qarapara Sea Turtles Chile NGO

On October 3rd, 2014 a Hawksbill turtle was found floating at Hanga Roa bay, Easter Island (27.0850°S; 109.2604°W). The turtle was taken to the shore by a surfer and was transferred to ORCA Diving Center from where we were contacted for professional advice. General information was provided, mostly about external condition, weight and morphometrics data corresponding to a juvenile size. First aids were developed by a local veterinarian under distance supervision by professionals from Qarapara NGO. This stage included shock doses of fluid therapy and temperature management out of the water. Subsequently, the turtle was sent to the mainland, where it was examined by professionals from Qarapara NGO. The clinical examination showed weakness, poor body condition, generalized cervical edema and hemorrhagic spots, and absence of right front wing. Incorporated in water the turtle appeared to be active with bilateral buoyancy disorder, with slight tilt to the left. The complementary tests reflected a moderate to severe anemic state (16% HCT) and a marked hyperglycemia (686 mg/dl). At radiographic level, solid content in the stomach and intestines was detected, and high gas content was observed in small intestine. The established treatment consisted of a single maintenance dose of fluids (NaCl 0.9%), antibiotics (broad spectrum), vitamin K and vitamin B complex supplementation, and tube feeding with fish and mineral oil. Furthermore, the turtle was kept in fresh water heated with red heat lamps, and was artificially salinized maintaining pH and salinity conditions within the optimal range for this species. During the process, the turtle kept active and the cervical edema disappeared, however it feces were observed with remains of shell and plastic into the pool. After two weeks, the animal was found dead in the pool. At necropsy, the signs observed were consistent with chronic renal failure and intestinal obstruction. Tissue samples were collected from different organs, which are in the process of histopathological analysis. The alteration observed in the digestive tract, supports intestinal impaction, which tends to be caused by ingestion of plastics. This is coincident with the feces and radiographic signs recorded throughout the process. However, evidence of intestinal injury is not considered sufficient to award them the cause of death, and should be considered in conjunction with the mismanagement of the water temperature, possible mishandling of chronic renal failure (due to the lack of information for uric acid in blood) and other suboptimal conditions detected along the process. Major conclusions will be reached once histopathology results are obtained. The present case demonstrates that although there are technical and professional capacities related to sea turtle`s rehabilitation in Chile, it exists a lack of resources destined to this area, which ultimately results in failures logistics and inadequate infrastructure. This situation leads to a poor success in the rehabilitation of these endangered species and highlights the need to increase economic resources destined to this issue.

MORPHOLOGICAL VARIATION ACROSS JUVENILE GREEN SEA TURTLES (*CHELONIA MYDAS*) AROUND SOUTH ELEUTHERA, THE BAHAMAS*

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Effectively quantifying the body condition of juvenile sea turtles in foraging grounds is important as it is a major component of individual fitness which in turn can influence many aspects of behavior including habitat selection, foraging, anti-predator behavior, migration, and reproduction. Typically body condition in sea turtles is assessed using indices derived from mass and length measurements or plastron shape, however, there are potentially many other methods which have yet to be tested Given the importance of measuring individual fitness, minimally intrusive and efficient means of obtaining body condition data in the field is of great interest and utility to marine turtle researchers. Shallow water, neritic habitats such as mangrove creeks and sea grass beds, serve as critical developmental and foraging habitat for juvenile and sub-adult green sea turtles. This study investigated the body condition of immature green turtles (*Chelonia mydas*) in foraging grounds on South Eleuthera, The Bahamas. We used sophisticated imaging methods (Exploratory Factor Analysis, or EFA) to both quantify the areas of different body parts (flippers, shell) and also to determine subtle variation in shape. This method creates a digital reconstruction of various body parts and analyzes slight variations in curvature that might not be detectable through standard linear morphometric techniques. We gathered digital images of each of the four flippers, as well as the shell and used EFA to examine variation in shape and area relative to body size both among individuals within a creek system and also among creek systems. We combined these data with simple measures of body depth and length taken at the time of capture. Our goal was to determine whether there exist morphological differences

among individuals in different creek systems within Eleuthera, and to determine if among-creek differences in food availability might explain these differences. Another goal was to use these measures, in combination with mass, to come up with a novel metric of overall condition and health that would inform us whether environmental variation might influence sea turtle health. These data could have broad applicability because morphological variation among individuals might ultimately impact the ability of these animals to migrate long distances.

AEROBIC BACTERIAL FLORA OF GREEN TURTLE (*CHELONIA MYDAS*) NESTS IN SUGÖZÜ BEACHES, TURKEY

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The aim of this study was to investigate the aerobic bacterial flora of the green turtle (*Chelonia mydas*) nests and studied as bioindicator to monitoring marine pollution in Sugözü Beaches, Turkey, which is one of the most important nesting beaches for green turtle. Sand and unhatched eggs which contains dead embryo from nest were taken randomly in four sub-sections of Sugözü Beaches. A total of 18 unhatched eggs from 11 nests and 22 sand samples from different nest were collected. All samples were transferred with sterile plastic bags during June–September of 2014. These samples were stored at 4°C prior to transport to the laboratory. Isolated cultures frozen at −80°C for further analysis. Following DNA extraction, samples were analyzed using 16S rRNA gene that targeted group specific primers for Real-Time PCR analysis. The sequences can be compared to the GenBank database by using the NCBI BLAST serve. These dominant isolates were *Pseudomonas* spp., *Bacillus* spp. and *Citrobacter* spp. by sequencing the partial and complete PCR amplified rRNA genes. Furthermore, species as an indicator of farming soil and factory wastewater were isolated. This study was pointed out a significant problem over biology and conservation of endangered marine turtles. Therefore, even there were important conservation measures for nesting and foraging grounds, migratory ways and physiological aspects, conservation studies by the light of biological data as determination of bacterial flora for the nests should be thought of as a conservation measure both for marine turtles and researchers on field.

HUSBANDRY AND REPRODUCTION OF *CARETTA CARETTA*

Sidonie Catteau

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Five adult loggerhead turtles (*Caretta caretta*), three males and two females, have been housed in Marineland, France, for over 30 years. At the end of 2007, new turtle facilities opened with 450 m^3 of natural sea water and a surface area of approximately 200 m^2. The most important improvement was the addition of an outdoor part of the enclosure with exposure to natural sunlight and access to a new artificial sandy beach. We observed the first mating in 2008, and since then, every year during winter, the three males mate with the two females. The mating period occurs in February and March and lasts for 5 or 6 weeks. Egg laying occurs about 6 weeks after the start of the mating period. Today, 20 eclosed hatchlings have been raised to sub-adult age. Eleven of them were transferred to differents European Aquaria for a limited time in order to communicate to the general public about the importance of sea turtle conservation. Growth data and other parameters of each individual are constantly collected. Furthermore, genetic analyseis were conducted to identify the paternity of each juvenile. Next to the details on husbandry and reproduction at Marineland Antibes, we present several conservation and research projects which were established in recent years and in particular our "PROJET *CARETTA*" a behavioural study on the behavior, development and adaption capabilities of aquarium-born turtles.

SKULL DIMORPHISM IN *CHELONIA MYDAS* (LINNAEUS, 1758) OF SOUTHERN BRAZIL

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Sexual dimorphism frequently occurs due to species-specific life history variations, morphology and behavior. For sea turtles specifically, secondary sexual characteristics often are observed among adults. Nevertheless, there have been few studies about sexual dimorphism that have included shape assessments. Such work is essential for understanding the interactions between individuals and their environment. This study aimed to evaluate sexual dimorphism in the size and shape of green-turtle skulls from dead, stranded specimens along the Paraná coast, south Brazil. Geometric morphometrics, which is a powerful tool for quantifying and visualizing biological shapes, was applied to 52 juvenile green-turtle skulls (34 females and 18 males). The dorsal, ventral and right lateral views of the skull were photographed using a digital camera (12 megapixcel). For each view, 23, 32 and 20 landmarks were digitalized using TPSDig software. The cartesian coordinates were obtained and superimposed using a generalized Procrustes analysis, which removes differences unrelated to shape such as scale, position, and orientation. Using principal components analysis, the two first components were demonstrated to cause variation in the three skull views, representing more than 27%. Visually, it was not possible to identify groups according to sex for any of the skull views. In order to statistically evaluate the sex influence over the skull shape, the first 14 components scores were used as shape variables in a one-way MANOVA, but no significant difference was found (dorsal: Wilks' lambda= 0.59, Fapprox.=1.86, p=0.06; ventral: Wilks' lambda=0.71, Fapprox.=1.09, p= 0.43; lateral: Wilks' lambda=0.58, Fapprox.= 1.90, p =0 .058). The centroid size (the only size measure considered for the method) was compared between males and females using a Student t-test, but also with no significant difference (dorsal: t= 1.63, df= 47.58, p= 0.11; ventral: t= 1.80, df= 47.39, p= 0.07; lateral: t= 1.76, df = 47.97, p= 0.08). The results showed that juvenile green turtles do not present sexual dimorphism in skull size and shape, and this can be explained by comparable habitat use. Specifically, all juveniles have a similar growth balance, occupying similar areas (same temperature) or preying similar items; manifesting as comparable jaw muscles and associated morphology. Genetic characteristics might have also contributed towards the observed result and further investigations are required.

RELATIONSHIP BETWEEN ESTERASE ACTIVITY AND METAL CONCENTRATIONS IN BLOOD OF OLIVE RIDLEY TURTLES FROM "LA ESCOBILLA" BEACH (OAXACA, MEXICO)*

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Esterases (EA), such as paraoxonase, are widely studied enzymes due to their multifunctional roles in diverse biochemical pathways such as protection against oxidative damage and lipid peroxidation, contribution to innate immunity, detoxification of reactive molecules, modulation of endoplasmic reticulum stress and regulation of cell proliferation/apoptosis. Marine turtles are classified as endangered species; pollution is one of the main threats that have led turtles to this point, within these Cd and Pb are ones of the most studied heavy metals in environmental biomonitoring due to their high toxicity potential. Thus, chronic exposure to these metals may affect aspects of the cell cycle and the antioxidant defence system, induced oxidative stress and affect enzyme activities; also Cd has been associated with renal and skeletal damage, and cancer, and was catalogued as highly embryotoxic and teratogenic. In the Mexican Pacific Ocean, turtles from La Escobilla Beach, one of the most important beaches in the world for Ridley turtles nest, have been previously reported to have the highest Cd levels worldwide. Forty-four blood samples were taken from randomly nesting turtles from "La Escobilla" Beach to measure the concentration of EA, Cd, and Pb. As data was not normally distributed, Spearman's correlation was used. $p < 0.05$ was considered significant. The EA values in turtles ranged from 0.36 to 3.95 UI/L, Cd from 0.01 to 0.32 µg/g, and Pb ranged from 0.02 to 0.24 µg/g. In turtles EA activity was negatively associated

with Cd (r= -0.31, p=0.02) and Pb (r=-0.26, p=0.04). In human medicine it was reported that EA activity was modulated by metal exposure; in this case it could be supposed that the similar situation could be happening with Cd and Pb concentration in this turtle population. To our knowledge this is the first report for EA on sea turtles. Acknowledgments: The first author received grants from CONACyT México (Nº 216671), without this support this work wouldn't have been possible, she also received grants from the International Sea Turtle Society, International Sea Turtle Symposium and all donors who make possible her assistance and presentation on this 35th Symposium. The authors want to thank Luz M. Ramírez for her invaluable help and knowledge. To Manuel Rodriguez and Cuauhtemoc Peñaflores from the Centro Mexicano de la Tortuga for permits and use of facilities and a especial thanks to Erika Peralta and Tere Luna from La Escobilla Camp for all their support during the fieldwork. Also to Dioseline Giron, Joel Alcantara and Mayra Bautista and all the students from the EMVZ and LIRA-UABJO for their huge help taking the samples. To F. San Nicolas and Susana Ros and their invaluable assistance in the sample analysis.

DIAGNOSING DECOMPRESSION SICKNESS (DCS) IN SEA TURTLES*

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Decompression sickness (the bends) as a clinical diagnosis, has been recently recognised as a new pathologic entity in sea turtles. The main goal of the present communication is to provide the basics to maximise diagnostic capabilities in all potentially affected animals. Patient history: until now, animals directly coming from by-catch (alive or freshly dead) are the only ones confirmed clinically to suffer DCS. However, some necropsy findings in dead stranded sea turtles, though highly compatible with the condition, could not be confirmed to be consequence of DCS due to certain putrefactive component interference. In our experience evaluating DCS in by-caught animals from trawlers and gillnets (N=83), we have observed a relatively high prevalence of positive animals (47%). Initial examination: a complete physical exam, including a whole neurologic assessment can provide clue information for a presumed diagnosis. Breathing difficulties, neurological signs (depression, hyper-excitability, lack of response) and signs compatible with pain (such as open mouth or flipper retraction) are common in decompressed animals. Blood work: a common finding is the severe increase in uric acid and creatine kinase, followed by an increase in lactate dehydrogenase on biochemistry panel. Haematology generally reveals leucocytosis specially the day after capture (observed after hyperbaric treatment), and sometimes an increase packed cell volume at arrival. Diagnostic imaging is the most reliable approach for clinical diagnosis, including common and relatively affordable veterinary techniques, such as radiology or ultrasonography. More advanced technologies such as CT-Scan or MRI, could provide additional useful information for quantification, functional testing, detailed anatomic mapping and in deep CNS evaluation. The most consistent diagnostic regions are: kidneys, heart and even liver, showing different degree of gas accumulation depending on severity. Careful dissection of deceased individuals could permit the prosector to directly visualize the presence of gas in certain key anatomical regions including: right atrium, sinus venosus, mesenteric veins and postcava. In less severe cases is rather complicate to visualize gas on necropsy. Other gross lesions such as congestive/haemorrhagic areas in kidneys, liver and/or intestinal mucosa are also present in many DCS cases. Gas analysis, although no diagnostic for DCS, it may help to rule out putrefaction gas. Intravascular gas bubbles associated with general congestion and perivascular haemorrhages in selected tissues represent the main histological findings in these cases. Gas amount and distribution in organic systems are directly related with clinical signs and rehabilitation viability of turtles diagnosed of suffering this disease.

THE EYES OF THE MARINE TURTLE *CHELONIA* (*C) AGASSIZII* CONTAIN MAGNETITE CRYSTALS AND CRYPTOCHROME 1A: IMPLICATIONS FOR MAGNETO-TRANSDUCTION

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Marine turtles perceive the intensity and inclination of the Earth's Magnetic Field (EMF). This information is used to set a referenced navigational course while juveniles and adults migrating through the ocean or hatchling crawl across the beach. However, we are yet unsure about the identity of the sensory organ(s) that transduce(s) EMF's intensity and inclination in these organisms. Some conjectures might be made based upon studies carried out in other vertebrate species. In birds, for instance, The EMS's inclination values seen to be primarily encoded by blue-light sensitive photoreceptors and/or retinal ganglion neurons, through a reaction mediated by cryptochrome (CRY) 1A. On the other hand, corneal epithelial cells containing magnetite, are thought to transduce ambient magnetic information in mole rats. Hence, in the present research we evaluated the presence of CRY 1A and magnetite in the eyes of hatchlings of the marine turtle by combining histological, histochemical and biochemical techniques. Our immunocytochemical studies revealed a group of CRY 1A positive photoreceptors and ganglion neurons in the turtle retina. These cells are likely to produce CRY 1A since both the protein and the messenger RNA were detected in eye extracts. With regard to magnetite, we revealed magnetic susceptibility artifacts within the nasal and oral cavities and in the eyes by Nuclear Magnetic Resonance Imaging (NMRi). In the retina, ganglion neurons, photoreceptors and the inner and outer nuclear layer were immunoreactive for ferritin, a protein that stores magnetite when iron availability is low within cells, but not for Prussian blue staining, in marine turtles overloaded with iron dextran. Finally, the identity of the ferric deposits as magnetite was unveiled by combining electron dispersion spectroscopy and X-ray diffraction. In sum, we believe our results support that the eyes contain the molecules/compounds require to transduce the inclination (CY1 A) of EMF, but not for intensity (magnetite), in spite of this last negative result, the result point out that the eyes might be considered as one of the sites where magneto transduction may take place in marine turtle in marine. Acknowledgements: Hugo olivera for technical assistance. Financial aid was provided by DGPA, UNAM (PAPITT N° IN203912-3); ZCR received a travel fellowship for Prosgrado en Ciencias Biologicas (PAEP), Conacyt and financial for lodging by International Sea Turtle Society.

HELMINTH FAUNA OF A STRANDED LEATHERBACK TURTLE, *DERMOCHELYS CORIACEA* IN THE WESTERN MEDITERRANEAN

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The Western Mediterranean waters are frequently visited by leatherback turtles, *Dermochelys coriacea*, from the Atlantic populations. However, stranding events are rare in this area, and the study of every specimen is essential for gaining knowledge on different aspects of the biology of the species, particularly in aspects in which information is scarce, such as parasitology. On 13 November 2014, a leatherback turtle was found stranded in Puzol (39º36′25″N, 0º15′53″E), at the eastern Spanish coast. Complete necropsy was performed and the stomach, intestine and liver were exhaustively examined for parasites. Three species of digeneans were isolated and fixed in 70% ethanol for morphological analysis, and in absolute ethanol for molecular analysis. A total of 299 individuals of *Calycodes anthos* Braun, 1899 (Calicodidae), and one of *Pyelosomum renicapite* Leidy, 1856 (Pronocephalidae) were found in the intestine of the turtle. Some specimens of *C. anthos* were found partially embedded in the intestinal ("honey-combed") folds. Two specimens of a third species, *Enodiotrema carettae* Blair and Limpus, 1982 (Plagiorchiidae), where collected from the liver. Compared to previous descriptions, specimens of *E. carettae* from this study were larger (body length > 8mm) and vitelline follicles slightly exceed the anterior edge of the cirrus sac. The three digeneans species here identified have previously been reported exclusively in marine turtles. *Pyelosomum renicapite* is a typical species from the leatherback turtle, whereas *C. anthos* and *E. carettae* have been reported also in other marine turtle species. However, *Calycodes anthos* had only been reported in leatherbacks turtles in Canada and Brazil waters, but not in the Mediterranean Sea, where this species was found only in loggerhead sea turtles, *Caretta caretta*. This study therefore adds useful information about the parasitic fauna of leatherback turtles in the western Mediterranean.

BLOOD BIOCHEMISTRY VALUES OF INTENTIONALLY CAPTURED GREEN TURTLES (*CHELONIA MYDAS*) IN PARANÁ STATE, SOUTHERN BRAZIL

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The green turtle, *Chelonia mydas*, regularly feeds along the Brazilian coast and nests mainly on ocean islands. Unfortunately, this species is still at risk due to anthropogenic activities and a viral disease that primarily affects green turtles, known as fibropapillomatosis. In order to assess the biochemical parameters of juvenile green turtles that feed along the coast of Paraná, southern Brazil, the animals were intentionally caught in gill nets placed daily in two different areas, Mel island (25°29'S 48°20'W) and Cobras island (25°28'S 48°25'W) during one week. Biometric data (i.e. body mass (BM); curved carapace length (CCL) were recorded for each animal. Additionally, turtles were also evaluated for nutritional status: good (1), medium (2) and poor (3) and the presence of fibropapillomas. Blood samples were withdrawn from the dorsal cervical sinus into tubes without anticoagulant. Each blood aliquote was centrifuged at 1800 × g (4000 r.p.m.) for 10 min (model 80-2B; Centribio) and kept frozen until analysis. Twenty-one serum determinants were measured with commercial kits manufactured by Dimension Clinical Chemistry System including: alanine aminotranferase (ALT), aspartate aminotransferase (AST), creatinokinase (CK), gamma glutamyl transpeptidase (GGT), alkaline phosphatase (AP), total protein, albumin, glucose, blood urea nitrogen (BUN), creatinine, uric acid, lactate, cholesterol, triglycerides, sodium, potassium, chloride, ionized calcium, calcium, phosphorus and magnesium. Total proteins were measured by refractometer. Biochemical values of sea turtles with or without fibropapillomatosis were analysed using a t-test for parametric assays or Mann-Whitney for non parametric assays using Sigma Stat. A total of 42 animals were sampled, of which 10 presented fibropapillomas (23.8%). The CCL and BM mean were 41.5 cm (SD=4.8) and 8.7 kg (SD=3.2), respectively, and turtles were in medium body condition (median=2). The results are as follows: ALT 2.7U/L (SD=2.7), AST 64.9U/L (SD=44.2), CK 378.2 U/L (SD=617.9), GGT 6.2 U/L (SD=2.0), AP 23.1U/L (SD=13.5), total protein 2.6 g/dL (SD=0.9), albumin 0.3 g/dL (SD=0.2), glucose 49.3mg/dL (SD=11.7), BUN 29.7 mg/dL (SD=42.4), creatinine 0.3mg/dL (SD=0.1), uric acid 0.8 mg/dL (SD=3.19), lactate 8.8 mmol/L (SD=5.2), cholesterol 78.8 mg/dL (SD=37.9) and triglycerides 52.5 mg/dL (SD=37.3),sodium 156.8mmol/L (SD=7.3), potassium 4.0 mmol/L (SD=0.5), chloride 114.2 mmol/L (SD=5.8), ionized calcium 1.9 mg/dL (SD=0.5), calcium 6.6 mg/dL (SD=1), phosphate 6.0 mg/dL (SD=2.1) and magnesium 11.4mg/dL (SD=4.1). Statistically significant differences were observed for BUN and cholesterol ($P \leq 0.05$). Turtles with tumors had significantly lower levels (BUN: 7.8mg/dL; SD=3.1; cholesterol: 57.1 mg/dL;SD=29.2) than healthy turtles (BUN: 36.4mg/dL; SD=46.9; cholesterol: 85.6mg/dL; SD=38.1). Low urea levels are usually caused by decreased proteins turnover or by decreased protein intake. Low cholesterol levels might indicate the beginning of chronic symptoms, such as, hyporexia or anorexia. Results indicate that the disease could hamper or impair the feeding behavior. The data presented here may be useful as reference in the assessment of health and disease of green turtle populations from southern Brazil. In addition, this study might contribute to the rehabilitation of sick individuals and hence, to their reintroduction in the wild.

RECORDING THE EPIBIONTS OF TURTLES UNDER REHABILITATION AND INTERNAL AND EXTERNAL PARASITES RECORDED FROM POST-MORTEM EXAMINATION OF SEA TURTLES IN THE EASTHERN MEDITERRANEAN

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Two species of sea turtle, loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*), are using Turkey's Mediterranean coastline for nesting and foraging. Loggerhead sea turtles are isolated from Atlantic population and colonized in the Mediterranean and their nesting population seems to be around 2000 females only. There are around 50 injured and 100 stranded turtles reported all along the Mediterranean coast of Turkey. The injured ones are transported to

Sea Turtle Rescue Centre (DEKAMER) and examined for both internal and external parasites and also epibiont species. Turtles died during the treatment period also examined for internal parasites. This study is the first evidence of parasites on these turtles nesting along the Turkish beaches. The external parasites usually recorded from nesting females but there was no information on male turtles. Twenty-two adult specimens of *Caretta caretta* and 12 green turtles were examined and these helminth groups were recorded: Digenea, Nematodes and Annelids (*Ozobranchus* sp.). Two epibionts species from Cirripedia (Crustacea) were also reported. The abundance and the turtles' health problems were recorded and overall parasite infection were discussed and compared with literature. Study of internal and external parasites is very important for the treatment of sea turtles especially under rehabilitation.

SELENIUM SPECIATION IN GREEN *CHELONIA MYDAS* AND HAWKSBILL *ERETMOCHELYS IMBRICATA* MARINE TURTLE EGGS

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Marine turtles worldwide, and especially the developing embryos, are threatening by environmental pollution such as pesticides and trace elements. Biological impairments of these pollutants and potential synergistic effects on marine turtles are still being unclear. The green *Chelonia mydas* and hawksbill *Eretmochelys imbricata* marine turtles are regular nesters in Guadeloupe (French West Indies) and have specific diet behaviour. The first one mostly feed on seagrasses while the second one on selenium-containing sponges. Both are thus exposed to diet-associated natural toxic products. A field survey was investigated in Guadeloupe in 2008. Eggs were collected from nesting green and hawksbill marine turtles and analysed for trace elements (i.e. mercury, lead, cadmium, selenium, copper, zinc and iron). By comparing the pollutant concentrations measured in eggs to toxic thresholds available in literature, selenium (Se) was indicated to threat the embryos' survival from both species. Since the Se toxicity depends on the chemical form (i.e. speciation), the most encountered inorganic and organic Se species were investigated in the turtle eggs (i.e. inorganic Se species: selenite and total inorganic Se; organic Se species: selenomethionine SeMet, selenocysteine SeCyst and methylselenocysteine MeSeCys). In both species, organo-Se (i.e. SeCys, SeMet and MeSeCys) accounted for more than 80% of the Se species measured in eggs. Species-differences were further observed with Se being mainly stored as MeSeCys (i.e. 41 ± 11% of the Se species) in the green turtle eggs but as SeMet (i.e. 39 ± 10% of the Se species) in the hawksbill ones. The SeMet toxicity was reported to be of higher concern for the developing embryos than the other Se species. Indeed, the unspecific incorporation of SeMet into proteins leads proteins more sensitive to oxidation and induces a greater use of the glutathione antioxidant (GSH) for non-enzymatic selenomethionyl residue reduction. Metabolic impairments due to the modification of the GSSG:GSH ratio probably explains the high concern of SeMet toxicity. Therefore, the present study suggested the hawksbill embryos as being higher threatened by the Se exposure than the green ones. Nevertheless, considering the diet behaviour of the hawksbill turtles, they may have developed strategies to face high Se pressure. Biological and ecological significance of SeMet, including Se, is still uninvestigated in marine turtles. Further works are needed to better understand the Se metabolism and requirement in marine turtles.

REVISION OF FIBROPAPILOMATOSIS IN GREEN TURTLES (*CHELONIA MYDAS*) IN URUGUAYAN WATERS

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Green turtle fibropapillomatosis (GTFP) is a disease of green turtles (*Chelonia mydas*) that is characterized by multiple cutaneous papillomas, fibromas, and fibro- papillomas, as well as occasional visceral fibromas. GTFP prevalence varies considerably among geographic locations, ranging from 0 to 92%, and can have substantial differences over relatively short distances. The aim of this study is to evaluate the evolution and the characteristic and mortality of this disease in green turtles (*Chelonia mydas*) in Uruguayan waters. In Uruguay, Fibropapilomatosis was first described and confirmed histopathologically in 2003 (Pastorino *et al*, 2004). Cutaneous tumors were founded in only 102 green turtles from a total of 2867 studied turtles (incidental capture, scientific capture and stranding data, Karumbe NGO database). The main peak of presence (7.8%) was in 2011, with 21 cases from a total of 473 juvenile green turtles. Mainly, the studied turtles were founded in Rocha department (La Coronilla, Punta del Diablo and Santa Teresa beaches). Only one was founded in

Maldonado department. These cases appeared during the austral summer (December-March), when water temperatures reach 20 – 24 °C. Exceptionally, 18 cases occurred during the austral winter (April-September), registering water temperatures around 10-15°. Most of them were in healthy condition, presenting moderate epibiota. The location of the cutaneous tumors weas in pericloacal, axillaries and inguinal regions, periocular surface, mouth, flippers, neck, carapace and plastron. We estimated, in the last three years only 9 turtles were captured or stranded with tumors. In July 2014, 17 green turtles were registered as stranded or capture individuals with hypothermia; one of them had many cutaneous tumors in periocular surface, flippers, cloacae and neck (weight 17.65 kg, LCC measure 56.4 cm, good body condition (ratio index= 1000), which did not present buoyancy problems. This turtle defecated and fed normally. Most of the tumors were unpigmented, papillary and pedunculated. Biochemical parameters were into normal values. The x-rays and the echography did not show any internal tumors. All the cutaneous tumors were extracted by surgery. The histopathology showed lesions compatible with fibropapilomas. This turtle was the most austral case of fibropapilomatosis in Green Turtle (34°52'33.13"S 55°16'49.69" W). The information collected along these years has shown that GTFP is not a cause of mortality in this population. *Acknowledgements:* To Daniel Del Bene for his help, the pathologist Deborah Cesar, the surgeon Fernando Cirilo, Ancap and all volunteers.

DECOMPRESSION SICKNESS IN SEA TURTLES: TREATMENT AND PROGNOSIS*

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Decompression sickness (DCS) has been recently diagnosed in sea turtles as a result of fishing gear interactions. According to our experience, disease outcome greatly depends on total amount and distribution of intravascular gas, time to hyperbaric oxygen therapy (HBOT), severity of clinical signs and evidence of pulmonary water aspiration. The condition is generally lethal in moderate and severe cases not receiving HBOT and could sequelae the patients even in mild cases. In the later, small amounts of gas are typically evidenced in the kidney region, being reabsorbed in 24 to 48 hours even without specific treatment. These animals tend to survive normalizing initial altered renal blood values during the following days post capture. However, kidney ischemic compatible lesions have been observed through MRI, necropsy and histopathology in late/none treated individuals several days after gas reabsorption and blood profile normalization, indicating at least, a temporal (and maybe permanent) loss or renal functional capacity. Permanent neurologic damage has been also associated with late HBOT treated mild embolism. In consequence, we consider all professionals dealing with bycaught sea turtles or animals forcedly submerged, should be familiar with diagnostic and therapeutic techniques in order to minimize sea turtle mortality or any other organic damage in survivors. In the present work, we provide some preliminary treatment clues for dealing with this condition. Different drugs/treatments including crystalloid fluidotheraphy, normobaric oxygen, anti-inflammatories, analgesics, cardiotonics or respiratory stimulants, have been used in several cases trying to reverse the condition. Conventional symptomatic treatment alone seems not to suffice in treating decompression cases. We found HBOT as the only successful therapeutic approach to revert the condition making the pathological gas and the clinical symptoms to disappear. Several sea turtles (N=7) had been already successfully treated in our facility using adapted human diver's recompression-decompression tables, which had been progressively readjusted with time towards longer treatment regimes for turtles. We assume this as a direct consequence of their relatively slower breathing and heart rates and hence slower nitrogen elimination through ventilation. We basically treat confirmed decompressed turtles in the hyperbaric chamber for a minimum of 10h (average 14 hours) at an average pressure of 1 bar. Total duration or recompression generally depends on the animals' condition and severity of signs, but it is remarkable that under this new prolonged HBOT protocol compared to the original human ones, turtles seem not to keep any residual pathological after treatment completion. Based on these preliminary findings, the present recommendation would be to apply HBOT as soon as possible in any sea turtle confirmed with gas embolism to decrease mortality and decrease risk of potential permanent damage. Besides DCS treatment and based on the experiences with other species, we also consider HBOT could be an additional interesting tool for the sea turtle practitioner, to treat other common conditions affecting these animals such as certain ischemic lesions, non-healing wounds, refractory osteomyelitis, severe blood loss, intracranial abscesses, necrotizing soft tissue infections, CNS trauma or other hypoxic conditions.

FIBROPAPILLOMATOSIS IN GREEN TURTLES IN CONGO: MONEL TAGGING, TIME SPENT IN COASTAL WATERS, CCL AND SEA SURFACE TEMPERATURE HISTORY HAVE SIGNIFICANT EFFECTS ON FP ONSET AND EXTENT*

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After an epizootic peak in 2009 (up to 25% of the green turtle were exhibiting skin masses), fibropapillomatosis (FP) is today considered enzootic in Congo with a steady or slightly decreasing prevalence around 10% in green turtles (2010-2014). From 2008 to 2014 6,473 observations of 4,880 green turtles were recorded from incidental catches in traditional fishing gears in the Republic of Congo. For each green turtle, FP lesion were scored, the date and place of the capture were recorded, as well as the type of fishing gear and practice responsible for the capture, and other individual information such as biometrical data (ccL), gender, presence of parasites (*Balanus* spp. & leeches). Additionally, each individual observed was identified with two Monel tags before being released. This data set was used to look for possible link between on the one hand the presence and the extent of FP lesions. On the other hand, the individual information and environmental factors. Two mixed generalized linear models (GLMMs) were built to address individual, historical and environmental factors that have a significant effect on the FP lesions observed. The GLMM response variable was successively the presence or absence of fibropapilloma(s) on the green turtle observed and the extent of the FP skin lesions. Predictors tested whether the individual was observed for the first time or it was a new observation of an individual previously tagged during a past capture event. In this case, the delay in days since the first observation determined thanks to the ID tag history register. These included curved carapace length of the individual, gender for green turtles exhibiting adult sizes, presence and number of external parasites, balanus and leeches, periodic time/seasonal effect through a pseudo-Fourrier transformation, and sea surface temperature (SST). GLMM was run iteratively for SST measured at different periods of time ranging from 0 to 52 week before the observation (SST Lag) and averaged on different lengths of time, ranging from 0 to 52 weeks around the (SST Lag). A heat map was then designed to determine which sea surface temperature regressor will produce the best GLMM fit. For both presence and extent of the FP, modeling results shows that tagging history (re-reading of a tag) is the predictor with the strongest effect. The FP lesions were significantly linked with history of tagging events. CCL of individuals and the length of time spent on the coastal feeding ground also showed significant positive effects on FP presence and extent. Significant effects of SST history were also detected: a short-term negative effect and a long-term positive effect of Sea Surface Temperature on FP presence and extent. The remote effects of the SST will be discussed in the light of herpes virus cycle and pathogenic mechanisms. Effect of water temperature has been previously described for the gray-patch disease another herpes virus disease occurring in maricultured green turtles. This study is to our knowledge the first study revealing the effect of SST history on the presence and extent of FP lesions in natural conditions.

ON THE CONCEPT OF EMBRYOLOGICAL THERMOSENSITIVE PERIOD FOR SEX DETERMINATION IN REPTILES*

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Sexual phenotype of the gonad is dependent on incubation temperature in many turtles, all crocodilians, and some lepidosaurians. While temperature has an effect on sex determination during approximately one-third of the embryonic development when the gonad begins to form, the exact delimitation of this thermosensitive period for sex determination is challenging both conceptually and logistically. The TSP delimitation varies according to the experimental procedures and criteria used. The effect is gradual both in time and level. The longer the embryo stays at a feminizing or masculinizing temperature, the more the effect will be visible. With extreme temperature manipulations, temperature can have effects at times during which lesser manipulations would be ineffective. But the level of masculinization or feminization is not directly proportional to the distance to the pivotal temperature (the constant temperature producing 50% of each sex). Finally, a new method is proposed to allow to identify the thermosensitive period for sex determination using a natural regime of temperatures and then to estimate the temperature during this period. We show that the approximation of the thermosensitive period for sex determination to be located at the middle third of incubation creates a systematic bias when estimating the average incubation temperature. A model of embryonic growth must instead be used to delimitate the limits of the thermosensitive period for sex determination.

EXPRESSION OF AROMATASE IN THE EMBRYONIC BRAIN OF THE OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*), AND THE EFFECT OF BISPHENOL-A IN SEXUALLY DIFFERENTIATED EMBRYOS*

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Brain aromatase participates in several biological processes, such as regulation of the reproductive-endocrine axis, memory, stress, sexual differentiation of the nervous system, male sexual behavior, and brain repair. Here we report the isolation and expression of brain aromatase in olive ridley sea turtle (*Lepidochelys olivacea*) embryos incubated at male- and female-promoting temperatures (MPT and FPT respectively), at the thermosensitive period (TSP) and the sex-differentiated period. Also, aromatase expression was assessed in differentiated embryos exposed to bisphenol-A (BPA) during the TSP. BPA is a monomer of polycarbonate plastics and is considered an endocrine-disrupting compound. Normal aromatase expression was measured in both forebrain and hindbrain, showing higher expression levels in the forebrain of differentiated embryos at both incubation temperatures, while no significant differences were detected in the hindbrain, although expression was slightly higher at MPT. BPA did not affect aromatase expression neither in forebrains or hindbrains from embryos incubated at MPT, while at FPT an inverted U-shape curve was observed in forebrains with significant differences at lower concentrations, whereas in hindbrains a non-significant increment was observed at higher concentrations. Our data indicate that both incubation temperature and developmental stage are critical factors affecting aromatase expression in the forebrain. Because of the timing and location of aromatase expression in the brain, we suggest that brain aromatase may participate in the imprinting of sexual trends related to reproduction and sexual behavior at the onset of sex differentiation, and BPA exposure may impair aromatase function in the female forebrain.

BLOOD CHEMISTRY OF NESTING FLATBACK SEA TURTLES (NATATOR DEPRESSUS)*

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Flatback sea turtles, *Natator depressus*, forage for molluscs and other invertebrates over the continental shelf of northern Australia. At least four discrete meta-populations use separated nesting sites on mainland Australia and coastal islands. Satellite tracking suggests the meta-populations mix on the feeding grounds and are exposed to the same environmental conditions. The northern populations, the focus of this study, nest either in the winter months, June to August, or throughout the year. Few reports address the physiology of flatback sea turtle blood and none address the usefulness of blood chemistry in assessing health. Efforts to use blood chemistry to assess the health of individual sea turtles and that of the population are hampered by boundary parameters such as size, sex and fasting condition. In the 2013 and 2014 breeding season, 31 blood samples were collected from the lateral cervical sinus of female flatback sea turtles after nesting on Bare Sand Island, Northern Territory, Australia. The blood was divided into lithium heparin and EDTA blood tubes, chilled and transported to Berrimah Veterinary Laboratories (BVL) in Darwin, 50 km away. The analyses started within 24 hours of collection with the packed cell volume determined from the EDTA tubes. Plasma from the heparinized samples was analysed for proteins, enzymes, electrolytes and other compounds. The boundary parameters in this study were constrained by the samples being taken from all individuals of the same sex, of the same gene pool, being adult in age, and of presumed similar fasting regime by being collected at night. The results are compared with published results from healthy green and hawksbill sea turtles with much wider boundary parameters that feed in the seas of northern Australian of a variety of plants and animals. The analyses from the adult flatback sea turtles with their results as means and standard deviations are given below: Packed cell volume (0.31 ± 0.04), glucose (3.94 ± 0.95 mmol/L), total bilirubin (19.40 ± 12.03 µmol/L), liver and cardiac enzymes; alanine aminotransferase (14.68 ± 12.91 units/L), aspartate aminotransferase (172.35 ± 68.4 units/L), alkaline phosphatase (77.58 ± 37.87 units/L), gamma glutamyl transferase (2.97 ± 1.56 units/L) and creatine phosphokinase (673.48 ± 555.51 units/L), proteins; total protein (44.55 ± 10.39 g/L), albumin (17.39 ± 5.08 g/L), globulin (27.16 ± 6.83 g/L), albumin/globulin ratio (0.66 ± 0.13), kidney function compounds; creatinine (20.97 ± 8.44 µmol/L), urea (1.01 ± 0.59 mmol/L) and uric acid (70.20 ± 14.72 µmol/L), electrolytes; sodium (144.90 ± 2.84 mmol/L), potassium (4.45 ± 0.43 mmol/L), chloride (106.19 ± 3.23 mmol/L), calcium (4.19 ± 2.45 mmol/L), phosphorus (3.25 ± 1.10 mmol/L) and magnesium (2.55 ± 0.28 mmol/L). These values form a small subset of future reference values that will be useful in monitoring the health of the Bare Sand Island nesting population of flatback sea turtles as the northern Australian seas

undergo increased oil and gas exploration, coastal dredging and port infrastructure. The values also form guidelines for assessing the condition of sick and injured sea turtles being retrieved from the coastal waters and their progress towards recovery and eventual release.

EFFECTS OF PRENATAL EXPOSURE TO STRESS ASSOCIATED WITH ARTIFICIAL INCUBATION ON OLIVE RIDLEY DEVELOPMENT

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Sea turtles are considered threatened or endangered. As a result, nurseries have been established where fresh eggs laid by females were transferred and incubated in artificial nests as a conservation strategy. Over time negative effects of artificial incubation on the offspring have been documented, suggesting that physicochemical factors of artificial nests may be the cause. Our hypothesis is that physicochemical factors generate chronic stress exposure in the embryo/fetus during artificial incubation. Therefore, the main objective of this paper is to show the effects of relocation and pre-hatching chronic stress exposure in newly hatched *L. olivacea* comparing the cytology of some brain regions, pituitary, adrenal gland and gonads, as well as corticosterone concentration, among turtles hatched from artificial nests or from natural nests. The choice of organs is based on evidence from mammals showing that chronic stress exposure during embryonic stages modifies the architecture of neural circuits leading to behavioral, cognitive and reproductive alterations in response to over-activation of the hypothalamic-pituitary-adrenal axis. The results obtained so far in our experimental model support the proposed hypothesis, since animals hatched from artificial nests have lower body weights, besides their pituitary and adrenal glands have a higher mass (data supporting over-activity of the pituitary-adrenal axis). By contrast, a significant decrease in the weight of the gonad was observed. Statistical analyzes reveal that these differences are significant. Regarding the neuronal cytoarchitecture, turtles hatched from artificial nests have hypotrophic dendritic trees.

THE FIRST OCCURRENCE OF THE CRUSTACEAN GENUS *HEXAPLEOMERA* AS AN ENDOSYMBIONT OF THE EMBEDDING MARINE TURTLE BARNACLE *STEPHANOLEPAS MURICATA*

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Hexapleomera is a genus of tanaid crustaceans with very low dispersal ability that are known to be epibionts on marine turtles and manatees. The Tanaidae are a morphologically diverse taxonomic group that are only recently becoming relatively well known. In fact, it is estimated that less than 20% of extant tanaids have been described and many of the described species may be highly similar cryptic species complexes. With no dispersive life history phase, *Hexapleomera* populations likely remain isolated. When *Hexapleomera* do disperse it is by crawling so dispersal of more than a very short distance seems unlikely. This lack of dispersal likely creates a series of small meta-populations that are more or less distinct from each other. In addition, as an obligate epibiont of marine turtles and manatees, *Hexapleomera* migrates passively on its vertebrate host, complicating the understanding of what constitutes a population as well as the connections between populations. Phylogenetic and population genetic studies in *Hexapleomera* are lacking but are likely to be highly informative for gaining insight into the life histories of both *Hexapleomera* and its host. Here, we present the first known account of *Hexapleomera* occurring as an endosymbiont of another crustacean - the turtle specific burrowing barnacle *Stephanolepas muricata*. A collection of four samples of *S. muricata* taken from green sea turtles (*Chelonia mydas*) from Edgecombe Bay, Bowen, Queensland, Australia were found too contain two individuals that had specimens of *Hexapleomera* existing as endosymbionts with the barnacles. One of the two specimens collected was sequenced at several common genetic loci including 18s, 16s and COI. These data were analyzed phylogenetically by comparison with known sequences from Genbank. In addition, due to the relative rarity of collecting these specimens it is likely that any comprehensive genetic survey will happen as a collaborative effort of many authors each independently submitting small catalogues of data to online databases such as Genbank.

AEROBIC GASTROINTESTINAL BACTERIAL FLORA OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) FROM THE MARINE TURTLE RESCUE CENTRE PULA, CROATIA

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The information on gastrointestinal tract bacterial flora in loggerhead sea turtles (*Caretta caretta*) is very scarce. It is known that normal gastrointestinal flora of reptiles is comprised primarily of gram positive bacteria such as *Streptococcus* and *Bacillus* species, and to a lesser extent of gram negative bacteria such as *Pseudomonas*, *Aeromonas* and *Salmonella* species. Most of these gram negative bacteria are also considered opportunistic pathogens since they can cause clinical diseases in immunocopromised animals, but also in humans. The aim of this study was to get more insight in the composition of gastrointestinal bacterial flora in loggerhead sea turtles from the Marine Turtle Rescue Centre Pula, Croatia. This informations can be of interest both in the treatment of injured and stressed animals in rescue centers, but also for the people who are in the contact with those animals during their rehabilitation. Oral cavity and cloacal swabs from total of 15 animals were taken during their rehabilitation at the rescue center. The samples were taken after manual restraint with the sterile cotton swab containing transport media and were analyzed at the Faculty of Veterinary Medicine, University of Zagreb. All the samples were plated on nutrient agar and brilliant green agar and incubated for 24 hrs at room temperature. In addition to this protocol, cloacal swabs were enriched in the selenite cysteine broth for optimal *Salmonella* sp. growth and incubated at 37oC for 24 hrs. After the incubation, these samples were plated on brilliant green and xylose lysine deoxycholate agars and incubated at 37oC for 24 hrs. All the bacterial colonies were further evaluated according to their morphology, Gram staining, catalase and oxidasetests and also by their biochemical characteristics using API commercial strips. Results. In total, 17 different bacterial species were isolated from both oral cavity and cloaca, among them 12 gram negative and only five gram positive isolates (Table). From oral cavity, altogether 13 bacterial species were isolated, while 15 different species were isolated from cloaca. Bacterial species isolated (number of isolates) from the loggerhead sea turtle oral cavity and cloaca (oral cavity, cloaca). *Schewanella putrefaciens* 7 4; *Escherichia coli* 3 4; *Pseudomonas fluorescens* 2 1; *Pseudomonas aeruginosae* 1 1; *Proteus vulgaris* 2 4; *Proteus mirabilis* 1 1; *Aeromonas hydrophila* 2 1; *Aeromonas salmonicida* 1 2; *Enterobacter aerogenes* 1 1; *Citrobacter braaki* 0 1; *Citrobacter freundii* 0 1; *Morganella morganni* 0 1; *Micrococcus luteus* 3 0; *Staphylococcus contus* 1 0; *Staphylococcus carnosus* 0 1; *Micrococcus* sp. 2 2; *Bacillus* sp. 1 1. Most of isolated bacteria belong to ubiquitous microorganisms specific for marine environment. Some of isolated bacteria, such as *Schewanella putrefaciens* group of bacteria, were already described as microorganisms that contribute to mineralization, and some others, such as *Enterobacter* sp. and *Pseudomonas fluorescensare* known as biocontrol agents against soil-borne phytopathogens. However, some of these bacteria, e.g. *A. hydrophila*, *P. aeruginosae*, *E. coli* and *Proteus* sp. were also described as pathogenic factors both for immunocompromised animals and humans.

APPLICATION OF NATURAL PLANT EXTRACTS TO NORMAL MEDICAL TREATMENT PROCESS OF INJURED SEA TURTLES

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Sea turtles are endangered species all around the world. Two species of sea turtle, loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*), are using Turkey's Mediterranean coastline for nesting and foraging. Dozens of sea turtles are being injured or died due to fishery interactions, speed boat accidents, ghost nets etc. along the coastline of Turkey. The first sea turtle rescue centre (DEKAMER) in Turkey was established in 2008 and a total of 101 injured turtles were admitted to the centre, during 2008-2014. Most turtles are being admitted by serious head injuries and, amputated extremities, carapace damage. Treatment of these injuries requires long term rehabilitation process. There are many medications described for sea turtles but a need for faster medication techniques was obvious. We used a new medication in order to speed up the recovery process of traumatic injuries on sea turtles. Six loggerhead individuals with serious head injuries and a green turtle individual with an amputated front-right extremity treated with topical antibiotics, beeswax and amber (*Liquidambar orientalis*) tree resins. We also used the extracts obtained from a lichen species (*Pseudevernia furfuracea var. furfuracea*) and the seeds of coriander (*Coriandrum sativum*). Head injuries recovered very fast in a 9-month period. The amputated area of the green turtle recovered in a 4-month period at relatively low metabolism rate during winter which reduces recovery rate of injured turtles. Using new therapeutic medications with natural and herbal support resulted positively in a small group of patients admitted to DEKAMER. It's quite likely that using this method may increase treatment of injured turtles and shorten the duration of treatment at rehabilitation centres.

EVOLUTION AND CONSTRAINT OF THERMAL REACTION NORMS FOR EMBRYONIC GROWTH RATE IN 3 POPULATIONS OF CARETTA CARETTA FROM THERMALLY CONTRASTED ENVIRONMENT*

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In the context of climate change, information about the biological response of organisms is needed at ecological time and spatial scales. Ectothermic species are supposed to be more affected by shifts in their thermal environment, especially those that exhibit temperature-dependent sex-determination (TSD). The adaptive significance of the TSD mechanism in reptiles is often misunderstood and assessing embryonic response to incubation-temperature variations in natural conditions remains a challenge. A norm of reaction describes the pattern of phenotypic expression of a single genotype across a range of environments, here the incubation temperature. The norm of reaction of embryonic growth rate in relation to temperature describes how growth of embryo changes when the temperature changes. Using recently published method, thermal reaction norm for embryonic growth rate can now be estimated from a set of field-incubated nests. It has been estimated for 3 populations of the globally distributed and threatened marine turtle *Caretta caretta*. These 3 populations nest in beaches with very contrasted thermally environment. However, the 3 populations have similar thermal reaction norm. Several hypotheses will be discussed to explain this result. It could be that *Caretta caretta* could be more resilient than generally thought to climate change at least for this important character.

FIRST RECORDED CASE OF IDENTIFICATION OF FUSARIUM SOLANI IN *CARETTA CARETTA* NESTS IN ITALIAN COASTS, LINOSA ISLAND

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This study aims to identify the responsible for massive fungal invasion in nests of *Caretta caretta* from Linosa Island (Sicily) throughout 2013. Research was conducted on 18 eggs extract in one of two nests located in the island at the end of incubation period. Both nests showed evident and extended signs of fungal infestation on the eggs shell. Cultural analysis allowed to isolate colonies of *Fusarium* sp. Molecular analysis were performed, by amplification and sequencing of the ITS gene. The sequence obtained of 500bp showed 99% identity with *Fusarium solani* FUS ITS 11 (HQ384397.1). *Fusarium solani* is responsible for high embryonic mortality rate in nests of loggerhead sea turtle in worldwide; it's implicated in low hatching success. To the authors knowledge this is the first time that the presence of this fungus is recorded, using molecular analysis, on loggerhead's eggs in Italian coasts. This finding indicates as also the mycetes could represent a threat of conservation for logger-head sea turtle in this areal. During this study the levels of heavy metals in different components of the eggs, as albumen, yolk and shell, were also appraised. Toxicological results showed that principal heavy metals (As, Pb, Hg, Cd, Cr) had low values in all studied components. A challenge for the future research will be studying the complex networks of these factors and im-proving our knowledge of the exact mechanism involved in embryo mortality rate in *Caretta caretta* on Italian coasts, as little is still known.

FIBROPAPILLOMATOSIS DYNAMICS IN IMMATURE GREEN TURTLES

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Emerging diseases in the marine realm are increasing. Among sea turtles, outbreaks of fibropapillomatosis (FP), a neoplastic infectious disease, have occurred at greater frequency worldwide since the 1980's. The expression of this disease is associated both with a novel alphaherpesvirus (CFPHV) and with altered environments, and research on the CFPHV genome strongly suggests that infection takes place upon recruitment to neritic habitats; however its aetiology, to date, remains to be clarified. This study aims to increase our understanding of FP dynamics, on two typical green turtle foraging grounds at Puerto Rico: Puerto Manglar and Tortuga Bay. Our dataset comprises 17 years of live capture-mark-recapture (CMR) records. We used nonlinear models to investigate the relationships between having FP and three potential explanatory covariates; i) straight-carapace-length (SCL), ii) year, and iii) abundance, and used multistate CMR models to estimate the probability of FP regression. At Puerto Manglar, FP was first observed in 2000, and prevalence peaked in 2003, with 79% of captured turtles expressing disease. At Tortuga Bay FP was not detected until 2005 and the peak of prevalence was 33% in 2009. The mean size at first capture with FP (mean ± SD: 55.29 ± 8.62 cm SCL) was significantly higher than mean size at first capture (mean ± SD: 46.3 ± 10.96 cm SCL), and the minimum SCL at which a turtle was captured with FP was 39.40 cm. At both sites SCL and year were significantly linked with FP risk. At Puerto Manglar FP prevalence first increased with SCL, peaking at 57.9 cm, then decreasing among larger individuals which presumably recover from disease, whereas at Tortuga Bay the risk of FP increased with size. FP regression rate was of 36% at both sites, but since mortality associated with this disease is rarely detected at our study sites, and larger turtles permanently migrate from these foraging bays, we believe this rate is higher. We applied expected growth rate functions and estimated the mean time from recruiting to the foraging bays and growing FP tumors to be ca. 2 years. We detected an epidemic at Puerto Manglar from 2000 to 2007, potentially associated with an environmental stressor. We show that, at our study sites, recruits take some years to before expressing FP, FP expression is year dependent, we report the highest FP regression rate to date.

CONCENTRATIONS OF SOME CHEMICAL ELEMENTS IN BLOOD OF GREEN SEA TURTLES (*CHELONIA MYDAS*) CAPTURED AT PARQUE NACIONAL MARINHO DE FERNANDO DE NORONHA, BRAZIL*

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Green turtles can be used as sentinels of marine enviroment due to characteristics as longevity and diet (omnivory when hatchlings to herbivory when adults) which may indicate the degree of oceanic contamination. Thirty-one juveniles of green sea turtles were intentionally captured at Praia do Sueste (3º86'68"S; 32º42'60"W), Parque Nacional Marinho de Fernando de Noronha, Brazil between April, 26th and May, 04th 2013. Specimens were identified by the number of ring provided by Projeto Tamar/ ICMBio (Instituto Chico Mendes de Biodiversidade) proceeding to the measurement of the Curved Carapace Lenght – CCL. Sex determination is not possible in juveniles by phenotypic parameters. It was collected 1mL of blood from cervical venous sinus, having the occiptal bone as reference. Turtles were released immediately after harvest. Samples were placed in Vacuette® Trace Elements Heparin Sodium tubes, kept on ice and transferred within 4 hours for the freezer (-20ºC) untill analysis. Analyses were carried out with an Inductively Coupled Plasma Mass Spectrometer (ICP-MS), operating with high-purity argon. Database management and statistical analysis were performed in R software (R Development Core Team, 2013). The correlations between the concentrations of 20 elements analyzed and the curved carapace lenght – CCL were analyzed using Spearman Correlation Test, since data did not show normal distribution or homoscedasticity. P values less than 0.05 (two-tailed) were considered to be significant. The Median (First Quartile-Third Quartile) for CCL and 20 elements was: CCL: 0.72(0.68-0.77), Al: 80.31(60.41-105.60), As: 204.84 (166.5-462.84), Ba: 3.29 (2.65-4.11), Be: 1.07 (0.74-1.44), Ca: 71.98 (59.49-89.62), Cd: 12.58 (4.66-12.58), Co: 40.24 (27.48-57.04), Cs 0.83 (0.67-0.91), Cu: 787.30 (626.26-861.71), Li: 32.16 (28.68-35.85), Mn: 40.76 (30.42-57.87), Mo: 10.16 (8.77-12.62), Pb: 25.29 (14.24-36.47); Rb: 1130.75 (954.40-1300.05), Sb: 4.96 (4.13-6.37), Se: 282.61 (191.49-379.69), Te: 0.30 (0.23-0.42), Tl 0.08 (0.02-0.22), U: 0.29 (0.22-0.42) e Zn: 12.18 (11.03-13.81). In our statistical analysis, we noticed a negative correlation between CCL and blood levels of Se while Zn, Pb and Cs showed a positive correlation with CCL. When compared these results with others studies made by colleagues worldwide, the levels of chemical elements appear to vary widely. Despite Komoroske *et al*., 2011 (United States of America) and Gaus *et al*., 2012 (Australia) used the same methodology (ICP-MS), only the results for Cu are similar. It's important to know that those researchers collected green sea turtles in anthropogenically impacted places while Parque Nacional de Fernando de Noronha is considered a clean area of waste, since it is an oceanic archipelago without industrial development and low enviromental impact. Studies of this kind, with a larger number of animals and in different areas of the Brazilian coast are in progress, which may better clarify the relationship of these species with inorganic elements and their envolvement in diseases or survival of green turtles. Freshly laid eggs from the green turtles were collected at random from different nests at Ras Al-Hadd Reserve located on the Oman Sea which hosts one of the largest nesting beaches in the world. Freshly laid green turtle, (*Chelonia mydas*), eggs were collected randomly from different nests. The eggs were incubated at 30 oC to produce females and examined at five stages of development to determine the progesterone receptors (PR). Gonadal tissue proteins were separated using of Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDS-PAGE). Duplicate gels were made, one set was stained by coomassie blue and the other was used for Western blotting. Both immunoblotting and Immunohistological techniques were used to detect PR expression. Primary rabbit polyclonal antibody and secondary conjugated mouse IgG with alkaline phosphatase were used to detect PRs. PR expression was detected between day 17-47 and remained stable throughout incubation period. Both immunohistological and Immunoblotting techniques demonstrated similar results for PR expression. The results revealed that gonadal differentiation occurred after day 20 of embryogenesis. The main objective of this study is to monitor the stages of embryogenesis in association with PR expression in female embryos during different stages of development. Such study will be of value to be used in the conservation program of Ras Al-Hadd Reserve.

THE IMPACT OF EXTENDED PRE-OVIPOSITIONAL ARREST ON EMBRYONIC DEVELOPMENT AND HATCHLING FITNESS IN THE FLATBACK TURTLE*

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Turtle embryos pause development before oviposition in a process known as preovipositional arrest. Embryonic development arrests due to hypoxia (low oxygen) in the maternal oviducts and resumes only after exposure to normoxia when eggs are laid. Recently, several studies have hypothesized that prolonged periods of preovipositional arrest may have a detrimental effect on embryo survival and development after eggs are laid. We tested this hypothesis by comparing embryo survival (determined by white spot formation and hatching success) and hatchling fitness (measured by self-righting, crawling, and swimming ability) of flatback sea turtle eggs following incubation in hypoxic (~1%) and normoxic (~21%) treatments for 5 d immediately following oviposition. We also measured embryo survival and hatchling fitness when eggs were incubated in hyperoxic conditions (42% oxygen), to determine whether hyperoxia could improve developmental outcome or whether some consequence of oxidative stress might manifest. Eggs incubated in hypoxia remained arrested during the 5-d treatment, and 97.5% of the eggs successfully recommenced development after exposure to normoxia when the treatment finished. At treatment commencement, 100% and 97.5% of eggs in the hyperoxic and normoxic treatments, respectively, began developing. Although hatching success was significantly lower following hypoxia (15%) compared to normoxia (80%) and hyperoxia (85%), hatchings from the hypoxic treatment were larger (carapace length and width and plastron length) than normoxic hatchlings. Similarly, hypoxic hatchings also swam significantly faster than hyperoxic hatchlings. Considering larger hatchlings may have a greater chance of survival, the production of larger hatchings may offset the high cost (lower hatching success) when preovipositional arrest is prolonged. Hyperoxia does not appear to have deleterious consequences for development.

PREVALENCE OF PATHOGENIC *BARTONELLA* SPECIES IN LOGGERHEAD SEA TURTLES IN THE SOUTHEASTERN UNITED STATES

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Bartonella is a genus of infectious gram-negative bacteria that have been reported to occur in loggerhead sea turtles (*Caretta caretta*) sampled from the southeastern United States. These bacteria are important terrestrial pathogens causing a variety of diseases in humans including the well known "cat scratch fever". Infection routes often include a terrestrial mammalian reservoir but marine vertebrates like sea turtles and dolphins, which also are known to harbor the bacteria, could be important animal reservoirs as well. Characterizing the prevalence of *Bartonella* in sea turtle populations is potentially important in understanding the role that sea turtles might play in the transmission of the bacteria between reservoirs. In addition, establishing patterns of *Bartonella* genetic variation in sea turtles, if any exists, may help to understand the non-nesting beach connections between populations of sea turtles. Unfortunately, the previous study relied on a relatively small sample of thirty-seven individuals, some of which were captive, rehabilitating turtles. Since it is unknown whether infection in sea turtles is opportunistic in association with some external stressor, or if they represent a natural reservoir, characterization of the prevalence of *Bartonella* requires the screening of a larger sample of wild-caught turtles from different life history stages. Blood samples from three hundred individual sub-adult loggerhead sea turtles, 22 debilitated turtles, and seventy-eight adult nesting females, have been screened for the presence of *Bartonella* using a set of *Bartonella* specific ITS primers as in Valentine *et al* (2007). Samples with ITS positive PCR reactions were rescreened at the Pap31 locus to attempt to identify which species of *Bartonella* was present.

CORRECTING FOR DIFFERENCES WHEN MEASURING CURVED CARAPACE LENGTH IN LEATHERBACK TURTLES: STANDARDIZING GLOBAL PATTERNS IN BODY SIZE

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In sea turtles, reproductive output, age, and vulnerability to certain fisheries methods has been linked to carapace length. However, there are two unique used methods for measuring curved carapace length in leatherback turtles *Dermochelys coriacea*. As the values generated by each of these two methods may differ, this can make comparisons between populations difficult. The first method involves measuring the turtle along the central dorsolongitudinal ridge (defined as CCLridge), while the second involves measuring the turtle to the side of the central ridge (defined as CCLoffset). In this study, we calculated correction factors between these two measurements of curved carapace length for leatherback turtles. We focused on leatherback turtles nesting on both the Pacific Coast of Costa Rica and the Indian Coast of South Africa to determine if these correction factors were globally applicable. Lastly, we used a standardized measurement of curved carapace length to investigate global patterns between regional management units. The relationship between CCLridge and CCLoffset was strongly linear at both sites and the slopes were not significantly different. However, when assuming a common slope, there was a significant difference in CCL. Specifically, turtles from Costa Rica had a lower CCLoffset than South African turtles at the same value of CCLridge. These data suggest that correction factors for CCLridge: CCLoffset cannot be generalized between ocean basins. In addition, the measurement data suggests that leatherback turtles in Costa Rica have more pronounced ridges, than South Africa turtles. This could be a product of foraging status, suggesting that Costa Rican turtles tend to have less fat during nesting than leatherback turtles in South Africa. This supports previous hypotheses that Eastern Pacific leatherback turtles are resource limited.

COMPREHENSIVE REVIEW OF TOXIC METAL CONTAMINATION IN MARINE TURTLE TISSUES AND ITS IMPLICATIONS FOR HUMAN HEALTH*

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Despite global awareness of trace metal contamination in the ocean, its bioaccumulation through the food web, and resulting detrimental effects on health, the quantitative toxicology of marine turtles is still poorly known. Quantitative assessments are generally limited in number of species investigated, number of tissues analyzed, and geographical distribution of samples. It is therefore difficult to assess potential human exposure to inorganic toxins through the consumption of turtle products in regions where no toxicological data has been reported. Here, we address these limitations by presenting a comprehensive review of sea turtle toxicology, and sea turtle eggs in particular given their widespread human consumption. We then compare our results to original data collected from sea turtle eggs (*Lepidochelys olivacea*, olive ridleys; and *Chelonia mydas*, green turtles) on the Pacific coast of Panama to assess the feasibility of predicting human exposure to toxic metals through the consumption of turtle tissues in data-deficient regions. We collated 70 studies reporting As, Cd, Hg, and/or Pb concentrations in edible sea turtle tissues. This data was quantitatively analyzed for differences between species, tissues, and geographic location. The majority (74%) of observations were from either *Caretta caretta* (loggerheads) or *C. mydas*, with 52% of data for liver, kidney, or muscle; and only 7.3% for eggs. Using a confidence level of 0.050, we found no statistically significant difference in tissue-specific metal concentration between species for any metal. Similarly, we found no significant difference in toxic metal concentration between eggs from the 2 species tested in Panama. In our review, we did observe a geographical effect, with Cd significantly highest in turtle tissues from the Pacific Ocean; however this effect was not found in eggs alone. Finally, we observed a significant tissue-selective distribution for Cd (kidney) and Hg (liver). Using the average global adult body weight (62.0 kg) and a standard serving size of 75 g, Cd contributed the most toxicity from turtles. When eating ≤75 g per week, only kidney and liver tissues were harmful; and at this consumption, Hg was toxic only in loggerhead liver. These conclusions show that some, but not all previously reported local-scale trends are globally robust; and that Cd, more so than Hg, is most important when considering human health. Similarly, we found Cd to be the most toxic metal in Panamanian sea turtle eggs. Overall, data are still sparse and more analyses of turtle tissues are needed to fully understand the health-risks of global sea turtle consumption.

HISTOPATHOGICAL AND MOLECULAR CHARACTERIZATION OF FIBROPAPILLOMATOSIS IN *CARETTA CARETTA* (TESTUDINES, CHELONIIDAE) CAUGHT AT BOCA DA BARRA, CEARÁ, BRAZIL

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Studies revealed that fibropapillomatosis (FP) has multifactorial etiology, in which several biological, genetic and environmental cofactors would also play a significant role in the pathogenesis in addition to viral etiology hypothesis, considering the alphaherpesvirus Chelonid fibropapilloma-associated herpesvirus (CFPHV). Lesions like fibropapillomas were reported in *Caretta caretta*, *Lepidochelys olivacea*, *Natator depressus* and *Eretmochelys imbricata* but histophatological tests were confirmed FP in lesions from *C. mydas*, *C. caretta* and *E. imbricata*. In Brazil, many studies have been done in order to understand the development of FP and to clarify its physiopathogeny. The aims characterized the FP by histopathological analysis and detected CFPHV by molecular tests in cutaneous growths obtained from one loggerhead sea turtle caught at Boca da Barra, Ceará, Brazil. The sampled specimen was captured incidentally in a fishing weir, known locally as "curral de pesca", at Boca da Barra, Ceará, Brazil in October 26, 2012. This loggerhead sea turtle was already captured in 2010, according to database of Projeto TAMAR-ICMBio, without lesions similar to fibropapillomas. This Brazilian region is considered an important feeding area for green sea turtles and reports of *C. caretta*, *L. olivacea* and *E. imbricata*. The studied turtle (84.6 cm and 64 kg) had thirteen tumors, which were classified according to size: A (< 1 cm), B (1 - 4 cm), C (> 4 - 10 cm) and D (> 10 cm) and anatomic region. Three tumors were obtained for histopathological and molecular analysis: (1) collected from right front flipper (category A), (2) obtained from neck (category D) and (3) collected from left front flipper (non-classified). Biopsies were collected using scalpel blade between the skin and tumor, with a margin of safety avoiding neoplasia recurrence and Povidine® solution was used for asepsis. Tumor biopsies were fixed in neutral buffered 10% formalin for histopathology analysis and kept in alcohol 70% and frozen at -20 °C until molecular processing. According to results, the samples analyzed were classified as papillomas or fibropapillomas, depending on epithelial proliferation and/or stromal, respectively. The presence of herpesvirus was confirmed in agarose gel and the amino acid sequence of the fibropapilloma sample suggests that is a fragment of the gene of DNA polymerase of ChHV-5, according to GenBank. However, new DNA extractions have been conducted to molecular characterization of ChHV-5. Financial support and acknowledgements: Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) (Processes 2009/53956-9 and 2012/14319-6) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). Authors wish to thank Projeto TAMAR-ICMBio that is, historically, a collaboration between the Brazilian government and Fundação Pró Tamar, officially sponsored by Petrobrás.

DETERMINATION OF POLYCHLORINATED BIPHENYLS IN BLOOD SAMPLES AND LEUKOCYTE ACTIVITY OF CHELONIA MYDAS (TESTUDINES, CHELONIIDAE) IN BRAZIL

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It has been known that fibropapillomatosis (FP) poses a significant threat to green sea turtles' conservation and the polychlorinated biphenyls (PCBs) may be co-factors in the pathogenesis of these disease due to their carcinogenic and immunosuppressant potential. The aims of the study were to assess phagocytosis and oxidative burst, to quantify six PCB congeners (IUPAC: 28, 101, 118, 138, 153 and 180) in blood samples and to investigate a possible correlation between both findings. Between August/2013 and April/2014, blood samples were collected from 110 green sea turtles (43 with FP). The leukocyte activity was analyzed in samples of turtles from Rehabilitation Center of Sea Turtles, Projeto TAMAR-ICMBio in Ubatuba/SP (N=38; 27 affected by FP). The stimuli applied were Phorbol Miristate-Acetate-PMA for oxidative burst and Zymosan A for phagocytosis; the acquisition was carried out in FACSCalibur™ flow cytometer (BD Immunocytometry Systems®). For PCBs determination we used blood samples from 80 turtles studied in feeding and nesting areas in Brazil (Ubatuba/SP, Almofala/CE, Vitória/ES, Florianópolis/SC and Fernando de Noronha/PE). The analytes were extracted from 1 mL of blood using hexane and dichloromethane (1:1) followed by two clean-up phases: (1) protein precipitation using sulfuric acid and (2) alumina column and dichloromethane as eluent. Extracts were analyzed with GC-μECD Agilent Technologies 7890A, the analytical performance was evaluated following the criteria proposed by Commission Decision 2002/657/EC and the limit of quantification was 0.5 ng mL-1. The correlations were analyzed only for phagocytosis results (N=8; 3 without FP) considering the principal component analysis (PCA), used to combine the concentrations of the PCB congeners determined. Leukocyte activity results did not differ between affected and non-affected turtles, but in affected turtle samples we observed significant differences between delta of mean fluorescence intensity of lymphocytes (Lym) and monocytes (Mon) ($P < 0.001$), Lym and granulocytes (Gran) ($p < 0.01$) for oxidative burst analysis, Lym and Gran ($P < 0.05$), Mon and Gran ($P < 0.001$) for phagocytosis analysis. Mean ΣPCBs ranged between 120.2 and 161.6 ng mL-1, with a predominance of PCB138 and PCB153. However, no differences between turtles with and without FP or between the areas studied were observed. It was not found a significant correlation between PCAPCB and delta of phagocytosis of Lym ($P = 0.352$, $R2 = 0.009$), Mon ($P = 0.787$, $R2 < 0.001$) or Gran ($P = 0.809$, $R2 < 0.001$), but it was observed an increase of the PCAPCB with the increase of delta of phagocytosis revealed by Lym. Even though we found significant concentrations of PCBs in the blood of green sea turtles along the studied Brazilian sites, we found no evidence that these pollutants are involved in the onset of FP. Acknowledgements: Work funded by Fundação de Amparo à Pesquisa do Estado de São Paulo (2010/01781-8, 2011/04565-7,2012/14319-6) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. Authors wish to thank Projeto TAMAR-ICMBio; Jorge Oyakawa, Herculano P. Pereira and Vagner Gonçalves Jr. from VPT-FMVZ-USP; Dr. Franz Z. Vilca, Rodrigo Pimpinato and Carlos A. Dorelli from CENA-USP and Marlon L. M. Batista from Pro-TAMAR-ICMBio.

HUMAN-RELATED INJURIES OBSERVED IN LIVE SEA TURTLES RESCUED ALONG THE SOUTH CALABRIA

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Associazione Ambientale No Profit Naturalmente Brancaleone, Brancaleone, RC, Italy

The Brancaleone CTS Sea Turtles Rescue Center is located in the Southern coast of Ionian Calabria (Italy). This area is a part of a wider foraging area for juvenile sea turtles from different Mediterranean nesting areas and was recently recognized as the main nesting area of the loggerhead sea turtle *Caretta caretta* in Italy. The pres¬ence of this endangered species calls for the need to identify and quantify possible threats in order to implement sound conservation measures. To the best of our knowledge there are no data on sea turtle health conditions in the area. This paper presents data on 210 *Caretta caretta* hospitalized in the Center between 2007 and 2013. For each turtle we performed a clinical and radiographic examination and we recorded biometrical data, rescue modality, general health condition, presence of lesions or diseases and any signs of interaction with human activity. Biometrical data confirm the presence of all age class in the population with 84.0% of juvenile, 13.0% of sub-adults and 3.0% of adults. The rescue modality show that 64.5% animals were found adrift and manually rescued, 21.0% were rescued by fisherman (19.0% catch accidentally by longline and 2.0% by trawl net) and 14.5% stranded. All the causes of illness of sea turtles were linked directly or indirectly to human activity, with 51.0% of the turtles reported hooks and/or lines in the gastrointestinal tract; 15.0% reported injury by entrapment of flippers and/or neck in plastic bags, fishing lines and nets; 4.3% reported impact with boat; 1.4% showed oil contamination; others reported deformity (eyes, head, carapace) and buoyancy disorders of unknown nature. The data indicate longlines as the major cause of problems and also death for sea turtles in the area. In hooked turtles, necropsy findings show the presence of acute inflammatory processes with ulcerative and fibrinous esophagitis, gastritis or enteritis and traumatic perforations. When present, the line produced inflammatory processes and infection but also injury incompatible with life, like plication with necrosis and laceration, strangulation and traction of the organs. Indirectly lines abandoned in the sea result in blood flow, loss of or damage to an appendage or jaw, inability to use one or more appendages, necrosis or amputations. The number of turtles reported problems related to fishing (n.106) is higher than that conferred directly by fishermen to the Center (n.45). If we also consider the chronic health condition of the turtles rescued with the line and the great length of the line (always more than 1mt), we can conclude how in the area there is not a good involvement of fisherman in sea turtle conservation program. The problem can be attributable to the large number of vessels fishing illegally in the area, that are not involved in in the official projects of awareness and education. We suggest to adopt measures to raise awareness and collaboration with fishermen, particularly with the illegal ones and to educate them to bring the animals to the rescue center, or at least to cut the line as short as possible. Attendance was supported through generous donations by the International Sea Turtle Society and all the others organizations.

COMPARATIVE SKULL ANATOMY OF STRANDED CARETTA CARETTA FROM HATAY AND CANAKKALE COASTS, TURKEY

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Comparative morphometric studies are useful for determining taxonomic relationships within animal groups, but a few such data are available for sea turtles. The cranial osteology of *Caretta caretta* populations living in three different geographical regions (Japan, Australia, and Florida) was reported as different. There is no study about cranial osteology of *Caretta caretta* population living in Mediterranean. Cranial osteology of 16 female *Caretta caretta* specimens from Samandağ beach and 4 female specimens from Çanakkale coasts were compared with qualitative and quantitative aspects. The quantative osteological results are obtained in the analyses using 20 cranial characteristics excluding the mandible. The qualitative osteological result is obtained using the skull bones morphology. According to these results it can be said that skull bone morphology of *Caretta caretta* have a great variation between two populations. Hatay coasts are located on the south east part of Turkey and at the same time this coastal area is the most eastern loggerhead population in Mediterranean. Canakkale coast, which is one of the most northern loggerhead populations in Mediterranean, are on the northwest part of Turkey. Similarity and dissimilarity belong to skull morphology in these too far away, the most northern and the most eastern populations of Mediterranean were determined in detail.

HORMONE LEVEL CHANGES IN LOGGERHEAD TURTLES BETWEEN HEALTHY AND INJURED LOGGERHEAD TURTLES

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Steroid hormones are playing crucial roles for controlling secondary sexual characteristics, metabolism, immune functions, blood electrolyte levels and metabolic response to injuries. Different steroid hormones are identified for sea turtles. Plasma steroid hormones levels were examined in various reproductive biology studies and identifying sex of juvenile sea turtles but not enough studies have been conducted to specify their roles in injuries. In this study we investigated the blood levels of circulating testosterone (T), estradiol (E2), corticosterone (B) and progesterone (Pro) levels in healthy (H) (n = 15) and injured (I) (n= 8) loggerhead turtles and results were evaluated according to their health and sex. The mean E2 (H= 127.5 pg/ml; I= 1039 pg/ml) and Pro (H = 499 pg/ml; I= 1440 pg/ml) levels of injured turtles were higher than healthy turtles while the mean T (H= 2529 pg/ml; I= 1061 pg/ml) and B (H= 780 pg/ml; I= 56.6 pg/ml) levels were lower. These preliminary results showing that plasma E2 levels are increasing in order to induce cell proliferation and circulating T levels are decreasing as a result of aromatization to E2 in both sexes during injuries. We believe that these results may help understanding of sea turtle physiology in injuries and also using E2 in severely injured turtles may help treatment procedure during rehabilitation.

EUTROPHICATION AND THE DIETARY PROMOTION OF SEA TURTLE TUMORS

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The tumor-forming disease fibropapillomatosis (FP) has afflicted sea turtle populations for decades with no clear cause. A lineage of α-herpesviruses associated with these tumors has existed for millennia, suggesting environmental factors are responsible for its recent epidemiology. In previous work, we described how herpesviruses could cause FP tumors through a metabolic influx of arginine. We demonstrated the disease prevails in chronically eutrophied coastal waters, and that turtles foraging in these sites might consume arginine-enriched macroalgae. Here, we test the idea using High-Performance Liquid Chromatography (HPLC) to describe the amino acid profiles of green turtle (*Chelonia mydas*) tumors and five common forage species of macroalgae from a range of eutrophic states. Tumors were notably elevated in glycine, proline, alanine, arginine, and serine and depleted in lysine when compared to baseline samples. All macroalgae from eutrophic locations had elevated arginine, and all species preferentially stored environmental nitrogen as arginine even at oligotrophic sites. From these results, we estimate adult turtles foraging at eutrophied sites increase their arginine intake 17–26 g daily, up to 14 times the background level. Arginine nitrogen increased with total macroalgae nitrogen and watershed nitrogen, and the invasive rhodophyte Hypnea musciformis significantly outperformed all other species in this respect. Our results confirm that eutrophication substantially increases the arginine content of macroalgae, which may metabolically promote latent herpesviruses and cause FP tumors in green turtles. We discuss recent developments in this work, including comparisons to tumor profiles from the Caribbean, and results from subsequent immunohistochemistry analyses.

HOW LONG DO TURTLE EMBRYOS TAKE TO BREAK EMBRYONIC ARREST FOLLOWING OVIPOSITION?*

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All turtle species studied to date display preovipositional embryonic arrest during embryonic development. It has recently been discovered that an increase in the partial pressure of oxygen, at the time of oviposition, is the trigger that recommences development. Significant levels of mortality occur when eggs are moved within 12 hours to 14 days post-oviposition in some species. This movement induced mortality is likely to be linked to the recommencement of embryonic development. The time taken for eggs to recommence development following exposure to normoxic conditions remains to be experimentally tested. It is assumed that an embryo has recommenced development within 48 h of oviposition, given the first external indicator of development (the white spot) can form within this time period. We aimed to identify the amount

of time an embryo takes to recommence development following oviposition and whether embryos can re-enter embryonic arrest. Green sea turtle (*Chelonia mydas*) eggs were randomly placed into hypoxia at one of 10 time intervals between 30 mins to 72 hrs post oviposition. Each treatment group remained in hypoxia for three days. An 11th group of eggs remained in normoxia throughout incubation, serving as a control for the experiment. Two eggs were opened and staged immediately following oviposition. Two eggs from each treatment were also opened and staged both before and after exposure to hypoxia. To determine the effect of hypoxia, hatching success rate was measured. Development and survival rate of embryos was then compared to determine both the time taken to break arrest and ability to re-enter arrest. Our experiment has identified the duration of exposure to normoxic conditions required to recommence embryonic development in green sea turtles. The information gained from this experiment will help turtle conservation groups better understand the ideal time to relocate eggs. In addition to this primary question, the experiment also elucidated whether it is possible for green sea turtle embryos to re-enter a state of arrest following recommencement of development. The knowledge gained from this research helps us to better understand the mechanisms of embryonic arrest during development. The findings of this research have the potential to improve hatchery management, through reducing rates of embryonic death or reproductive failure. By using this knowledge, we can maximise the reproductive output and enhance survival of these threatened animals.

IDENTIFICATION AND CHARACTERIZATION OF PATHOGENIC AND PANDEMIC BACTERIA IN SEA TURTLES IN NORTHERN SINALOA (GULF OF CALIFORNIA, MEXICO)

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Sustained habitat destruction and species extinction has resulted in disequilibrium within ecosystems, including altered patterns of disease transmission, accumulation of toxic pollutants and the invasion of foreign species and pathogens. The lagoon system Navachiste, located within the Municipality of Guasave is recognized as a site of high conservation concern, which was decreed in 1978 as an Area for the Protection of Flora and Fauna "Islands of the Gulf of California" and as a registered RAMSAR site in 2008. This site is part of the migratory corridor and foraging area that connects sea turtle nesting sites in southern Sinaloa and another states from Mexico. However, information on the areas sea turtle population is lacking especially with regards to possible threats. Therefore, our aim was to identify the bacterial flora and its zoonotic risk. From January to December 2012, 30 sea turtles (8 *C. mydas* and 22 *L. olivacea*) were captured, from which oral and cloacal swab samples were taken which resulted in the isolation of 10 species of microorganisms, a fungus and nine species of Gram-negative bacteria in olive ridley turtles (41 isolates) and three species of microorganisms in black turtles (9 isolates). In order of the number of isolates, the most important bacteria *Vibrio alginolyticus*, *V. parahaemolyticus* and *V. cholerae*, of these, *V. parahaemolyticus* was characterized by serotyping and genetic analysis, resulting in the isolation of a strain with the cloned pandemic serovar (O4: K10) which included the enteropathogenic genes tdh, toxRS/new and/or Orf-8, without the trh gene and five pathogenic strains including enterotoxin tdh and/or trh genes. *V. cholerae* was also isolated in six samples from captured olive ridley turtles, of which four samples were potentially pathogenic presenting the gene enterotoxin ace. The presence of these pathogens in sampled turtles highlights the zoonotic risk of continued sea turtle consumption in the study area as the bacteria strains identified have been previously reported to cause diarrheal outbreaks in humans.

CONSERVATION, MANAGEMENT AND POLICY

HUMAN DIMENSION TO LEATHERBACK NESTING IN LAGOS SOUTH-WESTERN NIGERIA, SEA TURTLES

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The leatherback sea turtle, *Dermochelys coriacea,* is one of the five species of sea turtles found in Nigerian sea and beaches. Like other species, it's endangered and less than exist in world. Based on reports from community monitors in coastal communities in Lagos and recent nesting surveys, it is an established fact that leatherbacks are captured anytime they venture ashore to nest in coastal communities both in the West and East of Lagos Coast. Whenever these species are captured, they are tied with a rope and the eyes are gouged out to make it blind so it cannot escape, this barbaric act rarely gets the attention of the people outside the coastal communities as the fish sellers mostly displaying the meat and egg for sale in the community markets and by then it is much too late for the sea turtle to be recovered. There is so much ignorance of conservation laws guiding sea turtles and coastal education programmes are nearly lacking for sea turtle conservation. This paper presents some information on the direct exploitation of female leatherbacks, their egg usage in Orimedu, Eleko and Aivoji communities and public opinion about leatherback exploitation in Lagos Nigeria. There exists a need to create marine conservation programmes for sea turtles particularly with the presence of leatherbacks in coastal communities in Lagos, Nigeria.

MARINE TURTLES AND SHIPS: RECOMMENDATIONS FOR A VESSEL TRAFFIC MANAGEMENT PLAN AT THE MAIN BAYS AND PRINCIPAL TOURISTIC PLACES OF SAN CRISTOBAL ISLAND- GALÁPAGOS

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The growing demand for tourism opportunities and an increasing human population in the Galapagos Islands has led to increased boat traffic around the islands. Key species and ecosystems are under threat from boating and will likely continue to be affected, due to the manner these types of activities are handled, especially in the shallow bays close to the islands. Therefore, it is essential to promote a zoning plan that allows a better understanding of how to manage boat use and ecosystem impacts in certain areas of the archipelago, particularly in the inhabited and most tourist visited parts. Doing so will help ensure an improved conservation of this pristine environment. The aim of this study is to identify the most risky regions for possible interactions between sea turtles and boat traffic in the bays close to the populated area of San Cristobal Island-Galápagos and to contribute with the development for a boat traffic management plan that could be applied with the zoning of the Marine Reserve. The principal objectives of this effort are: To contribute with the scientific assessment about the movement, site fidelity and habitat use of sea turtles on the shallows bays of San Cristóbal Island. To categorize the most susceptible areas to sea turtle interactions with vessels and speed boats around the touristic places on the archipelago. And to generate boat traffic management recommendations. We expected to give scientific information to the decision makers on the Galapagos, to aid them implement a management strategy included in the actual zoning plan of the Galápagos Marine Reserve (GMR). Create awareness in the local community about the importance of compliance of these zoning plans in order to conserve the species and ecosystems on the islands. We recognize the crucial support and collaboration of the following institutions: Galápagos National Park (GNP), Universidad San Francisco de Quito (USFQ), Galápagos Science Center (GSC), Ecofondo Foundation, Ministry of environment, Eastern Pacific Hawksbill initiative (ICAPO), James Cook University-Australia and Ecuador Secretary of higher education science technology and innovation (SENESCYT).

AN OVERVIEW OF MARINE TURTLE LEGISLATION AND CONSERVATION IN THE MALDIVES

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Five species of marine turtles have been recorded in the Maldives: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*) and olive ridley turtle (*Lepidochelys olivacea*). However, only green and hawksbill turtles are commonly observed either feeding or nesting in the country. Until 1980s, local consumption of turtle meat and eggs was very common in most islands (especially for green turtles). Hawksbill turtles were also exploited for their shells. In the late 1970s, as tourism began, concern was raised over the rate of turtle harvesting in the country. The tourism sector started to lobby for the conservation of marine turtles, which resulted in the first ever management measure on marine turtles, introducing size limits for turtles being harvested. This first measure was followed by other actions that led to the implementation of a ten-year moratorium on turtle harvesting in the entire Maldivian exclusive economic zone in 1995. In 2006, a second ten-year moratorium on turtle harvesting was implemented, which included a ban on harvesting of turtle eggs from 12 nesting beaches. By the end of 2007, turtle egg harvesting from a total of 14 nesting beaches were prohibited. Nevertheless, even if a moratorium is in place, illegal poaching still occurs in some parts of the country. With the end of the second moratorium approaching, the plans are to re-evaluate the management decisions with the possible renewing of the moratorium. The development of a national program for consistent monitoring of marine turtle populations within the Maldives is currently under discussion.
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PHOENIX RISING FROM THE ASHES: 42-YEAR HISTORY OF CHANGING ECOLOGY AND RESTORATION OF THE HAWAIIAN GREEN TURTLE*

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In 2012 the genetically discrete and geographically remote Hawaiian green turtle population was downlisted within IUCN's Red List to the category of Least Concern following a comprehensive assessment by the IUCN Marine Turtle Specialist Group (see http://www.iucnredlist.org/details/16285718/0) For the past 40 years Hawaii's green turtles have exhibited new behaviors and adaptations along with their increasing numbers and concomitant expansion into new habitats. These favorable changes have included: significant increases in terrestrial basking; nesting in the Main Hawaiian Islands; formation of underwater cleaning stations; daytime foraging in shallow water near shore; close co-existence with and tolerance of people; feeding on new types of vegetation; and the use of streams and rivers for underwater resting. Even more beneficial changes and acclimation can be expected in the future, including shifts in nesting to adapt to climate change and sea level rise, as sea turtles have successfully done with resiliency for millions of years. Several other sea turtle populations besides the Hawaii stock are also showing remarkable restoration from over-exploitation caused by efficient fishing technologies and human encroachment into previously pristine turtle habitats. At the same time there are many sea turtle stocks at seriously low levels that continue to decline. This dichotomy in sea turtle conservation status is one of the great challenges of our time in balancing appropriate protective measures along with limited sustainable use, where such harvest and other forms of human utilization might be legally allowable and advantageous to both turtles and people. The natural direction toward which we should be moving regarding sea turtle conservation, as expressed by the Sea Turtle Association of Japan, is "to bring back rich and plentiful nature that allows and tolerates a diversity of values and world views." In light of their 40-year rise to abundance, Hawaiian green turtles constitute a unique experimental model to

comprehensively understand the dynamics of a recovering sea turtle population. In addition, conservation practices in Hawaii, founded upon four decades of research results, can serve as a real-life learning ground for people in other regions striving to save and sustain their own charismatic and culturally important sea turtle resources. Successful conservation programs that endure are best built with local communities as their foundation. National legislation and international conventions, based on sound ecological principles, clearly also have importance. However, strategies for conservation are made robust and equitable when they integrate cultural and traditional components forged at the local level by the very people closest to the turtles and their environment.

SPREADING ROOTS OF SEA TURTLE CONSERVATION ACROSS THE OSA PENINSULA, COSTA RICA

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The Committee for the Conservation of the Sea Turtles of Corcovado (COTORCO) is a grass-roots association committed to conserving sea turtles on the Osa Peninsula, Costa Rica through community involvement. In 2010, research showed that human poaching and predation by unnatural predators were serious threats to sea turtle nests on a 18km stretch of pristine beach. COTORCO was established in 2011 in hopes to minimize these threats through engaging communities and institutions locally and globally. The Osa Peninsula is an important area for four species of sea turtle: olive ridley (*Lepidochelys olivacea*), Pacific green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*). Geographically, our focus takes place on Carate, La Leona and Rio Oro Beaches, totaling approximately 10km of beach. These beaches became our focus after discovering they were the most susceptible to poaching and predation. The components of our grass-roots efforts include: biological monitoring, hands-on education, nest hatchery, and community stake-holder meetings. Beginning in fall 2014 we are inserting PIT tags into our nesting females. Locally, our operations center on community engagement and education in order to sustain their involvement in the conservation of their homeland and sea turtles. Community members are welcome to attend COTORCO meetings so they may be involved in decision making. Seasonally COTORCO is able to hire locals as hatchery and patrol managers, giving them income opportunity in an area where it is limited. Starting in 2015 we hope to increase our patrols from 9 months a year to 12 months. In Costa Rica, we work closely with the local organization of Osa Conservation as well as Reserva Playa Tortuga so that all involved may collaborate and learn from each other. The Federal Government assists through MINAE-SINAC-ACOSA, police, and coast guard and with their beach patrol personnel assistance we are able to enforce the country's anti—poaching laws. Additionally, the federal government will be supplementing salary for one employee starting in 2015. Internationally, we are receiving support from the Georgia Sea Turtle Center, Frontier, Raleigh, Rustic Pathways and Planet Conservation. These organizations provide volunteers, data collection, hatchery monitoring, community education, and scientific expertise. The future of our project will continue spreading conservation education throughout the Osa Peninsula to locals and visitors alike. This will be facilitated through festivals, workshops, hands-on training, and volunteer positions. We are currently designing a plan for governmental agencies to have a more permanent presence on our beaches. COTORCO will also conduct collaborative scientific research in hopes to increase the knowledge of beneficial sea turtle conservation across the globe.

THE SUCCESS RATES OF IN SITU AND RELOCATED LOGGERHEAD TURTLE NESTS IN KEFALONIA, GREECE

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The sea turtle nesting beaches of Kefalonia are short in length, narrow and backed by cliffs, limiting nesting space with optimal incubation conditions. Storms regularly transform many of the island's beaches during the nesting season. Loggerhead sea turtle (*Caretta caretta*) nests laid here have a high probability of failure due to elevated levels of moisture, removal of sand, or washout caused during storms. The nesting environment in Kefalonia requires development of specially adapted relocation criteria and methods to help prevent nest failures and to improve nest hatching and emergence success. The goal of this study was to examine the difference in hatching and emergence success in nests which were left in situ and nests which were relocated. We hypothesised that there would be an improvement in hatching and emergence

success in nests which had been relocated compared to nests which had been left in situ. Relocation, hatching and hatchling emergence data were recorded by the Wildlife Sense conservation project from May to October during the 2013 and 2014 nesting and hatching seasons on beaches in Kefalonia. All nests (n=112) were considered for relocation if the position in which they were laid would compromise successful incubation of the eggs. Criteria for relocation included distance to the sea (n=22), depth of the top egg (n=5), microenvironment conditions (high levels of clay or duration of shading during the day, n=8) or a combination of the three. With an average distance to sea of only 5.57m before relocation, these nests were exposed to high probability of inundation and would not incubate successfully, leading to very low or no hatching or emergence rates. Hatching and emergence data were obtained through a nest inventory of each in situ nest (n=79) and each relocated nest (n=33). The number of hatched eggs, the stages of development in unhatched eggs, dead or live hatchlings and lost eggs were recorded and the hatching and emergence success rates were calculated for in situ nests (hatching success = 53.39%, emergence success = 49.65%) and relocated nests (hatching success = 69.34%, emergence success = 68.77%). Our results suggest that even though there was not a significant difference in hatching ($p=0.350$) and emergence ($p=0.162$) success rates when all nests were considered, in 2013 there was a significant improvement in both hatching ($p=0.003$) and emergence ($p=0.005$) success rates, while in 2014 the difference in both hatching and emergence was not significant. This confirms that when a nest was laid in unfavourable conditions, relocating the eggs did not harm the overall success and in many cases greatly increased the success of the nest. These results may be applied to future conservation strategies and management efforts specifically adapted to the population of loggerhead sea turtles in Kefalonia.

RISING SEA LEVEL AND SEA TURTLE NESTING ON ST. CATHERINES ISLAND, GEORGIA, USA: WHAT THE PRESENT AND PAST TELL US ABOUT THE FUTURE!*

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Geologists involved in sea turtle conservation on St. Catherines Island, Georgia, a Sentinel Island, have documented deterioration of sea turtle nesting habitat during sea level rise in The Modern Transgression. Deterioration of habitat (declining from 25% to 12% adequate habitat in a decade) has resulted in rapid erosion of backbeach nesting habitat at ~ 3.0 to 6.0 m/year, including fragmentation of three beaches in 1990 into eight beaches in 2013, formation of washover fans and wash-in fans onto backbeach marsh meadows and into maritime forest, nearly continuous tree "boneyards," scarps, and relict marsh mud exposures along most of the beach. All these phenomena contribute to difficult nesting conditions for loggerhead sea turtles; forcing relocation of approximately 80% of "at risk" nests into nurturies. The Modern Transgression is driven by rising sea level, impoundment of sediment in coastal rivers to the north decreasing the southward flow of sand along the coast and removal of sediment by dredging at ports, such as the Savannah Ship Channel, exacerbate the disequilibrium of sand moving through the Georgia beach system. Erosional effects are expected to accelerate as the rise of sea level accelerates, leading to increasing barrier island erosion and deterioration of loggerhead sea turtle nesting habitat on St. Catherines Island, up and down the southeastern coast of the USA, and around the World. Our conservation response on St. Catherines Island to deteriorating conditions in loggerhead nesting habitat has been to relocate "at risk" or "doomed" nests into habitat that is better suited to hatching clutches of eggs while at the same time is still being utilized by the loggerheads as natural nesting habitat; developing a concept of nurturing nests in "nurturies." Thermologger data indicate that relocation of nests into nurturies does not bias gender ratios, and that nest temperature is, in fact, primarily driven by the timing of rain events though out the summer. However, concentration of nests into nurturies does put them at increased risk of depredation by raccoons, feral hogs, and other predators. The SCISTP has linked predation management to nest relocation to counter these effects in a proactive relocation program that we believe minimally impacts the Northern Sub-Population of Loggerhead Sea Turtles (*C. caretta*). This research is presented as one possible model for sea turtle conservation in The Modern Transgression and points the way for additional research. The critical nature of sea turtle nesting habitat on the Georgia coast has been recognized with the development of the designation of "Loggerhead Sea Turtle Critical Habitat" on Sapelo, Blackbeard, and St. Catherines Islands. Extreme coastal erosion has seriously affected St. Catherines Island, and bordering Ossabaw and Beackbeard/Sapelo Islands to the north and south, and is increasingly affecting other southeastern barrier islands; these extreme erosional effects are expected to spread north and south along the southeastern USA coast. If this proves to be the situation, governmental, non-governmental, and land managers and planners must factor sea level rise and coastal erosion and inundation into their management and planning systems.

WHEN GOVERNMENT, CONSERVATION NGO AND OIL COMPANIES FIND COMMON INTEREST TO TACKLE THE ILLEGAL FISHING PRACTICES

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Sea turtles conservation needs to include all stakeholders acting on the marine and coastal environment, including fisheries. In the Republic of Congo, many cases of illegal practices and techniques are recorded among artisanal or industrial fisheries. The government seem to be powerless in this situation. Despite the existence of appropriate laws and regulations to manage fishing practices, enforcement is really poor. These phenomena represent an important threat for sea turtle populations. Additionally, it creates conflicts with other economic operators on sea, including the oil companies operating offshore platform. Indeed, trawling in prohibited areas can cause damages to oil facilities such as pipelines and sea lines. Illegal industrial fishing also directly impacts the artisanal fisheries. Industrial vessels fishing in areas reserved for artisanal fishing often destroy the artisanal dormant gilnets left at sea in nearshore waters. Then the gilnet sinks to the bottom of the sea and creates ghost fishing. Additionally, ghost nests can wrap around oil hoses making them less flexible to the sea rolling and therefore more prone to breaking. Based on those observations, the Rénatura Congo NGO has developed a public/private partnership joining an oil company and the Congolese Ministry of Fisheries and Aquaculture. The fisheries management scheme is called "The Congo Fishing Practices Accompaniment Program". This project is funded by Total E & P Congo. It has two components: a compensation scheme towards artisanal fishing communities in order to encourage the release of sea turtles incidentally caught in fishing nets and a patrol scheme to strengthen the industrial fisheries monitoring efforts by the agents of the Ministry of Fisheries. After two years, this project has shown its strengths: it strengthens the link between civil society and government, increases the efficiency of government actions. The main program limitation is the weight of corruption.

BAHÍA SALADO'S SEA TURTLES AND SEAGRASSES: A PRODUCTIVE AND HIGH ECOLOGICAL VALUE ECOSYSTEM

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Qarapara Sea Turtles Chile NGO

Bahía Salado (27°41'08''S; 71°00'32''W) is the southernmost foraging site of black sea turtle (*Chelonia mydas*) in the southeastern Pacific. It is also, one of the two localities described for *Zostera chilensis*, a Chilean endemic seagrass. These two species are categorized as Endangered by the IUCN. Between 2013 and 2014, four fieldwork campaigns were carried out, with the aim to assess black sea turtle foraging colony and its habitat, ecology and health. Sea turtles specimens were entangled using a capture net. Clinical examination, photographic-identification, morphometric measurements, biological sampling, sex determination and marking were done after each capture. All individuals were released after the completion of these procedures. Seven captures and two recaptures, were obtained after fieldwork campaigns. Age group composition consisted of five juveniles and two adults. Sex was only possible to determine in the latter, which were females. All captured specimens were in proper body condition and had scarce epibiont amount. Carapace length and body weight averages were, 59.3 cm and 41.0 kg, respectively. Habitat characterization was done concurrently, which consisted in Bahía Salado's soft bottom substrate sampling. Identification and description of invertebrate benthic macrofauna associated to *Zostera chilensis* meadows, was the main objective of this study. Preliminary results, indicates this seagrass species, harbor a great diversity of organisms' early ontogenic phases, acting as a nursery of important economical marine species for artisanal fisheries. This information suggests that this species would be a key matrix for ecosystem productivity and sustainability. Therefore, Bahía Salado would constitute a high ecological value ecosystem, in which black sea turtles would play an essential role in the future viability of *Z. chilensis* meadows.

TUNISIA SEA TURTLE RESCUE CENTRE: ELEVEN YEARS OF CONSERVATION ACTIVITIES

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A sea turtle rescue centre was founded in Tunisia (Southern Mediterranean) in 2004. It is the unique of its kind established at the central coast of Tunisia and in front of the most important loggerhead nesting site (the Kuriat islands: Monastir). Its mission is conservation through rehabilitation of suffering sea turtles, education and research. From 2004 to 2014, 112 stranded and incidentally caught loggerheads were admitted in the centre. They were mostly large juveniles with a mean curved carapace length (CCL) of 51.79±16.28 cm. About half of the total specimens (41.9 %) were brought dead and were necropsied in order to determine the cause of mortality. The high incidence of injuries and hook and line ingestions recorded reflect the negative impact of fishing activities on loggerheads. All rehabilitated turtles were tagged before release into the wild. Moreover, educational strategy was developed during these years in order to raise awareness on sea turtle protection and to promote conservation in stakeholders. Public educational activities targeted fishermen, school children, local people and authorities. Greater involvement and collaboration of citizens especially NGOs were observed in the past few years. Genetic analyses realized on patient sea turtles (n=60) over a 6 yr period (2004 to 2009) showed that they came from two genetically distinct origins: Mediterranean and Atlantic. Thus, the turtle rescue centre of Monastir contributes to the protection of not only Mediterranean Sea turtles but also of Atlantic ones.

RELATING SATELLITE-DERIVED ARTIFICIAL LIGHT DATA TO BROAD-SCALE MARINE TURTLE NESTING BEHAVIORS OVER TWO DECADES*

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Since 1879, the world has become awash in electric light, currently two- thirds of the world's population no longer experiences truly dark nights. Light pollution has also been shown to impact the biology and behaviors (e.g., orientation, foraging, reproduction, and communication) of many organisms. Marine turtles are among those species affected by artificial lighting, causing misorientation, disorientation, and lower nesting activity. Nesting attempts by green (*Chelonia mydas*) and loggerhead turtles (*Caretta caretta*) were reduced to almost zero at Melbourne Beach, Florida when beaches were experimentally exposed to lighting. Understanding where and how marine turtles are impacted by light pollution is necessary to establish management strategies. In order to better understand how artificial night light influenced marine turtle nesting patterns in Florida, this study will use annual satellite-derived night light imagery from 1992 to 2013, as well as annual nesting and false crawl patterns of three different marine turtle species (loggerhead, green and leatherback) to analyze the relationship between artificial night light and nesting behaviors from the Index Nesting Beach Survey (INBS) of Florida beaches. All satellite images were collected by the Defense Meteorological Satellite Program (DMSP) satellite Operational Linescan System (OLS) at 30 arc resolution grids, and the weighted pixel brightness value for each spatial unit will be extracted by the Geospatial Modeling Environment (GME) tool. Moran's I will be used to test the dependency between each turtle nesting and false crawl pattern data in each spatial unit of the study area. The spatial autocorrelation will also be provided for developing the simultaneous autoregressive modeling of nesting and false crawl pattern for each marine turtle species in order to understand the relationship between artificial lighting and sea turtle nesting behaviors in the study area. The variance inflation factor (VIF) will also be used for evaluating which parameters should be incorporated in the model. Moreover, the hot spot analysis of nest density, false crawl density and light intensity density will be analyzed by Hot Spot Analysis (Getis-Ord Gi*) to test the hypothesis that if the coastal development and human population along the Florida coastline was increased, then the light pollution problem had gotten worse. Florida coastline is an important nesting site for marine turtles. According to the previous study, an estimated around 25% of American loggerhead turtles (*Caretta caretta*) and around 30 % of American green turtles (*Chelonia mydas*) nest on the Florida coastline from Melbourne Beach to Wabasso Beach, which is also part of the study site. An understanding about how marine turtles interact with their environment is important from a conservation point of view. Finally, Marine turtles are endangered species, which may need a long-term conservation strategy to help them recover their populations and reduce the impact from anthropological threats.

INTERNATIONAL COOPERATION FOR INCREASED KNOWLEDGE AND BETTER MANAGEMENT OF LOGGERHEAD POPULATIONS IN THE WESTERN INDIAN OCEAN: THE COCA-LOCA PROJECT

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The COCA-LOCA project (Connectivity of loggerhead turtle *Caretta caretta* in the Western Indian Ocean: Implementation of local and regional management) started in 2013 and will be spread over a three years period. The objective of the project is to increase knowledge and awareness about the ecology of the loggerhead sea turtle (*Caretta caretta*) in the Indian Ocean, including the oceanic migrations and the connectivity between populations of the main identified breeding sites of the western Indian Ocean. The ultimate purpose is to implement effective management measures at the local and regional level. To achieve these goals, scientists and conservationists from all over the region are working together as this project gathers people and institutions from Reunion Island, Mayotte Island, the Sultanate of Oman, South-Africa, Mozambique and Madagascar. The scientific approach of the project focuses on three complementary axes involving multidisciplinary methods such as satellite tracking, genetics, stable isotopes and modeling. The first approach aims to increase the tracking effort with twenty-two additional satellite tags being deployed on individual accidentally captured by fishermen around Reunion Island. Secondly, genetic and isotopic analyses are conducted on nesting populations of the Western Indian Ocean (Oman, South-Africa, Mozambique and Madagascar) as well as on juvenile loggerhead turtles from Reunion and Mayotte waters. Finally, hatchlings dispersal models are conducted considering active movement behavior. The project also clearly has an immediate conservation goal. Awareness actions are undertaken across the region. Long-line fishing boats from Reunion Island have been equipped with sea turtle release kits. The feasibility of a sea turtle care center in Mayotte Island is also under consideration. In the medium term, the project should also allow the optimization of the means dedicated to conservation of this species thanks to a largely improved knowledge of the areas occupied during the different life stages. This knowledge is required and will be used to complement the mitigations measures already put in place and to direct the conservation effort where they are most needed. The COCA-LOCA project is the first of its scale regarding this species in the region and an excellent example of international cooperation for the benefit of sea turtle conservation.

DEVELOPING A GOOD ENVIRONMENTAL STATUS (MARINE STRATEGY FRAMEWORK DIRECTIVE) FOR SEA TURTLES IN THE MEDITERRANEAN SEA

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The Mediterranean Sea is one of the most polluted seas by human debris, most of them being land-based plastics. Marine litter impacts all ecosystem services and threatens the conservation of many species, especially sea turtles, which ingest them and/or become entangled in. On the basis of trend indicators of debris densities and impacts (Descriptor 10), the Marine Strategy Framework Directive (MSFD) provides a framework to its member states to achieve a Good Ecological Status (GES) by 2020, that corresponds to a non-detrimental effect of marine litter on ecosystem services, species and habitats. Because of its wide distribution and its sensitivity to marine litter, the loggerhead turtle (*Caretta caretta*) was chosen as an indicator for debris ingestion (indicator 10.2.1). MSFD aims to harmonize the protocols used by Regional institutions intended to protect the marine environment and marine turtles (i.e., OSPAR for North-East Atlantic and

MedPol for the Mediterranean) and to provide a cut-off threshold of ingested litter below which the GES is met. A literature review showed spatio-temporal variations of the frequency of loggerhead turtles and the quantity of ingested litter at the worldwide and the Mediterranean scales. This study allowed us to propose GES scenarios, which were then discussed within an expert group from the North Eastern Mediterranean. Some biological constraints (e.g., size, health, movements) in the use of the indicator were underlined. A preliminary map of risk was established which combines turtles and debris location data based on aerial censuses in the North Western Mediterranean. This study shed light on the lack of data and highlighted the urgent need to collect an international database gathering data from the whole Mediterranean Sea. Data collected by stranding networks and rescue centers and based on a standardized protocol provided by MSFD will help to determine a realistic GES threshold and to target areas to protect marine turtles in the Mediterranean. We thank the French Ministry of Ecology and Sustainable Development for its financial support.

IS THE WORLD'S LARGEST MARINE PROTECTED AREA LARGE ENOUGH?*

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The largest contiguous global marine protected area (MPA), the Chagos Archipelago MPA has been established to protect 640,000 km2 in the Indian Ocean. We used beach track survey data (2012-2014) to identify those sites within the Chagos MPA having the highest numbers of nesting turtles and estimated the size of the nesting populations of hawksbill (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) within the MPA compared to estimates derived from population surveys conducted during the previous two decades. We used satellite tracking to determine the extent to which the MPA will protect the endangered and emblematic migratory green turtle during the breeding season, and protect some turtles on their foraging grounds within the MPA and others during the first part of their long-distance post-breeding oceanic migrations. We recorded the longest ever migration for an adult cheloniid turtle (3979 km) and demonstrated that most (7 out of 8) tracked individuals migrated to distant foraging grounds outside the MPA. These findings highlight how networks of small MPAs might be developed synergistically with larger MPAs to increase the amount of time migrating species spend within protected areas. Our results highlight the need for international cooperation so that networks of targeted small MPAs supplement the Chagos Archipelago MPA. We discuss how our results can be used in regional conservation planning, such as the Site Network being developed under the Indian Ocean South East Asian (IOSEA) Marine Turtle MoU.

EVALUATION OF LOGGERHEAD HEADSTARTING MANAGEMENT TECHNIQUES IN THE CEGMA (ALGECIRAS, SOUTHERN SPAIN): METHODOLOGY AND RESULTS

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Since 2008 Andalisian Regional Goverment´s Environment and Land Management Ministry worked together with the Scientific Research National Center (CSIC) on the "Project for recovering loggerhead sea turtle (*Caretta caretta*) nesting areas in andalusian coasts". The Traslocation of eggs from Cape Verde population to beaches in Cape Gata-Nijar Natural Park (Almería. Spain) started in 2006. Most of them were incubated in artificial nests on the beach, just a Little group were put into incubators. After hatching, chicks were taken to Andalusian Marine Environment Management Center (CEGMA, Algeciras) where they were raised for 9 months and released on the next summer in the same beaches where they were incubated. The aim is to improve their survival rate and to try that these turtles will come back to our coasts to lay in the future. After four years of traslocation campaigns the team got an average hatching success of about 88%, much higher than estimated values of some other studied populations (with values between 45-70%). A total of 910 sea turtles passed by CEGMA facilities and there was a reintroduction success of 90%. In this presentation we will discuss the methodology (feeding, husbandry, marcking, check-up) as well as the results obtained during the 3 years period that CEGMA received these specimens.

INVISIBLE ARCHITECTURE FOR MARINE TURTLE RESEARCH, EDUCATION, AND CONSERVATION: BUILDING STURDY BRIDGES WITH INTANGIBLE CONCEPTS AND VALUES*

Jack Frazier

Smithsonian Institution

For more than 3 decades the International Sea Turtle Society (ISTS) has maintained a leadership role far beyond specialised research, education, and conservation on marine turtles. Of immense importance, it has provided a unique and respected forum nurturing integration between: individuals and organisations; countries and regions; disciplines and philosophies; public and private; formal and informal; and much, much more. Yet, no bridge, no matter how short the span, can be constructed without risks; there are many challenges to breaking down disciplinary walls, democratising science, merging "tribal" areas, popularising research, and other aspects critical for constructing sturdy bridges. There will always be obstacles and those who resist integration, for whatever reason. But, more expansive, comprehensive research, education, and conservation attain greater efficiency and relevance for far more people, over far more time through integration and "cross-fertilisation" with diverse groups. Unquestionably, members of the ISTS have been leading architects of superb bridges – in countless ways – between many diverse origins and destinations. Nonetheless, there is an on-going need to evaluate advances and strengths, as well as the challenges from past experiences that must be addressed in the future. Perceptions and suggestions of key ISTS actors (e.g., past Presidents; members of the Board of Directors; regional workshop organisers; and others) will be presented to elucidate the most significant strengths as well as the greatest challenges (including perceived failures). This information will be presented in the light of fundamental international documents that promote enhanced relevance of research with society as a whole, such as the UNESCO World Conference on Science. Such comparisons will indicate how the ISTS measures up with other major international initiatives; and these insights will provide unique guidance for the future of the ISTS, as well as for research, education, conservation, and other activities of the global marine turtle community. There could be no more relevant a venue for celebrating and evaluating these incredible accomplishments than at the historic crossroads between Africa, Asia, and Europe.

MONITORING THE WINTER AND SUMMER AVAILABILITY OF SEAGRASS (*HALODULE WRIGHTII*) AND ASSOCIATED MACROALGAE ALONG THE PARANÁ COAST, SOUTH BRAZIL

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In Brazil, *Halodule wrightii* is the most abundant seagrass, occurring on reefs and throughout estuarine areas along the northeast coast south to Paranaguá Bay, Paraná. Paranaguá comprises a port and intensely urbanized areas; both of which threaten seagrass beds due to contaminants and dredging. Seagrass is an important environmental health indicator, representing a high energetic value item for green turtles. On the Paraná coast, seagrass meadows grow and flower in summer and spring. Seagrass beds are present in shallow areas throughout Paranaguá Bay, including at: Baixio do Perigo (BP) (in Ilha das Cobras), Baixio do Saco do Limoeiro (SL) (in Ilha do Mel) and Ilha Rasa (IR). In order to evaluate seagrass spatial-temporal variability in abundances, two sample methods were applied: (1) quadrat and (2) linear-transects. The maximum areas of seagrass meadows were evaluated and the largest area estimated using end-point coordinates and the minimum convex polygon method. Using quadrats each area was delimited in ArcGIS 10 to 100 m, with the central point (centroid) also delimited. Four sub quadrants (25 m) were used to evaluate seagrass percentage cover. Also, five linear transects of 100 m each were used in each seagrass meadow, and seagrass and macroalgae were registered using a quadrat of 1 m^2 as a sampling area at each 20 m. In every sample for quadrants methods, 30 centroids were randomly sorted and analyzed about the percentage of seagrass and associated macroalgae coverage. For the linear transects, a presence/absence matrix was made. Ilha Rasa was the largest area, with 1 km^2; followed by BP, with 0.18 km^2; and by SL, with 0.18 km^2. Seagrass availability significantly varied among meadows and between seasons (Summer: BP 3.75%; SL 10.9%; IR 7.78%; Winter: BP 0.014%; SL 3.65%; IR 8.25%; p-value = 0.05). Three macroalgae were observed and identified in the meadows: *Ulva* sp. [a], *Gracilaria domingensis* [b], and *Acanthophora* sp. [c]. In summer, all macroalgae were found at BP ([a] 10.9%; [b] 0.09%; and [c] 2.56%); and *G. domingensis* and *Acanthophora* sp. in SL, with 0.10% and 5.74%. In winter, the three macroalgae were found only at SL; and only *Ulva* sp. was present at BP (0.048%) and IR (0.08%). In summer, *H. wrightii* was present at all meadows. *Acanthophora* sp. was mostly present at SL. In winter, *H. wrightii* was present only at IR; and *Ulva* sp. was the only macroalgae found at BP. The coverage and presence of seagrass and macroalgae were greater in summer, which was explained by the warmest temperatures and more ambient light. Nevertheless, at IR the percent of coverage was greater in winter, probably because along the summer that area has been

influenced by high rainfall values (high turbidity) and low light incidence. The latter anomaly may explain the green turtles presence along the Paraná coast throughout the year. The continuous monitoring of seagrass areas is necessary for evaluating health, and any associated anthropogenic impacts. Acknowledgements: The authors thank the CNPq for the financial support.

SEA TURTLE HABITAT AT RISK; LONGITUDINAL RECORD OF SEA TURTLE NESTING ON ST. CATHERINES ISLAND, GA. "WHAT THE PAST TELLS US ABOUT THE PRESENT AND THE FUTURE!"

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Geologists involved in sea turtle conservation on St. Catherines Island, Georgia, a "Sentinel Island" for barrier islands during the Modern Transgression, have documented sea turtle nesting for 25 years (1990-2014). During this time 3080 nests have been documented, including seven leatherback, three green sea turtle, and 3070 loggerhead nests (99.68%). Deterioration of adequate nesting habitat from 25% to 12% in the last decade has resulted in rapid erosion of backbeach nesting habitat at ~ 3.0 to 6.0 m per year, including fragmentation of three beaches in 1990 into eight beaches in 2013, formation of washover fans and wash-in fans onto backbeach marsh meadows and into maritime forest, formation of nearly continuous tree "boneyards," scarps, and relict marsh mud exposures along most of the beach. All these phenomena contribute to difficult nesting conditions for loggerhead sea turtles; forcing relocation of approximately 80% of "at risk" nests into nurturies in this Critical Habitat. This initial study of the patterns of nesting on St. Catherines Island tracks the proportion of nests deposited on each of our initial three beaches as they fragment due to sea level rise. Overall proportions of nests by beach vary from year to year, with variance ascribed to differing cohorts of nesting loggerheads. As beach migration occurs on rising sea level, nesting habitat is dramatically changed over time, opening small nurturey areas into which nests may be relocated and then, they subsequently erode away during succeeding years. Two major areas capable of hatching nests most years have been persistent over 25 years and remain intact. The North Beach Nurturey (occupying 0.611 km of beach front) is currently the only accretional part of the Island, but is underlain by two bodies of ancient marsh mud, producing a perched water table capable of drowning eggs during wet years. The McQueen Dune Field Nurturey (occupying 1.124 km of beach front) is now under significant erosional attack by the Atlantic Ocean and is rapidly deteriorating. Dynamic modeling and observation of the changes occurring in St. Catherines Island's Critical Sea Turtle Nesting Habitat show a pervasive deterioration of habitat quality through time with historical average rates of beach migration of ~3,0 m/yr now accelerating to ~ 6.0 m/yr as sea level rise accelerates. All primary sea turtle nesting habitat on St. Catherines Island is now at risk and will be compromised as sea level continues to rise, potentially disappearing altogether and/or certainly being strongly modified within the next 25 to 50 years. Conservation of sea turtles under these conditions consists of assessing the likelihood of the hatching of each nest deposited in this dynamic habitat, leaving as many nests in situ as seems wise; and relocating as many nests as is necessary to maintain a healthy hatch rate in as natural a manner as is feasible. This protocol is very labor intensive. Fragmentation of the beaches makes them increasingly difficult to monitor, so monitoring by drones is being introduced in 2015.

KAPTAN JUNE, DALYAN BEACH AND THE SEA TURTLES- HER COMMITMENT FROM 1984-2015

June Christine Haimoff

Kaptan June Sea Turtle Conservation Foundation, Dalyan, Turkey

Greetings To The Assembly. My name is June Haimoff or Kaptan June, I am English and I have made my home in Dalyan for the last 30 years. My first encounter with a Loggerhead Sea Turtles occurred in 1984 on the then pristine Dalyan beach, it was so incredible it changed my life. I watched in wonderment as she prepared her nest in the sand then deposited 100 eggs, covered the nest and lumbered the few yards to her element to the sea. Deeply moved I have been devoted to these solitary mothers ever since, and intense emotions filled me and when I learned later that plans were in place for initial built on the beach, I began to think about possible protection of the beach and turtles. In November 1986, I went to Ankara with 300 signatures hoping to lobby to the Prime Minister Turgut Ozal. A beach friend Abidin Kurt went with me, he also knew the Prime Ministers Secretary Can Pulak, miraculously we were well received and many doors were open to us. The media joined in and our cause to prevent building on the beach became known. In April 1987, a huge blow to our hopes, building of a six hundred bed holiday village began at the Iztuzu end of our beach. All seemed lost, but thanks to the Intervention

of Environmentalist and powerful NGO's like WWF, Greenpeace, David Bellamy and Prince Philip. Building work was suspended in September, incredibly came the fabulous news The Turkish Government has declared Dalyan beach and delta the first S.P.A in Turkey. This giving us complete protection to an ecosystem and of course the turtles. It is a special delight for me to attend the Sea Turtle Symposium taking place adjacent to Dalyan beach. I offer my special thanks to Professor Yakup Kaska for organising this symposium. Welcome and thank you for your attention, this wheel has come full circle indeed. In 2011 The Kaptan June Sea Turtle Conservation Foundation was established and I am its president. Another wonderful example from potential loss of their habitat in some 30 years ago- to S.P.A status in 1988 the turtles now have their very own symposium. Well thank you for your presence.

REVIEW OF OLIVE RIDLEY PRESENCE IN SÃO TOMÉ AND PRÍNCIPE ISLANDS, WEST AFRICA, WITH NEW NESTING OCCURRENCE IN PRÍNCIPE ISLAND

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The Olive Ridley turtle (*Lepidochelys olivacea*) is one one of the most common and abundant sea turtle species,yet the knowledge of its distribution and nesting beaches is still limited, especially in Western africa, where its presence ranges from Northern Senegal to Southern Angola, and nesting in the gulf of Guiné islands reported in Bioko and São Tomé islands. The lack of data and trends on specific nesting beaches make it difficult to estimate nesting populations. At present, the species is categorized as vulnerable on the IUCN Red List (IUCN, 2014). The main cause of the historical, worldwide decline of the olive ridley sea turtle is long-term collection of eggs and killing of adults on nesting beaches, and this is especially true for the São tomé and Príncipe Archipelago, and reflects the situation along the entire west coast of Africa, where nesting olive ridleys are captured along the entire west coast of Africa and sold in local and regional markets, with a potential devastating impact to the entire Eastern Atlantic population. Here we present a short review of the conservation status of the Olive Ridley turtle in São Tomé and Príncipe islands. Mortality estimates form the last three seasons, as well as historical data, may demand a reassessment of the current listing for the region, and urge specific conservation actions to hault a extremely high, unsustainable illegal harvest.

PROTECTING BEACHES AND SEA TURTLES: AN ANALYSIS OF BEACH NOURISHMENT, LOGGERHEAD SEA TURTLES, AND SEA LEVEL RISE IN NORTH CAROLINA

Kimberly Hernandez

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With sea levels rising and beachfront development continuing, barrier island beaches are increasingly squeezed between rising tides, storm surges and coastal development. Because of the economic value of coastal property and the historic ban on seawalls, groins, and other hard structures on North Carolina beaches, beach nourishment is often the accepted engineering solution utilized to combat eroding shorelines. With North Carolina prioritizing nourishment as a viable and effective option, it is important that species that rely on certain beach characteristics are considered during the permitting process. Given the July 2014 Designation of Critical Habitat for the Northwest Atlantic Ocean Distinct Population Segment of the Loggerhead Sea Turtle (*Caretta caretta*), this particular species warrants further attention. This project was completed in partial fulfillment for the degree of Master of Environmental Management in the Nicholas School of the Environment of Duke University, with funding support provided by North Carolina Sea Grant and the North Carolina Coastal Resources Law, Planning, and Policy Center. Each beach selected for this study is: 1) a developed barrier island; 2) a known loggerhead sea turtle nesting beach; 3) vulnerable to sea level rise; and 4) within the terrestrial critical habitat. The study area included the southern North Carolina barrier islands of Bogue Banks in Carteret County, Pleasure Island in New Hanover County, Bald Head Island, Oak Island, and Holden Beach in Brunswick County. Historic nourishment data was used to quantify the current cost trends of beach protection, hypothesizing that sea level rise will exacerbate that cost in the future. Historic sea turtle nesting trends were also gathered and compared to the historic nourishment activity. Nesting density was overlaid atop areas that were identified by the US Geologic Survey Coastal Vulnerability Index as "high" to "extremely high" vulnerability to sea level rise. An extensive literature review of the impacts of beach nourishment on sea turtle nesting beaches was also conducted. The analysis uncovered ways North Carolina can responsibly move forward with beach nourishment while taking both sea turtles and sea level rise into account. First, North Carolina and the United States Army Corps of Engineers must maintain and uphold the environmental windows for dredging and nourishment projects. Because sea turtles exhibit temperature-dependent sex determination and the color of sand can dictate sand temperature, sand color should be incorporated in to North Carolina's Technical Standards for Beach

Fill. The Coastal Resources Commission must also direct the Division of Coastal Management to account for sea level rise and increased sand needs/costs before permitting future nourishment projects. Finally, agencies and volunteers should continue to monitor nesting beaches to further understand how modified beaches impact nesting loggerhead sea turtles.

ASSESSING POPULATIONS OF HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) AND GREEN TURTLES (*CHELONIA MYDAS*) IN THE MALDIVES USING PHOTOGRAPHIC IDENTIFICATION: FIRST RESULTS OF A CITIZEN SCIENCE PROJECT

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The ability to identify individuals within a population is often a starting point for ecological and conservation studies. Realistic estimates of population size and distribution of a species are important for creating effective management strategies. Previous studies have relied on invasive tagging techniques that are both expensive for the researcher and stressful for the animal. For sea turtles, recognition is often achieved through the attachment of tags to flippers or by the use of Passive Integrated Transponder (PIT) tags. The inevitable loss of these tags makes long-term studies of long-lived species difficult and limits the number of turtles identified to those that can be easily captured. Photographic identification (Photo-ID) is an approach that uses photographs of unique features or markings on an individual animal's body to aid in its recognition. Photo-ID has advantages over traditional capture-mark-recapture techniques because it involves no physical capture or handling of the animal, the natural markings are stable over time, and the behaviour of the animal is less likely to be affected. Five species of sea turtles can be found in the Maldivian archipelago. Illegal hunting, taking of eggs, and development of nesting beaches are assumed to have resulted in a decline in the local turtle population but there has been a lack of resources and capacity for a nation-wide, long-term monitoring study in the country. Results for the first three years of a citizen science Photo-ID program for marine turtles in the Republic of Maldives are presented here. Turtles were identified both visually and by using a program developed by SeaMarc Pvt. Ltd., based on the method developed by Jean *et al*., which gives the facial scutes of each turtle a unique code based on their order, shape, and interconnectivity. Over 1,200 hawksbill turtles, over 170 green turtles, and one loggerhead turtle were positively identified (using both the left and right facial profiles), with over 4,000 sightings recorded. Turtles were photographed eating, resting, and swimming on the reefs of over 225 different islands in 16 Maldivian atolls. Approximately 97% of the green and hawksbill turtles photographed were juveniles or females. Males, when seen, were photographed in deeper water and stayed on reefs for shorter periods of time. Extremely high site fidelity was observed for both hawksbill and green turtles. The maximum distance between resightings was 13.3 km for a green turtle and 12 km for a hawksbill turtle. When the animals did move between reefs, this distance was usually <1.5 km and they often moved to reefs within the same lagoon (considered part of the same large foraging site). This study demonstrates that the participation of "citizen scientists" (people with little or no scientific training, such as tourists) is both a powerful awareness tool and a method of gathering large amounts of data in remote areas that could not otherwise be surveyed given time and resource constraints. The rise of social media has also given researchers a time efficient, engaging, and wide-reaching method of interacting with, and giving feedback to, citizen scientists.

AT LOGGERHEADS OVER INTERNATIONAL BYCATCH: INSIGHTS FROM THE FIRST NATION IDENTIFIED FOR BYCATCH UNDER THE MAGNUSON-STEVENS ACT*

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The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA) is the primary law that codifies marine fisheries management in United States federal waters. The MSRA was amended in 2006 with Section 610, an international provision that directs the Secretary of Commerce to identify nations engaged in the incidental capture (bycatch) of protected living marine resources (PLMRs) under specific conditions. In 2013 the United States identified Mexico for bycatch of a PLMR – the North Pacific loggerhead turtle – representing the first time a nation has been identified for bycatch under section 610. To date, unintended sociopolitical consequences of the identification have impeded existing bycatch mitigation efforts. In the wake of the unilateral identification, Mexican officials, surprised by the identification and alarmed by the threat of trade sanctions, downplayed and denied the bycatch problem that their agencies had previously accepted and agreed upon to act, the opposite of the intended outcome of inspiring them to address it. Moreover, the identification jeopardized fisher-led bycatch reduction programs and has yet to reduce turtle mortality

rates. In anticipation of the imminent reauthorization of the MSRA, we make broadly applicable recommendations to the identification process that provide increased flexibility and discretion under the law to better fulfill its intended conservation objectives. These recommendations are: 1) The maximum age of bycatch data that can be considered in the identification process should be extended from one to three years. 2) The Secretary of Commerce should be mandated and funded to work through international fishery organizations to continue establishing binding bycatch reporting requirements. 3) The Secretary of Commerce should be required to alert a nation as soon as it obtains potentially actionable bycatch data. 4) The MSRA should be amended to direct the Secretary of Commerce to consider comparable fisheries in identification decisions. 5) Identification decisions and any other official communications should include as much information as possible, in as timely a manner as feasible, to help nations understand the implications of the identification.

PROBLEMS FACING LOGGERHEAD SEA TURTLE IN FETHIYE BEACH AND MITIGATION MEASUREMENTS

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Fethiye beach is one of the most important nesting sites of loggerhead sea turtles (*Caretta caretta*) in Turkey. Previous studies were showed a negative population trend of the loggerhead sea turtle population at Fethiye beach, Turkey based on nesting data. Tourism development in recent years has increased risks that may cause the loss of sea turtle nesting habitats. Our studies were identified that the problems in the area as intensive human activity, sun beds and parasols, light and noise pollution, traffic on the beach and night visitors. Also, human activity on nesting beaches may affect sea turtle eggs, hatchlings and adults. These problems that affect the development of eggs and therefore hatchling success and the usage of vehicles that also compress the sand. The mortality of adults and juveniles can be caused by speedboats. Meanwhile, a conservation action plan was started in order to protect nesting females, nests and hatchlings on Fethiye beach. Training activities was started for tourists, local peoples, and restaurant and hotel owners regularly during and before the nesting season. We held a meeting with all stakeholders and manager of ÇALIŞ-DER (an NGO for environment and tourism located in ÇalışBeach) before the nesting season. All the visible lights of the hotels and restaurants from the beaches are removed, screened and/or painted as black. The light shows and/or similar activities in front of the hotels, affecting the beach and turtles were stopped and these were accepted by the stakeholders at the beginning of the nesting season. Vehicle access and ditch digging by municipality workers was stopped according to our suggestions. Drivers were also informed and warned. The car parks were designed by the Municipality at the back of ÇalışBeach. The fisherman and motorized water sports businesses explained all code of conduct and they have a long list of rules they have to be followed. Any illegal activities if it is found and seen by our project team, coast guards were immediately informed.

STRATEGIC PLAN FOR REVERSE THE DECLINE FOR THE STATE OF FLORIDA, USA SEA TURTLES*

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Sea turtle populations in the southeastern United States of America (USA) continue to face many threats to their recovery. In the State of Florida, where approximately 90% of all sea turtle nesting in the USA occurs, recovery of sea turtle populations is a high priority. To aid in this effort, the Disney Worldwide Conservation Fund has identified Florida sea turtles as a group of species to include in their Reverse the Decline initiative, which aims to develop a strategic plan and implement conservation actions during the next 10 years. In collaboration with stakeholders in Florida, the Archie Carr Center for Sea Turtle Research is developing the strategic plan for this initiative using the U.S. Loggerhead Recovery Plan (2008) as a foundation document. Using a conservation planning software tool, Miradi, results will be presented from workshops held with stakeholders (e.g., NGOs, researchers, educators, government personnel) throughout Florida to develop strategies and actions that will guide the implementation of the Reverse the Decline initiative to reduce threats and improve the conservation outlook for Florida sea turtles. Among these results are Results Chains developed to guide conservation actions by explicitly identifying desired conservation results, and actions needed with expected outcomes to achieve the desired results. In our presentation, we will provide a summary of the strategic planning process and results from stakeholder workshops.

TWENTY YEARS OF NEST MONITORING OF *CARETTA CARETTA* IN FETHIYE, TURKEY. FIRST CONSERVATION EFFORTS OR PROGNOSED DECLINE IN NEST NUMBERS?

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Since 1994 the University of Vienna, in collaboration with Hacettepe University, Adnan Menderes University, Dokuz Eylül University and Pamukkale University, has conducted a field course to protect, maintain and gain a better understanding of *Caretta caretta*. The study area Fethiye is a key nesting beach in the Mediterranean and was declared a SPA (Specially Protected Area) "Fethiye-Göcek". Based on a 12-year trend analysis, the number of nests here was predicted to decline by 2015 to about 25% of the peak value in 1993. In fact, the number now appears to have leveled off at a higher value. However, more closely examining the two different beach sections – Çalış, a touristic area, and Yanıklar, containing natural beach sections – reveals different trends. Yanıklar always had more nesting activity in the last 20 years, with an average of 80 nests, while Çalış had an average of 20 nests. The new data show a continuous decline of nests in Yanıklar, whereas in Çalış the number reached a new peak of 35 nests in 2013 and 2014, a value last documented in 1994. In the touristic Çalış area, the upward trend could potentially be interpreted to reflect the long-term conservation and monitoring program. In the Yanıklar sections, however, increased conservation efforts are apparently needed in order to avoid losing the natural beach area as a nesting site for *Caretta caretta*, especially in the light of ongoing and proposed major construction projects. This underlines the importance of examining beaches and their subsections separately, and developing tailored management strategies for each.

THE OLIVE RIDLEYS OF ORISSA: 10 YEARS AFTER!*

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Over 10 years ago, Shanker *et al* provided the last comprehensive review of nesting of olive ridley turtles in Odisha. The authors used multiple sources of information, including estimates using standard procedures as well as 'guesstimates' to derive a population trend for the nesting population of ridleys at Gahirmatha. They also detected a decrease in adult sizes of turtles, and used a combination of data to infer an imminent decline in nesting populations. Much of the attention in Odisha has been focussed on nesting numbers reported from the Gahirmatha beach. However, monitoring at this beach has been highly restricted as it is within a Protected Area. In the meantime, the other nesting beach at Rushikulya has remained largely neglected. We have been monitoring nesting at the Rushikulya rookery in collaboration with local community members and the local forest department since 2008. We used standardised protocol, to census mass nesting event. Between 2008 and 2014, the size of nesting events have fluctuated, ranging from ~14,000 (in 2014) - ~ 150,000 (in 2013). No further decrease in adult sizes was detected. Mortality at the Rushikulya rookery is fairly low, though a few thousand are turtles are washed up elsewhere on the Odisha coast. Often, an alarmist approach is used by the conservationists and media to grab people's attention for a conservation cause. At the same time, management authorities may have grossly overestimated nesting populations to show increasing numbers of turtles over time to please the conservation audience. Here, we question the earlier inferences that the olive ridleys of Odisha are on the verge of decline; current data appears to suggest that, while there may be periodic fluctuations, these populations may be more resilient than earlier believed. In the absence of adequate research, conservation action might prove to be futile or even harmful in the long run. We recommend a more holistic approach to conservation which goes beyond short term numbers and rates, and emphasizes the long-term conservation of sea turtles and their habitats.

AN ECOSYSTEM SERVICES PERSPECTIVE FOR THE OCEANIC EASTERN TROPICAL PACIFIC: COMMERCIAL FISHERIES, BIODIVERSITY, CARBON STORAGE AND CULTURAL SERVICES*

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Implementation of marine ecosystem-based management (EBM) has primarily focused on coastal ecosystems. Much less progress has been made for oceanic ecosystems due to the inherent challenges associated with studying and managing these systems. However, oceanic systems are heavily utilized, comprise a large proportion of the earth's surface, and are in need of more holistic management. The concept that ecosystems should be evaluated for their full range of ecosystem services, or natural benefits, is central to EBM. An understanding of ecosystem services informs decisions about trade-offs associated with alternative uses of the system. Our research provides a case study application of the ecosystem services concept to an oceanic ecosystem, with a focus on the eastern tropical Pacific (ETP), an area of 21 million km2 that includes waters of 12 nations and the oceanic commons. We analyzed the ETP in terms of production, distribution, and consumption of its major ecosystem services. We examined commercial fisheries as a key provisioning service, biodiversity (a measure of ecosystem resilience) as a key supporting service, carbon storage as a key regulating service, and examples of recreational uses (including recreational fishing) as cultural services. Using 35 years (1975-2010) of historical fisheries and economic data, we estimated a recent average wholesale value of $2.7 billion for the 10 most abundant commercially-fished species. We linked total catch and landings to specific countries, identifying Ecuador, Mexico, and Panama as key fishing nations, with the first 2 also receiving 3/4 of total landings. Using a 20-year dataset (1986-2006), we quantified species richness patterns and geographic extent for cetaceans, seabirds and larval fishes, and sightings density for marine turtles. The results show that the ETP contains over 1/3 of the world's species for cetaceans, seabirds, and turtles, and that commercial fisheries overlap with hotspots for these taxa. We estimated the value of carbon export to the deep ocean at $12.9 billion per year, the lost value of carbon storage in two depleted dolphin populations at $1.6 million, and the annual carbon storage value for total fishery removals (544,000 mt) at $1.6 million. Finally, we highlighted the case of sport fishing from recent studies which suggest it is worth at least $1.2 billion. Our results illuminate the biological and commercial importance of the ETP in a global context and offer insights into the relative magnitudes of economic value associated with its major ecosystem services. This research sets the stage for further analysis of trade-offs in the ETP and has implications for populations of cetaceans, seabirds and marine turtles in the region. This project was funded by NOAA Fisheries, Southwest Fisheries Science Center while S.L. Martin was a Ph.D. student at Scripps. Travel support was provided by NOAA Fisheries, Pacific Islands Fisheries Science Center as part of a postdoctoral fellowship.

THE FIRST COMPLETE REPORT ON THE STATUS OF THE IMPORTANT LOGGERHEAD ROOKERY OF CABO VERDE: IMPLICATIONS FOR CONSERVATION*

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The Cabo Verde Archipelago hosts the largest nesting ground for loggerhead turtles (*Caretta caretta*) in the East Atlantic, and is an independent RMU that has recently been considered one of the eleven world's most endangered sea turtle populations. Surveys conducted between 2007 and 2009 on the island of Boa Vista provided a mean nest abundance of around 13.000 nests per season. Since 2008 accurate nest surveys have progressively been extended to most of the islands. All monitoring programs have been coordinated by the Environment Directorate of Cape Verde within the frame of the National Plan for the Conservation of Sea turtles. Data was gathered by several NGOs grouped in the Cape Verde Sea Turtle Network TAOLA. In the present study, we have analyzed available data from 2008 to 2013 collected by all monitoring programs on the different Cape Verde islands (Santo Antão, São Vicente, Santa Luzia, São Nicolau, Sal, Boa Vista, Maio, Santiago, Fogo, Brava and islet of Rombos). This has resulted in the first complete analysis of nesting activities on 211 km of nesting beaches. The island of Brava was excluded because it does not have any suitable beaches for nesting. The annual number of nests counted between 2008 and 2013 on Cape Verde averaged 17343, ranging from 6400 to 31157. The island of Boa Vista, despite hosting 30% of the kms of beaches in Cabo Verde, contributed with an average of 76.3% of the nesting activity. Other important islands for nesting are Sal (6.9%), Maio (6.2%) and Santa Luzia

(4.6%). These four islands that are characterized by white sandy beaches host 94% of the loggerhead nestings in Cabo Verde. The island of Maio, despite presenting a high percentage of nesting beaches (18%), host a relatively low percentage of nests (6.2%) suggesting an important potential for increasing its nesting activity. The most populated islands have the lowest abundance of nests suggesting that human activities have an important impact on the nest site selection and abundance of loggerhead turtles. The slaughter of females on the beaches has also been reported on all islands and islets. The current annual number of hunted females average 460, with more than half occurring on Boa Vista. There is a high correlation between nest abundance and hunting pressure. However, it is remarkable that islands with very low nesting activity are still suffering a significant loss due to the slaughter of nesting females, impeding the recovery of the depleted nesting grounds. Programs to reduce turtle hunting in the Archipelago have to be reinforced adapting their priorities to the specific circumstances of each island. The main nesting beaches of the islands of Boa Vista and Maio are already included in protected areas. It is extremely important to declare the main nesting beaches as protected areas on the remaining islands, as well as approve and implement rigorous management regulations for the declared protected areas in order to ensure the preservation of the main habitats for turtle reproduction and aid in the recovery of this highly endangered and internationally relevant loggerhead nesting grounds.

HAWKSBILL TURTLE REPRODUCTION IN BRAZILIAN URBAN BEACHES

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Since 2002, an urban nesting ground for hawksbill turtle *Eretmochelys imbricata*, is being monitored by a non-governmental organization: Associação Guajiru, through its project Projeto Tartarugas Urbanas. The nesting area is located at João Pessoa (7º08'S, 34º48'W) and Cabedelo (7º01'S, 34º49'W), in northern Paraíba state. The monitored area consists of 7km of highly urbanized beach, chronically exposed to human intervention and city lights. Here we analyze and summarize the data of 12 nesting seasons, focusing on some of the aspects of the hawksbill turtle nesting activities and some implications on the management techniques applied to protect the sea turtles nesting in urban beaches. The area has on average 118±27 nests/year. A total of 1415 nests were recorded throughout the project's activity, 86 washed away by the tide, hence 1329 nests were counted on the analysis. Daytime nesting activity was recorded only one during 2004, in the presence of spectators. A total of 125,318 neonates were born from 191,108 eggs resulting in 65.6% success rate (max of 85% in 2004-05, min of 45% in 2009-10). There is significant difference between seasons. Similar to other sites, the incubation lasted from 45 to 73 days (mean 55 ± 4) with the majority (67.5%) between 47 and 55 days. There was no significant difference on emergence period between seasons and within each season. In the period, the annual mean clutch ranged from 134 ± 35 to 150 ± 43 (overall period mean of 143 ± 30). Clutch size historically ranged from 11 to 241 eggs. The nesting season generally lasted from October to June on the 12 years analyzed, similarly to other sites in Brazil. Yet, the nesting peak was between February and March, differing from other localities, where the peak nesting activity was evenly distributed throughout January and February. We found no evidence, regarding number of nests, of an increasing or decreasing trend in the nesting activity during the period analyzed. Inter-annual variability in nesting activity is common for sea turtles, although the variation may differ between species. An array of techniques area applied to protect the nesting activity in the urban beach landscape, protecting the nests from compaction and neonate disorientation caused by photopollution. The nests are fenced with stakes and plastic net, and assisted emergences are performed during the day to liberate the neonates in a period with no artificial light interference. This modest hawksbill turtle population nest under conditions very different from the ones registered elsewhere in Brazil. Their conservation efforts must be prioritized both to maintain the genetic group and to study their reproductive behavior in urbanized beaches. Ackowledgements: Associação Guajiru, Associação Guajiru's volunteers' team, and Caio Graco Zeppelini for translating the abstract to English.

DYNAMIC OCEAN MANAGEMENT: A NEW APPROACH TO MANAGING MOBILE MARINE SPECIES*

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Highly mobile marine species such as sea turtles are challenging to manage because of the large spatial and temporal scales they utilize as they follow ephemeral oceanographic features that are critical to foraging or breeding. Many human users, such as fishermen, follow similar oceanographic features as they search for resources in the open ocean. Despite the dynamic nature of marine systems, species and users, most marine management techniques are relatively static, drawing stationary boundaries (e.g., marine protected areas) around often mobile marine features, animals, or resource users. While these approaches can work for relatively stationary marine resources, to be most effective for mobile marine species that are impacted by mobile human users such as fishermen, marine management must be as fluid in space and time as the resources and users we aim to manage. Here we describe dynamic ocean management, or management that rapidly changes in space and time in response to changes in the ocean and its users through the integration of near real-time biological, oceanographic, social and/or economic data. Dynamic management can refine the temporal and spatial scale of managed areas, thereby better balancing ecological and economic objectives. Further, dynamic management complements existing management by increasing the speed at which decisions are implemented using predefined protocols. With advances in data collection and sharing, particularly in remote sensing, animal tracking, and mobile technology, we are poised to apply dynamic management broadly. We will describe existing examples that demonstrate that dynamic management can successfully allow managers to respond rapidly to changes on-the-water, however to implement dynamic ocean management widely, several gaps must be filled. These include enhancing legal instruments, incorporating ecological and socioeconomic considerations simultaneously, developing 'out-of-the-box' platforms to serve dynamic management data to users, and developing applications broadly across additional marine resource sectors.

ECOSYSTEM APPROACH TO SEA TURTLE CONSERVATION IN CORISCO BAY, GABON*

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Corisco Bay is an important foraging ground for green and hawksbill turtles on the border of Gabon and Equatorial Guinea in Western Africa. Until recently the local Benga people openly hunted these sea turtles for use in their cultural traditions. As a result of local conservation awareness efforts and legislation at multiple levels, the hunt has been halted with the exception of a few poachers. However, the health and survivorship of this mixed-stock population is also threatened by a variety of other sources, including incidental capture in industrial trawl and artisanal gillnet fisheries, habitat degradation through accelerated coastal development and oil exploration, and disease (fibropapillomatosis). At present, Gabon is expressing great interest in the preservation and sustainable use of its marine resources. As such there is a pressing need for the empirical information that can be used to guide conservation management efforts with the recognition that such an approach requires a holistic vision that protects key species, habitat quality and structure, and trophic networks that fuel ecosystem function. Manga and the Wildlife Conservation Society, work out of the village of Cap Esterias to protect Corisco Bay's foraging sea turtle population by providing educational outreach, building capacity, engaging with the local

fishermen, conducting ecological and basic oceanographic research, and liaising with authorities. Previous genetic research has demonstrated Corisco Bay turtles' link to numerous rookeries in the Atlantic and Indian Oceans, denoting its global importance. Satellite tracking has shown these foraging turtles are resident throughout the year and show strong site fidelity to particular sites within the 10 m depth contour. As a result, we have been looking at what may drive the spatial structure in habitat use observed with the goal of encouraging trans-border marine protected area(s) in Corisco Bay. We have used a multifaceted study approach to be able to provide managers and local communities with a more robust ecological picture of the habitat use and requirements of Corisco Bay's sea turtle population. Between 2010 and 2013, we characterized habitat types within the bay and surrounding mangrove rivers using pirogue-based surveys and quadrat sampling to analyze with turtle sightings and tracking data. These methods provided quantitative measures of habitat features, species lists, and food availability across the study area, as well as a relative abundance of turtles. Analysis of stable Carbon and Nitrogen isotope ratios from green turtle skin tissue and potential food items (i.e. algae and seagrass) corroborated the spatial patterns observed in the sightings and tracking data. Moreover, stable carbon isotope signatures of turtles sampled in the mangroves were significantly different from those in the bay, suggesting that habitat use within the study area may be distinguished isotopically. Stomach content samples collected were used to identify key prey species and refine our isotope analysis. Given that habitat quality may also vary with water quality, we also monitored essential water quality parameters across representative sites to better describe temporal and spatial conditions of the area.

SEA TURTLE FRIENDLY LIGHTING IN FLORIDA: UNDERSTANDING THE POLICY IMPLEMENTATION AND ENFORCEMENT PROCESS

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Artificial lighting negatively impacts sea turtle populations. It discourages females from nesting and interferes with hatchlings ocean-finding abilities. To reduce the impact of artificial light on sea turtles and their nesting habitat 82 local governments in Florida have passed beach lighting ordinances. As written most lighting ordinances do not include sufficient enforcement clauses. Less than 10% mandate a lighting inspection during the nesting season and less than 20% include provisions for educating the public. However, a local ordinance may not accurately reflect the activities actually occurring in that area. Code enforcement officers are responsible for the translation of sea turtle lighting ordinances into action. By exploring the implementation practices of code enforcement officers we can better understand the implementation process, highlight best practices and discuss suggestions for improvement. This study examines the policy implementation process of sea turtle lighting ordinances by conducting semi-structured interviews with code enforcement officers. Best practices and suggestions for ordinance improvement are compiled. A cluster analysis was used to form groups with similar program structure. The enforcement style of each code enforcement officer was also measured using information gathered during interviews. Regression analyses will be used to determine whether there is a correlation between disorientation rate, program structure and enforcement style.

LIFE + PROJECT *CARETTA* CALABRIA: "LAND-AND-SEA ACTIONS FOR CONSERVATION OF *CARETTA CARETTA* IN ITS MOST IMPORTANT ITALIAN NESTING GROUND (IONIAN CALABRIA)"

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The Southern coast of Ionian Calabria is currently recognized as the main nesting ground for loggerhead turtles in Italy, accounting for 60% of nests laid nationwide each year. This small (15-20 nests/year) and residual nesting population, hosting a unique mitochondrial diversity, is seriously endangered by several threats, not only in the pelagic phase (specially by-catch in fishing activity), but also directly by human presence (off-road vehicles, increase of artificial lights), and by

coastal management for tourist purposes (beach cleaning or mechanical levelling in summer time, construction of harbours, buildings). A European Union LIFE+ Nature project (LIFE12 NAT/IT/001185) to reduce these threats was recently launched (October 2013). The project will address the main threats occurring both at land and at sea, and will propose an integrated approach between institutions and stakeholders, suitable for different local contexts at different levels of the life cycle of this species. The main objectives of the project are: a) Conservation and restoration of four key nesting areas in coastal habitats (dune series) identified by the studies conducted since 2000 by the Dept. of Ecology, Univ. of Calabria ("Progetto TARTACare Calabria"); b) Elimination and/or mitigation of the main treats and risk factors for the reproductive success in the area. These operations will be performed primarily in the above key areas; c) Reduction of the impact of fishing activities (by the Calabrian and Sicilian fishing fleets) on populations of *C. caretta* frequenting the marine area off the nesting beaches; d) Integrated dynamic coastal zone management for the protection of NATURA 2000 habitats (dune series) and of *C. caretta* habitats under high anthropogenic pressure; e) Produce guidelines for the management of coastal habitats; f) Adoption by the coastal municipalities of a shared Action Plan for the prompt implementation of conservation actions along the Ionian Coast of Calabria; g) Widespread dissemination of best practices for a correct use of coastal areas where *C. caretta* nests, addressed both to the local administrators and the resident population; h) Revision of Natura 2000 sites in the project area and update of Management Plans. Local administrators and citizens will be provided with adequate information and will be involved in the design of a more correct management of the beaches, coherent with the conservation needs of sea turtles and their habitats. The project will implement conservation measures aimed at the elimination or mitigation of the main threats to the target species and habitats of the project. The main interventions will be carried out in coastal areas identified as key for sea turtle nesting, where human pressure and dune habitat degradation are particularly high as well as offshore, where high numbers of turtles are incidentally captured. Finally, the project will disseminate the results and will carry out awareness campaigns targeting the local population and the economic operators working in the marine-coastal sect.

SEA TURTLE EGG HARVESTING IN GUATEMALA - IS IT SUSTAINABLE?

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Guatemala has approximately 254kms of sea turtle nesting beaches on the Pacific coast of the country, and 50kms on the Caribbean. Sea turtle conservation efforts have been carried out since the early1980's and rely heavily on the use of hatcheries where donations of 20% of each olive ridley nest are donated to a local hatchery. The rest of the nest is sold on the local market. The collection of eggs from other species is prohibited. Much has changed since the 1980s. Then, Guatemala had a population of 7 million; how it has 14 million people. Then, most beaches were sparsely populated; now most have vacation homes and hotels. Then, most residents made a living from fishing, farming and egg collection; now, tourism is the biggest employer. In the 1980s, most beaches were relatively pristine; now, there are problems with pollution and infrastructure construction, and certain beaches are unsafe. Institutionally, much has changed as well. The National Sea Turtle Strategy was elaborated in 2002. In 2013, ARCAS renewed the strategy, putting greater emphasis on the regulation of the sea turtle egg trade. The Interamerican Sea Turtle Convention has come into force, and Guatemala became a signatory in 2003. Under this Convention, Guatemala must justify its "exemption" allowing the collection and consumption of sea turtle eggs. To better regulate the egg trade and monitor the sea turtle population in general, ARCAS is carrying out crawl count surveys on 9 points along the Pacific coast. It is also conducting socioeconomic surveys to better understand the importance of sea turtles in the local economy and culture. Using this data, ARCAS produces an annual Sea Turtle Situational Analysis that is distributed to decision-makers, the press and regional counterparts. Among the principal findings of the 2014 Situational Analysis: • Olive ridley nesting density is much higher in the southeast of the country than in the southwest, with the peak area being Hawaii, followed by La Barrona and Candelaria. • There is no evidence of hawksbill nesting on the Pacific coast of Guatemala, though juveniles are caught incidentally by fishermen both in the mangrove lagoons and in the ocean. Recent years have seen the first documented nestings of Pacific green turtles (*Chelonia mydas* agassazi) and it is possible that the range of this species is shifting. Nesting of leatherbacks continues to decline, with only 0-5 nests per year. • Given this relativity in nesting density and taking into consideration crawl counts carried out in a systematic fashion in the Hawaii area since 2003, an estimated 673,304 olive ridley eggs are laid each year on the Pacific coast of Guatemala with a beach value of Q1,124, 869 or US$148.007, much lower than previous estimates. • On a national level, since 2003 conservationists in Guatemala have been able to increase the number of eggs rescued from 60,000 to almost 270,000, largely through the purchase of eggs by the private sector (hotels, eco tourists ...). In 2013 40% of eggs laid on the Pacific coast were rescued and incubated.

SEA TURTLES RESEARCH PROGRESSES IN ECUADOR: SOCIO-ECOLOGICAL APPROACHES FOR SCIENCE AND CONSERVATION

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The green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and olive ridley turtle (*Lepidochelys olivacea*) are keystone and charismatic coastal marine species, with global distributions. Although they are internationally protected species, they are still seriously threatened (IUCN Red List CR: *E. imbricata*; EN: *C. mydas*: VU: *L. olivacea*) by direct and indirect anthropogenic influences in many areas. This abstract discusses advances in the understanding of the ecology and biology for these three species in Ecuador, as well as national conservation efforts currently being undertaken to elucidate anthropogenic impacts. We are collaborating with information on green and hawksbill turtle feeding areas in the Galápagos Islands, providing knowledge on relative abundance, habitat use, standardized coastal censuses, biochemical parameters, and health assessments. In collaboration with the Galápagos National Park's (GNP), our findings will be incorporated into a new zoning plan currently being elaborated for the Galapagos Marine Reserve. Additionally, we present outcomes of sea turtle conservation and management efforts at nesting and feeding grounds in Machalilla National Park (MNP), located on the central coast of Ecuador, where a continuous, comprehensive sea turtle monitoring and protection program has been in place for approximately six years. MNP also represents the only consistent nesting ground currently known for hawksbill turtles along the Pacific coast of South America. Finally, we show the results of including the communities of coastal villages into conservation management strategies at an important nesting site for olive ridley turtles in Ecuador, at Portete Island (northern coast of Ecuador). Our findings provide baseline information that will make it possible to monitor sea turtle population sizes over time and in this sense can contribute to effective management of the taxon in Ecuador. We emphasize the need to replicate these initiatives along the entire Ecuadorian coastline, particularly in non-protected areas, as doing so will generate information that can facilitate the effective protection and management of sea turtles in Ecuador. The development of suitable conservation strategies will assist the Government of Ecuador to implement the Sea Turtles National Conservation Plan. We recognize the crucial support and collaboration of the following institutions: Galápagos National Park, Parque Nacional Machalilla, Universidad San Francisco de Quito (USFQ), Galápagos Science Center (GSC), Ecofondo Foundation, Conservation International (CI), Ministry of environment, Eastern Pacific Hawksbill initiative (ICAPO), James Cook University-Australia and Ecuador Secretary of higher education science technology and innovation (SENESCYT).

ASSESSING THE POTENTIAL IMPACTS OF SEISMIC SURVEYS ON MARINE TURTLES*

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Seismic surveying is widely used in marine geophysical oil and gas exploration, employing airguns to produce sound-waves capable of penetrating the sea floor. In recent years, concerns have been raised over the biological impacts of seismic noise, particularly for marine mammals. As such, several countries have developed statutory mitigation guidelines to minimise the potential effects upon these animals. Exploration occurs in the waters of at least fifty countries where marine turtles are present but the degree of threat posed by seismic surveys is almost entirely unknown. This is because the extent to which turtles are affected by noise, both physiologically and behaviourally, is not well understood, nor are the population level effects of entanglement with seismic equipment. To investigate this issue, a mixed-methods approach involving a systematic review, policy comparison and stakeholder analysis was employed and recommendations for future research were identified. This study found that marine turtles have been heavily neglected both in terms of research and their inclusion in mitigation policies. Although, auditory studies have found that turtles are capable of hearing the peak amplitude, low frequency sound emitted by seismic airguns, very few have examined whether this leads to auditory damage

and, if so, whether there are ecological implications for turtles. Alongside this, little information is available regarding the potential for seismic surveys to cause behavioural changes or physical damage indicating an additional knowledge gap. The policy comparison revealed that only three countries currently include turtles in their seismic mitigation guidelines and very few of the measures they specify seem to be based on scientific evidence or proven effectiveness. Opinions obtained from stakeholder groups further highlight the urgent need for directed, in-depth empirical research to better inform and develop appropriate mitigation strategies.

PRELIMINARY INVESTIGATIONS ON GIS MAPPING OF LEATHERBACK TURTLE NESTING SITES IN SOUTH AFRICA: IMPLICATIONS ON CONSERVATION AND TOURISM

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The leatherback turtle (*Dermochelys coriacea*) is an endangered species and one of the five major species of sea turtles found in South Africa, nesting and hatchling along the coastlines of South Africa in the Indian Ocean. The abundance of these species within the Wetland Parks along the Coastlines of South Africa has promoted turtle-based tourism known as turtle watching at locations where they are found nesting and hatchling from the months of October to March annually. As much as the Wetland Parks of South Africa support conservation of sea turtles, tourism activities are reported as posing great threat to turtle species at some other locations where their meats, eggs and back are exploited as food delicacy, tourists souvenir and often associated with accidental egg trampling among others. There is the need to map out the nesting sites of the leatherback turtles in these coastlines in order to curtail the negative effects of tourists' activities. This study therefore designed to map out the spatial distribution of leatherback turtle nesting sites along the coastlines of South Africa and thus establish the correlation between nesting sites and sea surface height. The Geographic Information Systems method of map creation was adopted. Longitude and latitude coordinate values of locations where the leatherback turtles are found were obtained with the aid of a satellite imagery of leatherback colonies occurrence along the coastlines of South Africa and the map of South Africa. These were saved as Microsoft Excel file and later into the ArcGIS environment. Within the ArcGIS, both the coordinates' information and the map of South Africa were juxtaposed resulting in a spatial distribution map of South Africa showing the location of leatherback turtle nesting sites. Also, maps of regions with highest and lowest colony sizes were obtained while the map of sea surface height in relation to the leatherback turtle nesting occurrence was also obtained. The spatial map of leatherback turtle nesting sites revealed a dispersed distribution and that this species is found in highest concentration along the coast of Isimangaliso in Durban with colony size of greater than 500 while the location with the lowest colony size concentration was the Western Cape with less than 20 colony size. Sea surface height was directly proportional to the concentration of the leatherback turtle colonies. Hence, this work concludes that sea surface height is a determining factor in the number of turtle nesting sites while establishing that the highest Leatherback turtle concentration site is found in Durban. The spatial distribution map created is expected to useful to conservationists in monitoring tourists' activities within the parks while serving as a template for further researches on spatial distribution pattern and factors that influence sea turtle nesting and hatchling sites in South Africa.

MARINE TURTLE NESTING BEACHES COMPARATIVE ASSESSMENT SURVEY 2013, TURKEY

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Since 1988, 21 important nesting beaches for marine turtles have been identified along the Mediterranean coast of Turkey. These are the following, starting from west to the east: Ekincik, Dalyan, Dalaman, Fethiye, Patara, Kale, Kumluca, Çirali, Tekirova, Belek, Kizilot, Demirtas, Gazipasa, Anamur, Goksu Delta, Alata, Davultepe, Kazanli, Akyatan, Yumurtalik and Samandag. In Turkey, marine turtles are under threat due to loss of nesting habitats, boat traffic/collision and bycatch. In 2003, the existing statuses of nesting beaches of marine turtles on Turkish Mediterranean coasts and the extent of threats

to these sites were assessed by WWF-Turkey with technical support from experts of universities. The assessments undertaken on the 20 nesting beaches in 2003 have shown that 64% of the beaches were in a bad condition. Although precautionary measures were required to be taken immediately, such measures have not been put in place due to the restructuring processes of the responsible organizations. WWF-Turkey has conducted an assessment study in order to reveal the current state of the 21 nesting beaches of marine turtles on the Mediterranean coasts in Turkey in 2013. The Marine Turtle Nesting Beaches Comparative Assessment Survey 2013 aimed to update the former study over the 10-year period between 2003 and 2013, and assess the impacts of conservation measures that had been taken in order to protect marine turtles nesting beaches in Turkey. It has also been targeted to put forward positive changes as well as threats that the beaches have been facing over the last 10 years. Changes in the physical condition of the nesting beaches have been assessed timely, as a result of the study. The team conducted their studies during the period of June 20-July 4, 2013. Positive and/or negative changes in marine turtle nesting beaches over the last 10 years have been assessed using an updated version of the method applied in 2003. The first phase included briefing meetings with local authorities responsible for site monitoring and conservation, academic institutions and local NGOs that have contributed to these studies. In additions of up-to-date observations, a literature review on related previous studies was completed for all beaches. The final assessment of the study was prepared by synthesizing comments of team leaders, that they stated independent of one another, on a standard evaluation form through "rapid assessment" method. The comparative assessment report 2013 emphasized increasing anthropogenic threats at a majority of the nesting sites. WWF-Turkey strives for adequate conservation of marine turtle nesting, feeding and wintering sites with effective management, as these areas are very popular for human use also and there is increasing pressure over the sites. Marine turtle nesting site monitoring studies have been conducted around the world since 1970s. There are specific standardization protocols that have been realized at national and regional levels. Therefore, results of different studies can be too incoherent to make a comparison. Also an important result of the assessment is to start establishment of a local monitoring system for nesting sites.

A COMPARATIVE MODEL FOR MALE SEA TURTLE REPRODUCTION*

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While not well studied in all species, recent research has shown that male sea turtles seem to conform to a generalized model of reproductive behavior and physiology. With some exceptions, the model includes annual or multi-annual cycles with multiple and dramatic physiological and anatomical changes, often long but sometimes minimal migrations to distinct breeding areas for mating and courtship and generalized female control of mating. Males appear to be interested in mating for up to a month while females have a defined receptive period of a few days. Male and some female competition for mounting opportunities occurs, while multiple paternity, minimal foraging during reproductive bouts, generally high clutch fertility rates and temperature-based sex determination are typical. Techniques of modern endocrinology, endoscopy, ultrasonography, electronic tracking, molecular genetics, nutrition and population modeling have advanced our understanding of the life history of males at a remarkable pace. Indeed the science of sea turtle reproduction has improved in the past 35 years to the extent that it has become a major contributor toward optimal decision making on conservation issues. Male leatherback, hawksbill and flatback sea turtles have not been well studied. An improved understanding of imprinting, migrations, sexual differentiation, age to sexual maturity, life history variations and captive care and maintenance for some of the species have surely improved the long-term prospects for sea turtle species survival. Nevertheless, the long-term threats of global climate change, poorly understood contamination challenges and continued and ever intensifying human encroachment on sea turtle habitat present many new questions in the biology of males that must be addressed.

MARINE TURTLES: A FLAGSHIP SPECIES FOR COASTAL HABITAT CONSERVATION IN NORTHERN CYPRUS

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Globally coastal zones are one of the most sensitive, fragile and threatened ecosystems. This is particularly the case throughout the Mediterranean region, where numerous anthropological related problems exist. Such problems threatening coastal zones include population expansion, uncontrolled or illegal tourism and residential developments. Although Cyprus faces several threats to its' coastal zone, most of the northern coastal dune ecosystems are protected under Turkish Cypriot

legislation. The protected coastal landscapes include the SEPA's (Special Environmental Protected Areas) of Karpaz, South Karpaz, Akdeniz and Tatlisu each receiving official legal protection in 2008. Alagadi SEPA was the first SEPA to receive official legal protection on the 25th August 1997. All the above mentioned sites have primarily been selected because of their importance as sea turtle nesting rookeries. Due to this legal protection numerous important European habitats and species have also received protection. A total of 24 different EU classified habitats and two Annex II plant species are included. Additionally, 59 animal species are included in the protection under the EU Habitats and Birds Directive, together with 31 endemic plant and 5 endemic animal species. The area of the protected terrestrial habitats total 21377.7 ha, this constitutes c. 6.4% of the total land mass of northern Cyprus. Therefore, this research underlines the importance of sea turtles in protected area designation and highlights them as one of the most important core 'units' for in situ conservation.

IN-WATER BEHAVIOUR OF THE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) UNDER THE PRESENCE OF HUMANS (HOMO SAPIENS) IN A MAJOR MEDITERRANEAN NESTING SITE

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In the greek island of Zakynthos, the peak of the loggerhead nesting and tourist season coincide (June-July), and as a result, encounters between snorkelers and turtles occur very often during these summer months. Moreover, since underwater action cameras are widely used nowadays, people are trying to approach turtles in order to photograph them more often than ever. Since energy preservation plays an important role in turtle nesting activity, it is important to have an indication of the degree of any disturbance. Furthermore, there are suggestions in the bibliography that a large-scale photo identification program can assess (additionally to traditional tagging methods) the size of the nesting as well as the local sea turtle population in Zakynthos. Since useful photographs for identification purposes are obtained more efficiently with underwater surveys, it is important to build a knowledge on how much sea turtles are disturbed by this process. We report on the behaviour of loggerhead sea turtles in Laganas bay, Zakynthos, Greece, under the presence of an underwater photographer (author) while the latter's objective is to approach them closely in order to photograph them. The author has been consistently snorkelling with and photographing loggerhead sea turtles in Laganas bay for the last 6 years (2009-2014). This report focuses on observations made during 2014 from June till September, a period that includes the peak of the nesting season in Zakynthos when nesting females can be frequently observed in the shallow parts of the bay. During the whole period, 33 snorkelling sessions were conducted that resulted in 69 encounters (51 unique individuals) and more than 12 hours and 29 minutes of total observation time. We classified the different behaviours into four categories. The responses of the turtles varied from immediate abandonment of the meeting site at a speed too high for a snorkeler to follow (category 1 - high disturbance) to indifference to human presence (category 4 - no disturbance). The intermediate categories 2 and 3 represent moderate and slight disturbance respectively. Precise descriptions of all the four categories are given and we make use of multimedia during the presentation (videos and photos) in order to define them accurately. We present the difference of distribution of the behaviours over these categories among all encounters, nesting females and resident female and male turtles (encounters well outside the nesting season). We finally present future research ideas and open questions upon which a more extensive survey of the same kind can be designed. The author would like to thank Aliki Panagopoulou and Gail Schofield for useful and stimulating discussions. He is also grateful to ARCHELON, the Sea Turtle Protection Society of Greece that gave him the opportunity to work in sea turtle conservation for the last 8 years.

COMMUNITY- BASED CONSERVATION IS A KEY TO SUCCESFUL SEA TURTLE PROTECTION IN MAIO ISLAND, CAPE VERDE

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Cape Verde has the third largest loggerhead sea turtle (*Caretta caretta*) population in the world. Within the archipelago, Maio Island is one of the three most important nesting sites for this endangered species, with approximately 500 females coming ashore to nest between June and October each year. In 2012 the island had the highest rate of killed turtles and poached nests in the country. Human predation was considered as one of the major threats here, while in contrast to other islands, Maio has not yet been influenced by touristic developments. With a total area of 269km2, Maio has important nesting beaches all along its coast. In 2013 the first year of the community-based project, the FMB teams patrolled nightly during the peak of the nesting season, from July 1 to September 30. The presence of the teams at the beaches helped to reduce poaching of turtles and nests. In addition, it made possible to collect valuable data on the nesting behaviour of the

loggerhead females to improve understanding for the better protection this species. The patrol effort of eight teams covered 20 beaches, resulting in almost 25km of protected nesting sites. As a result, just in one season the number of killed females was reduced by 75% on the protected beaches (38 in 2013) as compared to the same area the previous year (152 in 2012) and only 2% of the nests were poached. In 2014 we increased the monitoring and patrolling effort to include most of islands' nesting beaches which corresponds to 34km of beaches under regular monitoring. One of the main strengths of the strategy was to base turtle conservation teams in eight local coastal villages around the island. The teams consisted of a minimum of two local guards from Maio, a Cape Verdean team leader and national or international volunteers. The team members were hosted by local families. The integration of the teams in the local communities made the effort to protect sea turtles more visible in coastal villages while local men, women and especially the youth had opportunities to observe and participate in turtle patrols, nesting beach clean-ups and awareness raising events. The activities opened the door to the turtle world and threats these animals are facing, especially during such a vulnerable period as nesting. In addition, local host families received financial benefits for their hospitality. It seems that the combination of both practical education and turtle friendly income opportunities were key to the success of FMB's strategy.

A NEW METHOD FOR INTEGRATING LIGHT AND MARINE TURTLE HATCHLING ORIENTATION DATA

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The impact of light on marine turtle orientation has been recognised since 1911 when Hooker reported on the influence of red light on hatchling orientation. The rapid and broad scale development of coastlines frequently results in conflicting pressures on night time light conditions; the perceived health and safety need for bright lighting in coastal industrial facilities vs. the need for darkness by nesting female turtles and emerging hatchlings engaging in sea finding. Increasingly, Environmental Practitioners with responsibilities for the protection of marine turtles are required to incorporate a range of biological, physical and social data into the monitoring and management of this interaction between human and marine turtle needs. Complications around precisely and accurately measuring light, in a biologically meaningful way, together with the inherent variability in biological data have impeded the development of a tool that can be used to quickly and easily collect, process, and present data in a way that is easily interpreted and understood by both scientific and non-scientific personnel. It is the development of a new tool that is the topic of this presentation. Using raw images that are collected with a digital camera, we processed the circular images into an average isophote map which is used to identify the source of the light pollution and to quantify the area of the sky illuminated at different light intensities, measured in magnitude per arcsecond2. Using GIS, the isophote map is then subdivided into 1° segments extending from the horizon and intersecting the centre. The average pixel intensity value along each 1° segment is calculated and plotted on a 2D graph along with quantified data on hatchling orientation. The result is a figure that is intuitive, easily read and interpreted, easily updated with new data, and easily reproduced through the lifetime of a project development.

HATCHERY MANAGEMENT PRACTICES AND SEA TURTLE CONSERVATION IN SOUTH AND SOUTH-EAST ASIA*

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Sea turtle hatcheries are common in South and South-east Asia, but their management practices are relatively undescribed and unregulated. We used a mixed-methods research approach, including a literature review and interviews with hatchery managers or owners, to identify hatchery practices that are likely to contribute to sea turtle conservation and negatively impact upon hatch success and hatchling survival. We present data about hatchery construction and practices for handling, transporting and incubating eggs, and releasing and releasing and holding hatchlings in South Asia (Bangladesh, India and its territories, Pakistan, Sri Lanka) and South-east Asia (Malaysia, Myanmar, Philippines, Thailand, Vietnam). While most hatcheries aim to protect sea turtle eggs from poaching, predation, habitat loss and beach erosion or promote public awareness about sea turtle biology and conservation through ecotourism, of great concern are the low hatch success (sometimes <10%) and holding of hatchlings (up to 3 weeks) that may negate the perceived benefits. We suggest a greater understanding of events that occur during egg incubation, embryonic development and hatchling emergence is needed to ensure hatcheries employ appropriate techniques to ensure hatcheries make a positive contribution to sea turtle conservation, however, incubation of sea turtle nests in situ should be the goal of conservation and management organisations.

USING COMPUTATIONAL FLUID DYNAMICS AND FINITE VOLUME HEAT TRANSFER TO PREDICT CLIMATE CHANGE INDUCED RANGE SHIFTS OF LEATHERBACK SEA TURTLES*

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Shifting suitable range limits under global warming will threaten many species. Modeling and mapping these potential range shifts are important for conservation. For marine species that are difficult to niche map we use a novel technique using 3D digital design, animation, computational fluid dynamics, finite volume heat transfer modeling and Niche Mapper™ to find animal core temperatures and current and future distribution limits for animals of different size and potential global nest locations. We use this method to build a fundamental niche map for nesting and inter-nesting leatherback sea turtles (*Dermochelys coriacea*) of different sizes and shapes. We demonstrate the importance of body size and shape in affecting locomotion efficiency. We illustrate how the flipper motion impacts total drag and thrust requirements. We present data from the literature and from our own research testing static and swimming leatherback momentum and heat balance energetics. We show that global warming threatens leatherbacks, particularly in Southeast Asia, with overheating, especially those of large size. We also show that the impact may be less on leatherbacks that shift their nesting season or location or who are smaller. Methods such these are important to efficiently and economically produce accurate maps of regions that will become inhospitable to species under global warming conditions.

CONSERVATION OF OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) AT GODAVARI RIVER MOUTH ROOKERY OF ANDHRA COAST, BAY OF BENGAL, INDIA

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The Godavari river mouth rookery of Olive ridley sea turtle (*Lepidochelys olivacea*) is situated at 16° 17’ and 18° 30’ N longitude and 81° 30’ and 82° 37’ E latitude in Andhra Coast of Bay of Bengal, India. Incidental mortality of breeding turtles was very high due to gill nets with a frequency of 2 turtles /2 nautical mile/1 hour haul. The gill net mortality was highest (3 turtles /2 nautical mile/1 hour haul), where as purse seines recorded 0.5 turtle / 2 nautical miles /1 hour haul. Besides the nests, eggs and hatchlings are exposed to various threats on the nesting beaches from erosion and tidal inundation causing severe mortality of eggs and hatchlings during middle of incubation. Moreover predation on eggs and hatchlings by vertebrate predators like dogs, foxes, jackals and invertebrates such as shore crabs was very high on the nesting beaches. The following conservation measures and policies were adopted for protection of olive ridley breeding and nesting population, nests, eggs and hatchlings at Godavari river mouth rookery. Protection on nesting beaches: In-situ Conservation- As part of In-situ conservation, a total of 3,000 freshly laid nests were protected and hatched under natural conditions, of which the mean hatching success was between 60 and 80 % with a mean incubation time of 55 to 60 days. Ex- situ Management: A total of 1000 freshly laid nests of olive ridleys prone to erosion; inundation and predation were relocated to the protected beach hatcheries for ex-situ management. Protection to migratory turtles: Awareness and education programmes were organized in all the major fishing villages and fish landing centers at Godavari river mouth to prevent incidental mortality of breeding turtles in gill/drag nets of mechanized boats and for implementation of TED. Acknowledgements: I am very grateful to program chairs for accepting my abstract for oral presentation in 35th sea turtle symposium. I am thankful to the 35 sea turtle symposium sponsors and duly acknowledge the Ministry of Environment and Urban Planning, Turkey, The Ministry of Forests and Water affairs-Republic of Turkey, TC MUGIA, ORTACA – BELEDIYESI, Pamukkale University, Denizli, Tubital, ISSF-International sea food foundation and HILTON for their generosity in providing me travel grant award.

FEMALE BIASED HATCHLING SEX RATIO OF HATCHERY RELOCATED GREEN TURTLE EGGS

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All sea turtle species studied show temperature dependent sex determination and data in a number of cases have suggested that the sex ratio of hatchling production may be highly female biased. The pivotal temperature, defined as the constant temperature during incubation which gives 50% individuals of each sexual phenotype, is around 29°C for sea turtles with higher temperatures producing more females and lower temperatures producing males. Studies on the pivotal temperature for green turtles show variations from beach to beach. Temperatures between 26 and 29°C has been recorded for those nesting in the Great Barrier Reef whereas in Tortuguero, Costa Rica, an estimated pivotal range of 28 to 30°C has been generated. The present study estimated the hatchling sex ratio of green turtle eggs relocated in two hatcheries in Sri Lanka. Clutch size was recorded and the eggs were buried in hand dug nests of 60 to 70 cm deep depending on the number of eggs per clutch. Temperature data loggers (ibuttons) were placed inside the nests to monitor the nest temperature. Mean (± SD) temperatures were calculated for each day during the incubation period for each nest and were aggregated for the entire incubation period. The incubation period was divided into thirds. The mean temperature from the middle third of the entire incubation period was approximated to be equal to the critical period or thermo-sensitive period. Data was recovered from 17 nests with a total of 2,212 eggs from the two hatcheries. Mean temperature of the nests varied during the study period recording 37.5 °C as the highest and 26.0 °C as the lowest. Middle third of the incubation temperature which determines the sex ratio of the hatchlings varied from 29.5 - 36.0 °C. In comparison to the published studies regarding temperature dependent sex determination in this species, these data are strongly suggestive of a highly female biased hatchling sex ratio. Incubation pens in the two hatcheries are exposed to direct sunlight throughout the day. For the present study, all the eggs from a clutch were buried in one nest at a depth similar to green turtle natural nest. However, the hatchery keepers claimed that the usual practice is that the eggs of a clutch are separated into two or three batches depending on the size of the clutch and buried in separate shallower nests to increase the hatching success as they believe it prevents rotting of eggs. These shallower nests may have higher incubation temperatures which alter hatchling sex ratios skewed even more towards females. This female bias hatchling population in hatchery relocated green turtle eggs underscores the importance of educating the hatchery keepers on the importance of use of shading to minimize nest temperature which can be introduced as a management strategy to mitigate sex biased effects of temperatures at these hatcheries.

DELINEATION OF SAFE ZONES FOR SEA TURTLE NEST RELOCATION

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Nest relocation in beaches is a usual procedure in sea turtle conservation policy worldwide. The subjacent idea is to increase the probability of success by minimising the influence of potential harm factors. Among the different factors considered for nest relocation, beach dynamics related ones are the most important natural ones, especially storm-induced inundation and erosion. These hazards verify at a short-time scale (storm duration) and they can generate a drastic change in beach morphology and thus, severely disturbing the incubation environment and thereby affecting embryonic development. In spite of this importance, many relocation processes are usually based on "in situ" experience and best guess of people involved without evaluating the magnitude and extension of affecting hazards. To overcome this situation, here we propose a methodology to define safe zones for nest relocation in beaches to reduce the potential effect of storm-induced hazards. The methodology consists of assessing the potential extension of storm-induced inundation and erosion profile in probabilistic terms for the area of interest. This will be done for a given time window which is defined as the season of the year with the highest occurrence of nesting, which is determined by the sea turtle species of interest and the location of the study area. We have considered a basic window with the highest occurrence and a secondary one (broader) where less frequent observed nesting is also included. Once this period is set, the extreme probability distribution of storm-induced inundation (vertical dimension) and erosion (horizontal dimension) is calculated. This permit to know for the site of interest which is the expected extension of inundation and erosion associated to a given probability of occurrence. The final element is to provide some clues to select the "proper" probability level for the analysis. This has been done in terms of "safety levels", which we have set in 4 levels as a function of the different criteria as the conservation status of turtle

species or nesting frequency in the area. Proposed criteria are generic and can (should) be adapted according to the characteristics of the study area and specialist's knowledge. Thus, once the safety level is selected, this is transferred to a probability of occurrence for considered hazards and, from here, their magnitude is directly obtained. Finally, to project the magnitude of these hazards on the beach, a Digital Terrain Model is used, resulting in a mapping of the beach in different safety areas for nest relocation. The application of this methodology will be illustrated with a real case in the Catalan coast (NW Mediterranean), where a series of *Caretta caretta* nesting episodes occurred in recent past years. Results revealed that the method can be easily and successfully applied. To conclude, underline that even the methodology doesn't take into account other factors such as beach water table fluctuations, this tool can help specialists or technicians make scientifically-sound decisions on sea turtle nest relocation.

EXPLOITATION OF TURTLE HATCHLINGS: HOW HEADSTARTING POSES AN INCREASING PROBLEM FOR SEA TURTLE CONSERVATION IN INDONESIA

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Sea turtle hatchlings are exposed to manifold natural threats during their first stages of life. It is generally assumed that only one out of 500–1000 hatchlings will make it into maturity. Therefore, so-called headstarting initiatives have long been discussed as measures to increase survival chances amongst turtle hatchlings. Headstarting in this context means maintaining sea turtle hatchlings in captivity for several months before releasing them to the ocean. Today, headstarting is generally not considered beneficial for sea turtle conservation. However, in Indonesia headstarting is currently becoming increasingly popular. Practicing headstarting is an official policy in Indonesian nature agencies concerned with sea turtle conservation, and headstarting facilities are also founded and run by private persons, NGOs, and companies. This practice is most popular in Bali but has already spread to other islands such as Java, Sumatra, and Lombok. For various reasons, this development is alarming. There are numerous general problems with headstarting, such as interference with imprinting and navigational cues, imbalanced sex ratios, nutritional deficiencies, behavioral modifications, etc. Other problems appear more specific to the situation in Indonesia. In almost all headstarting facilities visited by and reported to the authors, virtually all turtles were infested with infectious diseases, and mortality was excessively high. This is attributed to poor maintaining conditions and low expertise in sea turtle biology. Further, there is no scientific validation of conservational benefits of headstarting measures. Finally, governmental resources allocated to headstarting programs are lost to more effective conservation measures, such as beach protection and law enforcement. Since the suffering of the hatchlings is so apparent that this method obviously can’t contribute to increased survival rates, why are headstarting facilities so popular in Indonesia? The answer is, of course, economic interests. Turtle releasing events are great tourist attractions for which tourists pay considerable amounts of money. On Bali, hotels and private headstarting facilities are known to buy turtle eggs and hatchlings from various nesting sites on Bali, Java, and elsewhere to supply the demand for turtle releasing events. Thus, headstarting has completely lost its conservational purpose and turned into a new form of unsustainable sea turtle exploitation. It is already against national law, which since 1990 has declared all sea turtles protected. But so far, governmental authorities have failed to review their guidelines for the management of sea turtles. In order to take action against sea turtle headstarting, the Indonesian NGO ProFauna and the Turtle Foundation are currently developing a two-sided approach: First, with lobbying and direct approaches through technical meetings we want to convince governmental authorities to abandon promotion and financing of headstarting. Second, with educational campaigns we want to inform local and international tourists as well as the Indonesian public about the problem, in order to discourage the business aspect of headstarting.

GREEN TURTLE REPRODUCTIVE FAILURE AT RAINE ISLAND – THE IMPACTS AND ADAPTIVE MANAGEMENT RESPONSE

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Raine Island is the nesting site for 90% of northern Great Barrier Reef green turtle population the largest remaining endangered green turtle rookery on the planet. It is in danger of collapse. Nesting and hatching failure is occurring on a grand scale. Few clutches of eggs provide offspring despite large numbers of nesting females. Climate change, through sea level rise, nesting beach sand temperature change and ocean acidification, is a major threat to the viability of Raine Island as a green turtle rookery. Inundation of the nesting area during high tides, related to sea-level rise or changes in the island's sand profile is being investigated as the major cause of hatching failure. Prior to the mid 1980's surface water had never been seen in the nesting area. Now only around 75% of the nesting area is viable due to inundation. Hatching success during the last three years has been recorded at less than 10%. Nesting success is only 20%, which necessitates repeated nesting efforts on successive nights. This effort depletes stored energy reserves and results in resorbtion of follicles. The result is fewer clutches laid in a season. The future poses even greater problems as sea level rise increases and the viable nesting area decreases. Even more alarming is the geomorphology of the island itself. The coral cay sits on a large reef system where single celled planktonic foraminefaran skeletons comprise 50% of the islands sand. These organisms are, like turtle rookeries, susceptible to the earliest facets of climate change. The acidification of ocean waters results in a reduced ability to lay down their calcareous skeleton. This in turn is predicted to turn the sand budget of the island into deficit increasing inundation and further reducing nesting and hatching success. So ... as managers of the most important site in the Great Barrier Reef World Heritage Area, what is the response? Trials are underway to re-profile the nesting area sand above inundation height to improve hatching success. Providing a more gradual slope within the nesting area to encourage more evenly distributed nesting, reduce disturbance and increase nesting success is also being investigated. The primary option being considered and trialled is to re-profile the most important sections of the nesting beach using existing island sand. A secondary option if required will investigate the provision of suitable sand from either the interior of the island or from external sites to replenish the nesting area. This should provide resilience to the population by greatly increasing hatchling production from the existing cohort of breeding age females. Long term management responses are being investigated now rather than later and include alternative rookery sites, hatchery production and continued action at Raine Island to ensure a viable nesting area keeps pace with sand loss and sea level rise.

MONITORING OF SEA TURTLES SPAWNING AND CONSERVATION ACTIONS ON ISLAND KATRACK (TRISTAO ISLANDS, REPUBLIC OF GUINEA)

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Guinea has undertaken to protect sea turtles frequenting the coasts by signing the MoU of Abidjan May, 29th 1999. Katrack is the largest Island of Tristao and Alcatraz Marine Protected Area, the border with Guinea-Bissau. Human populations are divided into several villages living mainly from subsistence farming and uncontrolled sea fishing. Many captured species, prohibited by law, are commonly consumed by very poor villagers, including sea turtles. The guards in charge for surveillance of this protected area do not have an adequate means for preventing poaching. For the first time, the monitoring of spawning area, about 20 km length of the beach, was conducted during 2013 and 2014 in spite of a very difficult logistics. During this first monitored season, the nests of *Lepidochelys olivacea* and *Chelonia mydas* were located and eggs transplanted into fenced enclosures. The distance from Conakry and difficulties to access makes the supervision very difficult for village team. We need to improve the training of the team. Parallel to this work, the supports from community activities have been started with the villages. The equipments was offered to primary school and community dispensary. The proximity of Katrack Island with Poilao Island makes this work interesting in terms of scientific knowledge and regional conservation. The consultation between this project and the traditional and religious leaders is needed.

MIGRATORY CORRIDORS AND FORAGING HOTSPOTS: CRITICAL HABITATS IDENTIFIED FOR MEDITERRANEAN GREEN TURTLES*

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Levels of sea turtle bycatch in the Mediterranean are thought to be unsustainable. We provide a comprehensive overview of adult green turtle (*Chelonia mydas*) distribution during nesting, migration and foraging phases, highlighting transitory as well as residential areas of high use in order to facilitate adequate protection for this long-lived, migratory species. Thirty-four females were satellite tracked from breeding grounds in the four countries with major nesting (Cyprus, Turkey, Israel and Syria) for a total of 8,521 (mean: 251) tracking days in a collaborative effort to summarise the most comprehensive set of distribution data thus far assembled for this species in the Mediterranean. Ten foraging grounds are identified, with two major hotspots in Libya accounting for >50% of turtles tracked to conclusive endpoints. The coastlines of Egypt and Libya contain high densities of migrating turtles following the nesting season, particularly July-September, and likely also pre-nesting (April-June). A high-use seasonal pelagic corridor running southwest from Turkey and Cyprus to Egypt is also evident, used by >50% of all tracked turtles. Bycatch levels and mortality rates for the key foraging areas and high-density seasonal pathways identified here are largely unknown, and should be investigated as a priority. We recommend that the Gulf of Sirte in Libya be explored as a potential biodiversity hotspot and considered for proposal as a marine protected area (MPA). Green turtle fidelity to nesting beaches, foraging areas and migratory pathways renders them vulnerable to localised threats but enables targeted mitigation measures and protection.

ON THE RIGHT SIDE OF THE LAW: PROTECTION OF ADULTS IN A MARINE TURTLE FISHERY

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Marine turtles are sensitive to harvesting because of life-cycle traits such as longevity and natal philopatry. The take of nesting females is of conservation concern because they are key to population maintenance and has led to global efforts to protect this life stage. In the Turks and Caicos Islands (TCI; a UK Overseas Territory in the Caribbean), previous turtle fishery legislation protected nesting turtles on the beach but not in the water, where turtles over a minimum size were subject to legal take. In a two-year study, we undertook nesting beach and in-water surveys, molecular analyses, satellite tracking and collation of fisheries landing data to investigate the populations of marine turtles in TCI and its fishery. No adult green turtles (*Chelonia mydas*) were harvested, but adult hawksbill turtles (*Eretmochelys imbricata*) were frequently taken in one of the Atlantic's largest legal and artisanal turtle fisheries. Using multiple lines of evidence, we proposed specific amendments to the fishery legislation including maximum size limits and closed seasons, which were approved by the TCI government and became law in July 2014. The new measures aim to protect breeding adults, improve the management of this fishery, and safeguard fisher livelihoods; TCI now has one of the World's most regulated turtle fisheries.

"LEGAL PROTECTION" THREATENS ONE OF THE MOST IMPORTANT NESTING HABITATS FOR *CARETTA CARETTA* IN THE MEDITERRANEAN

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ARCHELON, the Sea Turtle Protection Society of Greece, Athens, Greece

Kyparissia Bay, western Peloponnese, Greece, features the second largest loggerhead nesting habitat in the Mediterranean that includes an extensive dune system and a coastal forest. The core area, in the southernmost 9.5km of the 45km beach, concentrates about 84% of the nesting activity. In the core area ARCHELON has operated a conservation project since the early 80's and from 2006 nest numbers have been increasing with over 1000 nests recorded for the first time in 2013 and 2014. Regrettably the Ministry of Environment has not implemented protection measures for the area. Consequently, conservation issues remained unresolved which has led to degradation of habitats as well as in direct and indirect disturbances to turtles. Specifically, buildings were erected including several on sand dunes. Dirt roads were paved and bright lighting was installed. The beach of Kalo Nero village, at the southern part of the core area, is almost entirely occupied by beach furniture and light pollution is severe. In the northern part of the core area, five roads were illegally constructed perpendicular to the beach, along a 2.5km coastal zone owned by a real estate company, which resulted in the destruction of dunes. Further 47 building permits were filed, involving construction of two-storey villas with swimming pools abutting the dunes and the forest. As a consequence the European Commission initiated a procedure in March 2014 to bring Greece to the Court of Justice for violation of legislation on endangered species. In order for the Greek authorities to meet their European and international commitments, the Ministry of Environment appointed a private consultancy to prepare, by August 2014, a Presidential Decree (PD) for the conservation of the area. Unfortunately, the proposed PD proved to be more in the direction of supporting private development plans, rather than ensuring sustainable use. Indicatively, it proposes: - Designation of the area as a Regional Park, thus seriously downgrading the need for measures that are required to achieve "favourable conservation status". - Fragmentation of the habitat into a multitude of zones and introduces a medley of measures, which are vague and do not take into account nesting data and anthropogenic threats. The natural continuity and connectivity of the forest with the dunes and the beach are interrupted and the last pristine part of the habitat will be destroyed, if building is allowed as foreseen at a distance of only 5m from the dunes and 20m from the nesting zone. The PD in effect legitimizes previous building activities and permits more tourist development. It even allows 30% of the pristine part of the core to be occupied by beach furniture, where there have never been requests for such use. Further, it does not prescribe visitor management measures, especially at night in Kalo Nero, and does not mention the need for restoration of natural elements that have been damaged, such as dunes. National and international pressure is urgently required to prevent the adoption of this Presidential Decree and to ensure the protection of turtles in this most important nesting area. PT acknowledges travel support from Ministry of Environment, Ministry of Forestry, Mugla Valiligi, Mugla Buyuksehir Belediyesi, Ortaca Belediyesi, Pamukkale University, Tubitak, ISSF, Hilton Dalaman, WWF Turkey, Wildlife Computers, and the ISTS.

KEY CHARACTERISTICS OF SUCCESSFUL FISHER LEARNING EXCHANGES*

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This talk presents the results of an in-depth case study analysis that examines the key attributes of successful fisher learning exchanges (FLEs). FLEs are used worldwide to improve conservation practices in fisheries. Organized by fishers, NGOs and governments to share challenges and solutions, FLEs bring fishers together from different communities and countries to share sustainable practices. They are credited as integral in the diffusion and adoption of conservation strategies, and most notably sea turtle conservation strategies. For example, through the exchanges organized by Pro Peninsula with Mexico, Japan, and Hawaii, fishers and scientists shared solutions for reducing turtle bycatch and have since created a transpacific network aimed at protecting loggerhead turtles. Another series of exchanges organized by the Marine Research Foundation brought Malaysian fishers and government officials to TED University sponsored by the United States National Marine Fisheries Service in Southeast U.S. Through these exchanges, Malaysian fishers and managers learned about turtle excluder device (TED) construction and adoption from U.S. fishers and government officials. As a direct result of these exchanges, Malaysia's top fisheries official established a national task force for implementing a nationwide TED program. Despite their numerous perceived benefits and large investments by NGOs and agencies, no comparative studies on why exchanges are successful have been conducted until now. The objective for this study was to identify the key attributes of successful FLEs with the goal of improving their effectiveness. To determine these attributes, six successful FLES were selected from around the world that involve topics related to conservation strategies in fisheries, including the two exchanges described above. Interviews were conducted with organizers and participants of those exchanges who

attended the FLExCELL workshop. Interviews and documentation on the six exchanges (e.g. exchange itineraries, participant lists, post-exchange summaries and report, and short documentaries) were analyzed to understand the important steps and challenges that go into planning and executing a successful exchange. Informants identified participant selection as an important part of organizing an FLE, highlighting the need to select participants who are community leaders. They also stressed the need to be flexible with exchange objectives as the exchange goes on and to not underestimate the many logistical challenges associated with transporting participants to the exchange event. Site visits, presentations, talking with local fishers, and spending time on boats were identified as the most common exchange activities. Informants expressed that it is extremely important to follow-up with exchange participants after an FLE and to disseminate information about what was learned during the exchange. Using these results, more effective and efficient exchanges can be conducted to further diffuse conservation practices in fisheries around the world. Thank you to my research and conference funders: University of Washington's School of Marine and Environmental Affairs, University of Washington's College of the Environment, Ministry of Environment and Urban Planning, Republic of Turkey: The Ministry of Forestry and Water Affairs, Muğla Valiliği, T.C.Muğla Büyükşehir Belediyesi, Pamukkale University, Ortaca Belediyesi, TÜBİTAK, International Seafood Sustainability Foundation, World Wildlife Fund, Istanbul Akvaryum, Hilton Dalaman Sarigerme Resort and Spa, and Wildlife Computers.

EDUCATION, OUTREACH AND ADVOCACY

GETTING FISHERMEN TO PARTICIPATE IN THE BYCATCH PROJECT IN MOROCCO

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To evaluate the accidental capture of sea turtles in the coastal fishing fleets along the Atlantic and Mediterranean waters of Morocco, ATOMM (Association to Protect Sea Turtles in Morocco) has been collaborating with local fishermen since 2003. To encourage their collaboration, ATOMM has conducted 10 training workshops in 9 ports (Tangier, Casablanca, Agadir, Laayoune, M'diq, Martil, Oued Laou, Kaeasrass and Larache). Fishermen, port authorities, and fisheries officials were invited to these workshops, which covered the biology and conservation of sea turtles, species identification, and bycatch data collection. During the workshop, activities for the fishermen's women and children were organized, which helped create a more congenial venue for discussions and collaborations. After the workshop, interested fishermen who volunteered to assist with the bycatch data collection were provided the necessary equipment, cameras as well as phone cards to contact the project leaders regularly. Over the course of the project, the trust of the fishermen was gained through frank discussions and through regular contact with them. It was also found that the younger fishermen and/or those with higher levels of education were better collaborators. Undoubtedly, the success of the bycatch project in Morocco relies entirely on fishermen accepting the project and volunteering their help.

BREAKING DOWN BARRIERS IN SEA TURTLE EDUCATION: PASSPORT AND PASSPORT AMBASSADOR PROGRAMS REACH BROADER DEMOGRAPHICS AT LOGGERHEAD MARINELIFE CENTER*

Kerri Allen

Loggerhead Marinelife Center, Juno Beach, Florida, USA

The mission of Loggerhead Marinelife Center (LMC), a sea turtle research and rehabilitation facility in Juno Beach, Florida, is to promote conservation of Florida's coastal ecosystems with a special focus on threatened and endangered sea turtles. To help accomplish this goal, LMC offers 28 education programs at the facility, which boasts 230,000 visitors annually. Year to date, 60,151 students and adults have participated in education programming; 14,954 through public programs, 26,395 through events, and 13,802 through academic programs. Many students; however, are unable to visit LMC due to financial or geographic constraints. As a result, LMC has developed the Passport and Passport Ambassador Programs. The School District of Palm Beach County (PBC) is the 11th largest in the continental United States and the 5th largest in the state of Florida with 185 schools serving 176,724 students. Of these 185 schools, 131 are designated as Title I. To be an eligible Title I school, at least 40% of a school's students must be from families who qualify under the U.S. Census's definition of low-income; over 70% of schools in PBC serve students living at or near the poverty line. LMC's Passport Program offsets the cost of programs for Title I schools, making field trips financially feasible. Field trip

curricula are based on grade-specific curriculum objectives, and meet Next Generation Sunshine State Science Standards. The program educates students by immersing them into the marine science environment, where they explore the diversity of the ocean, discuss sea turtle anatomy, biology, and rehabilitation, and learn the ecology of coastal ecosystems. Due to the large geographic range of PBC (2,386 mi2), it is not always feasible for schools to travel to LMC; Passport Ambassador brings science directly into to the classroom through Outreaches, Virtual Field Trips, and Turtles to Go. Outreaches send LMC Education staff into classrooms, where they lead students through interactive lessons focusing on sea turtles, coastal ecosystems, and marine conservation. By the end of the lesson, students can identify the five species of sea turtles found in Florida, describe their behavior, diet, and habitat, discuss the unique geography of Southern Florida, and are eager to implement conservation-minded ideas in their own community. Virtual Field Trips allow students from around the world to journey through LMC's sea turtle hospital through the use of a free Skype account and a computer. These, live, interactive tours allows students to see patients and learn all about the work carried out at LMC's rehabilitation facility. Turtles to Go is a portable hands-on experiential learning lab, wherein teachers borrow trunks of sea turtle artifacts, lab materials (i.e., models, calipers, measuring tapes, syringes, radiographs) and ready to go lesson plans and resources. Through Passport and Passport Ambassador, LMC has been able to deliver programming to 7,865 Title I students who would not have otherwise had the opportunity to learn about sea turtles and the marine environment. Through advancing science education, these programs instill in students a sense of ocean stewardship that is felt on regional, national, and global scales.

EIGHT YEARS OF SEA TURTLE ECOTOURISM IN THE PROPOSED MARINE PARK OF MAYANGE NA ELOMBO-CAMPO (CAMEROON, WEST-AFRICA)

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For the conservation and sustainable management of the future marine park of Mayange na Elombo-Campo in southern Cameroon (West-Africa), an ecotourism program was set up in 2004 in partnership with villagers to conduct awareness-raising campaigns, and conservation through a sponsorship campaign to release captured sea turtles to sea and to create alternative sources of incomes for villagers. From 2004 to 2011 at least 693 ecotourists have been registered, coming from various continents (Europe75.90% (N= 526); Africa 9.96% (N=69); America 5.05% (N=35); Asia 1.01% (N=7) and undetermined 8.08% (N=56). The yearly distribution was:2004 =0.14% (N=1); 2005=9.81% (N=68); 2006=15.73% (N=109); 2007=9.67% (N=67); 2008=13.42% (N=93); 2009=17.17% (N=119); 2010 =16.45% (N=114) and 2011 =17.60% (N=122). The average number of arrivals per year is around 250 individuals. The activity generated more than 40,116 € (26 275 980 Frs CFA) from 2004 to 2011. Additionally, an eco-museum and eco-lodge were set up in the village in partnership with ECOFAC and Courteranges Council from France, an eco-health program was initiated, and "Turtle day" was established. Other projects in the village included electricity and water supply. All of these activities were undertaken from tourism revenues. This study suggests that ecotourism can be used in this area to support protection and conservation of this proposed protected area. To reach these goals, efforts to raise awareness, education and training of all stakeholders involved shall be encouraged.

AN OVERVIEW OF POST-GRADUATE THESIS ON MARINE TURTLES IN TURKEY

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Since the scientific researches on marine turtle are going back to the first half of 20th century, first scientific papers on marine turtles of Turkey was published by a Turkish researcher in 1982 and 1984 looks quite late. No comprehensive research was published until the end of 80's after these first papers. These papers were a preliminary research on sea turtle nesting ground in West Mediterranean coasts of Turkey. The first post graduate thesis on marine turtles was published in 1988 and after this thesis, a total of 39 theses were published to date. First doctorate thesis was published in 1997. 75% of these theses were published as master thesis and 25% were published as doctorate thesis according to the degree level. Post graduate theses were equally distributed on both nesting species of Turkey, loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*), in both master and doctorate levels. Due to the annual disperse of the theses, there was a discontinuous trend through 1988 to 2003, besides thesis were published quite regularly through 2003 to date. The mean

number of master thesis was 1.1 theses per year since 1988, and the mean number of doctorate thesis was 0.4 theses per year since 1997. Of these theses, the main research topic in master level was on population and ecology (23%) and congruently the topic of population and ecology has the highest proportion in doctorate theses with its' 50% ratio. In this study, post graduate theses published on marine turtles by researchers in Turkey were evaluated. Theses were evaluated by their types, species, topics and annual disperse. Furthermore, subjects of the thesis were evaluated in detail for doctorate degree, also effect of financial situation of the researchers on doctorate studies was utilized.

CONSERVARTE, TEACHING THE COLORFUL CONNECTION WITH NATURE. CONOCIMIENTOS VIVOS PARA COLOREAR UN MUNDO MEJOR

Barbara H. Cardoso, Antonio D. Rozada and S. Hoyt Peckham

ConservArte, La Paz, Baja California Sur, Mèxico

ConservArte´s commitment since 2011, as one of Ocean Foundation programs, has evolve into a quest to find better ways to share knowledge with kids and teachers that live on the long-establish fishing villages of Bahía Magdalena, on the western coast of the Baja California Península, a place that mixes endemic cactus, an enormous lagoon - birthplace of the Mexican Grey Whale, every winter – massive Saharan-like dunes and of course the mighty Pacific Ocean, yellow sea turtle migrating hotspot all the way to Japan. Our mission is to pamper a feeling we all share, the connection between ourselves and everything we sense around us. We refer to it as Nature, we refer to as Art. Every year we work with 4 schools, more or less 1500 primary school kids, and their teachers. ConservArte opens the possibility of connecting passionate people that want to share there live ling knowledge. Some of our talks have been about: sustainable fisheries, Apnea-scuba diving, folk music, sea turtle field experience with local fishermen, whale research in my town, permaculture, grand format painting, Dancing and more. We strongly believe that people have the responsibility to learn better ways to connect with our mother PachaMama. and that this effort could be implemented on any community where the need of cultural connection with nature is needed. We have previously implemented some of Conservarte´s features in Cocodrilo, Cuba and Kobe, Japan and would like to continue connecting with new schools and cool nerds. :)

ENVIRONMENT AND SEA TURTLE CONSERVATION WORKSHOPS FOR LOCAL COMMUNITY AT ATACAMA REGION, NORTHERN CHILE*

Juan Contardo, Emma Figari, Bojana Kuzmicic and Fernanda Norambuena

Qarapara Sea Turtles Chile NGO, Region Metropolitana, Santiago de Chile

Caldera is a coastal city situated in Atacama Region, northern Chile, approximately 71 km northward from Bahía Salado. The latter, is the southernmost foraging ground, described for the black turtle (*Chelonia mydas*, Endangered by the IUCN) in the Southeast Pacific. In this place, we also find one of the two populations of the endemic seagrass *Zostera chilensis*, which is categorized as Endangered by the IUCN. This zone is not protected by the Chilean law. Therefore, it is important to raise awareness among the local community. During 2014, Qarapara Sea Turtles Chile NGO developed environment and marine ecosystem conservation workshops, with children, fishermen and local people of the region. Sea turtles conservation, was the main topic of these activities. Workshops for children were carried out in two public elementary schools in Caldera, Villa Las Playas and Byron Gigoux James, each with 39 and 37 eight-year old children, respectively. The developed activities were called "didactic classroom workshops". These, were carried out in two sessions, which consisted in an interactive oral presentation of contents, and a practical life-experience activity. Marine ecosystems, trophic networks, ecosystem services and local threats to marine wildlife, were the topics addressed in the first session. While, sea turtles' special features, life cycle, Chilean dwelling species identification and threats, were the topics addressed in the second session. On the other hand, two workshops for fishermen were carried out at two different fishermen unions, Caleta Totoral and Caleta de Caldera, where 5 and 21 fishermen attended, respectively. These workshops, were composed of a single training session, which consisted in an interactive oral presentation of contents and a practical activity with a sea turtle puppet. The main topics reviewed in these workshops were Chilean dwelling sea turtle species identification, human interaction with sea turtles, main causes of sea turtle strandings and release of sea turtles from gillnets. Educational efforts conducted with children were relevant, because Chilean regular elementary school education program, does not include contents related with Chilean wildlife and its conservation. Environmental education and sea turtle conservation workshops, produced a positive valuation of local children and fishermen biological heritage, and a belonging feeling with their natural surroundings. Furthermore, outreach is a key component for sea turtle conservation in Northern Chile, by allowing local communities, to learn and address the most important issues related with sea turtle threats.

RESPONSIBLE PIER INITIATIVE

Tommy Cutt and Demi Fox

Loggerhead Marinelife Center, Juno Beach, FL USA

Each year, more than 250,000 sea turtles are accidentally captured, injured, or killed by U.S. fishermen, many while migrating through fishing areas. To mitigate these effects and better conserve sea turtles, Loggerhead Marinelife Center, a non-profit organization in Juno Beach, Florida, implemented the Responsible Pier Initiative (RPI) as a pilot program at the Juno Beach Fishing Pier in 2011. The RPI has since expanded to 24 piers in the State of Florida and six piers in the state of Virginia. The Initiative is designed to provide fishermen with the appropriate action steps to follow in the event a sea turtle is accidentally hooked or entangled on or around a fishing pier. The RPI consists of the following three key components: (1) "First-responder" educational signage displayed on fishing piers (2) Educational workshops conducted for fishing piers' first-responders and management (3) Underwater cleaning of the pier and surrounding areas on a regular basis (when possible). Since its establishment, the RPI has facilitated the successful rescue of multiple sea turtles and the removal of thousands of pounds of debris from areas surrounding the recognized piers. With the critical need for continued conservation measures for sea turtles in North America, Loggerhead Marinelife Center is working to expand the Responsible Pier Initiative to the remaining piers in the state of Florida, across the gulf region and along the eastern seaboard of the United States.

AWARENESS PROGRAMMES ON SEA TURTLES AND COASTAL BIODIVERSITY CONSERVATION FOR THE COASTAL COMMUNITIES IN SOUTHERN AND EASTERN COAST OF SRI LANKA

Lalith Ekanayake

Bio Conservation Society (BCS), Kandy, Sri Lanka

The green turtle, leatherback, olive ridley, loggerhead and the Hawksbill come ashore to nest on the beaches of Sri Lanka. Furthermore their feeding habitats and migratory routes located around the island. The coastal communities of Sri Lanka have to depend on their surrounding natural resources for their survival. Thus many coastal habitats and biodiversity are under the threat of extinction. The coastal communities in Sri Lanka heavily exploit sea turtle populations by egg poaching. Although turtles are protected by the Fauna and Flora protection ordinance since 1972 still the egg poaching occur most of the nesting beaches. One of the least understood and possibly most serious threats that face marine turtle populations in Sri Lanka is by-catch in fishing gears. So coastal communities must be educate about the importance of conserving the sea turtles and coastal ecosystems including various habitats such as coral reefs, mangroves, sea grass beds etc. For the last thirty years there was no any proper awareness programmes were conducted in the eastern and northern coast of Sri Lanka due to the civil war. However, the armed conflict was over and tourism and other industries booming along coastal lines. Fisherman and other coastal communities are free to access all the beaches due to removal of restrictions. Therefore, it is must to conduct a proper education and awareness programme for the coastal communities giving priority to these areas. The aims and objective of this programmes was to increase the education and awareness on sea turtle biology & conservation, legislation and law enforcement on sea turtles among the coastal communities such as fishermen, school children and other coastal resource users. During this project 48 awareness programmes was conducted in the southern and eastern coast of Sri Lanka targeting over 5,000 school kids and fisheries community members. Further educational materials and many newspaper articles were published on sea turtle and coastal ecosystem conservation in the Wijeya (Sinhalese) and Wijey (Tamil) weekly children newspapers. Altogether the message was approximately reached to about 700,000 school children and their parents through out the island. Acknowledgements: We would like to acknowledge the Rufford Foundation for the funding support and BCS volunteers for their valuable contribution to conduct these programmes. Further we would like to acknowledge the International Sea Turtle Society, travel committee and all the donors for there generous support to attend this symposium.

SOCIAL IMPACT OF THE PRESENCE OF *CARETTA CARETTA* NESTS ON THE COASTAL AREA OF TARANTO IN PUGLIA, SOUTHERN ITALY

Candida Fasano[1], Marco D'Errico[1], Fabio Millarte[1], Romina Paradies[2] and Simona Soloperto[2]

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The regular nesting of *Caretta caretta* on the western side of the Mediterranean basin clearly shows that this species is widening his nesting areas on the italian territory. After a monitoring program of the beaches, the southern coast of Ionic Calabria has been recently recognized as the most important Italian nesting area of the loggerhead sea turtle. The northern side of the Ionian coast (Puglia, Basilicata, Calabria) is potentially suitable as a nesting ground too, but in this area records of nesting are occasional, probably because a regular monitoring program of beaches is still missing. In summer 2011 and 2014 "WWF Taranto" (WWF-Ta), duly authorized by Ministry of Environment, has coordinated the supervision and permanent observation of *Caretta caretta* nesting sites founded in both cases along a part of ionian costline 300m long and located in the area of Campomarino-Maruggio, province of Taranto (Southern Italy). In 2011, 33 eggs successfully hatched on a total of 90 laid by the female loggerhead. In 2014, the nest contained more eggs (110 eggs) than the one of 2011, but unfortunately there has been no outcome, because sea storms have produced the outcrop on the surface of the eggs that were also trampled by unaware swimmers. Despite the failure of the nest, the presence of volunteers on the site has brought a number of positive effects on the territory. In this period WWF-Ta volunteers, supported by other environmental organizations (WWF Oasi Policoro, Greenrope, WWF Martina Franca) led a number of education and awareness campaigns through bathers and created positive synergies with local communities, tourists and authorities. Volunteers gave informations to help people becoming more conscious about knowledge and conservation of the Mediterranean marine environment and its sensitive species as the loggerhead sea turtle. The incrising awareness about *Caretta caretta* presence allowed an exchange with local authorities to promote and apply activities to protect the coast and its plant and animal life. Local authorities, above all the district of Maruggio gave support to the monitoring campaign through funds and infrastructures. This cooperation has promoted a three years plan including regular night patrols of the beaches in the nesting area, to ease the sighting of the female laying eggs, to early protect the nest from sea storms, to increase the awareness of people working and living near the sea and to plan enviromental education courses for schools and seasonal tourists. Overall the presence in this area of species under risk of extinction, as *Caretta caretta*, requires a careful context analysis, to prevent and estimate the extent of potential threats for nests and to develop new tourism scenarios.

EDUCATE AND EDUCATE YOUTH: ENSURE THE FUTURE

Alain Gibudi[1] and Gabriel Manga[2]

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Today conservation work is not only research or monitoring, education plays a big role. Our mission was to work with children aged 12 and 15 years old in secondary schools on conservation. Five schools and nearly 300 students participated in the program instilling a strong concern and responsibility for the marine environment. The foundation of our society addresses environmental issues with hope for tomorrow and responsibility for changing the current mentality. The goal is to peak young people's curiosity and give them a sense of responsibility to environmental problems. These young people are not only leaders of tomorrow, they are a channel of communication betweens schools, parents, and other youth. We hope the flow of information on environmental issues continues. Thus, conservation problems are borne by all of society and are not only for specialists.

THE SEA TURTLES VOLUNTEERS CAMP PROJECT REALIZED IN THE "BRANCALEONE CTS SEA TURTLES RESCUE CENTER", SOUTH CALABRIA (ITALY)*

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Associazione ambientale no-profit "Naturalmente Brancaleone", Brancaleone (RC) Italy

Worldwide Ecotourism and Volunteer Camps are adopted like a strategy to make awareness and education and to create market incentives for wildlife conservation. Naturalmente Brancaleone is a non-profit organization that manages the Brancaleone CTS Sea Turtles Rescue Center, a hospital for ill and injured sea turtles. The Center is open to the general public with an exhibit gallery and a rehabilitation area with viewable turtle patients. The Center also focuses on

environmental education and research in the general field of ecology and wildlife. In 2012 we start the Sea Turtle Volunteer Camp Project, with the aim to enrich and empower students, develop them into independent thinkers and leaders, and instill in them respect and responsibility for the environment. Volunteers must attend a short training course to be able to work safely with the animals and to provide adequate information to visitors. Daily they attend several lectures related to biology, ecology, threats and conservation of sea turtles. Roles of the volunteers are supporting the staff in the management of hospitalized turtles from the rescue to the release; take care of the turtle's nutrition and survey of physiological parameters of the animals and of water quality. Volunteers are responsible to give information to visitors and are involved in the education and awareness of fishermen and the local community. In summer 2014 thanks to a participatory approach to planning, together with volunteers, we realize 'TartaLab", a new education program dedicated to children, which was attended by about 30 children daily. As the center is located in a very important area for nature, volunteers can also enjoy ecotourism experiences, visiting the local protected areas, discovering the local wildlife and human community. Over the years the number of volunteers is increased, with 40 volunteers in 2012, 84 in 2013 and 136 in 2014 and increase also the number of international volunteers with none in 2012, 6% in 2013 and 15% in 2014. We care about the quality standards of the Camp for our volunteers and visitors. From 2013 we began a survey to assess the volunteer's expectations and the degree of satisfaction. The questions concerned how do volunteers see themselves contributing to wildlife conservation, the appreciation of the lectures, the involvement in practical activities, what they think about the ability and the organizational capacity of the staff. Volunteers consider education an essential part of their experience and value their role as educators. Also they are confident in assuming the responsibilities of the work with the turtles, considering very important their role as scientific data collectors. The results obtained indicate the success of the project. We believe that a Rescue Center must act not only for the care and rehabilitation of turtles but also to realize awareness programs and education to more levels. The example of what we are implementing demonstrates how important it is to properly plan such activities and to have qualified staff. In this presentation, some of the most significant data concerning the "Volunteer Program" and the developed activity are reported and discussed.

SKELETONS IN OUR CLOSET: SEA TURTLE SPECIMENS AT THE BERNICE PAUAHI BISHOP MUSEUM IN HAWAII

Molly Hagemann[1], George Balazs[2], Irene Nurzia Humburg[2] and Teresa Lopez[1]

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There are many advantages to natural history collections collaborating with marine turtle research and conservation programs to archive well-documented biological material. From a scientific standpoint, a diverse collection of taxonomically identified specimens located in a single institution can provide a wide variety of research opportunities without the financial and logistic costs associated with field studies. Specimen data, such as localities and collection dates, allow population, ecological, and genetic studies to be calibrated with time, which makes it possible for researchers to examine changes in populations and to track those patterns in relation to natural or human-induced changes in the environment. From an educational standpoint, donated specimens can be used during collection tours and special events to generate awareness within the non-scientific community of the challenges faced by those involved in sea turtle conservation. Bernice Pauahi Bishop Museum and NOAA's Marine Turtle Research Program (MTRP) recently partnered to archive a collection of sea turtle skeletal material, the vast majority of which was collected in the Pacific over the past three decades. This accession of 120 specimens has vastly improved the Bishop Museum's marine turtle assemblage, making it one of the world's largest and most diverse collections of sea turtles from the Pacific region. It has doubled the number of specimens of the following species: *Caretta caretta*, *Dermochelys coriacea*, and *Eretmochelys imbricata*. And it has more than doubled the number of *Chelonia mydas* specimens, bringing the count up from 49 to 125. This poster outlines the workflow used by Bishop Museum staff to catalog, house, and database this large and valuable collection of specimens. By generously donating this material to the museum, MTRP has made the specimens themselves and their data accessible to the scientific community, ensured that the specimens will be housed in excellent storage facilities in perpetuity, and provided outreach tools that the museum can use to further its educational mission and promote interest in conserving sea turtle populations around the globe.

EDUCATIONAL PROGRAM FOR SCHOOL CHILDREN IN SIRTE, LIBYA. A MESSAGE OF HOPE*

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The Libyan Seaturtle Program (Libstp) was established in 2005, to study, protect and raise public awareness on conservation of loggerhead sea turtles (*Caretta caretta*) in Libya. The last three years, due to the overall situation in the country following 2011 uprising, the program activities were almost halted. In summer 2014 as a new start of the program outreach and education activities, a group of students from nine primary schools in Sirte city were selected to conduct an in-school program of activities related to the current status and conservation of sea turtles in Libya. The program was designed and conducted with the help of teachers and the Libstp staff. Students were briefed on seaturtle species diversity and conservation activities in the Mediterranean in general and in Libya in particular. Then they were allocated to conduct one or more activities related to produce materials that can help the general public to understand and become aware of seaturtle importance in the Ecosystem. Works ranged from drawings, clay modelling and a third group have come up with a short play on turtles. The products of this activity were presented in a joint exhibition between the nine participative schools, opened for the public in Sirte city. The exhibition was an opportunity to present the message of Libyan school children of renewed hope for peace and better environment in Libya, using sea turtle as a carrier for that message. In this symposium we will present a short video on this initiative and also some samples of the students work. The future of conservation programs is embedded in the need to prepare future generation of conservationists through such activities.

EFFECTIVE AND USER-FRIENDLY PHOTO-ID SOFTWARE FOR MARINE TURTLES: AWARENESS AND SURVEY TOOL ADOPTED BY SIX COUNTRIES AROUND THE WORLD*

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There have been multiple attempts to use photography to identify sea turtles with more or less success. Photo-ID, as a research technique, offers several outcomes particularly interesting to monitor foraging sea turtle populations: it is non-intrusive, sustainable, and inexpensive. This technique also provides a useful educational tool in which the general public may be involved and strongly contribute to increase knowledge on marine turtle populations. As marine turtles remain emblematic animals worldwide, people are generally willing to participate to their conservation. TORSOOI Photo-ID recognition software was developed in that double purpose. The project, started in 2005, involves hundreds of recreational local divers who contribute to individual surveys of green and hawksbill turtles foraging around Reunion Island. More than 1,800 sightings have been reported to date leading to 350 individual identifications. The older sighting report for an individual still monitored today is about 8 years. This citizen science program also shed light on key research issues related to spatial attachment and residency patterns for both species. More recently, the software has been improved and new applications have been implemented to allow broad use of the database and to strengthen regional and international conservation efforts. Several countries joined the project around the world - South Africa, Maldives, Mayotte, French Polynesia, French West Indies, and Brazil - and are using this tool for their respective monitoring programs involving citizen scientists. At the same time, a specific tool dedicated to recreational divers has been developed, allowing them to search on their own into the database any turtle they encountered. Depending on the results of the research, they may either sponsor and name an unknown turtle or contribute to the sighting reports history of an identified individual. Citizens can support professional researchers in a lot of ways – by submitting data, sharing experiences or spreading valuable information– as they spend time in the field. Simultaneously, scientists benefit from having a lot more data to analyse. This photo-ID project is a great example of effective and operational collaboration in which scientists and citizens from around the world work together for the conservation of marine turtles.

USING COMMUNITY THEATRE TO INFLUENCE ATTITUDES TOWARDS MARINE TURTLE CONSERVATION IN TANZANIA*

Temu Pastory, Boniventure Mchomvu and Lindsey West

Sea Sense, Dar es Salaam, Tanzania

Direct take of marine turtles persists in many coastal communities in Tanzania due to poor understanding of the important role of marine turtles and other marine mega fauna in the wider marine ecosystem. In addition, weak governance systems allow turtle poachers to operate without fear of arrest, trial or sentencing, despite the presence of comprehensive national fisheries legislation protecting marine turtles and their habitats. To address these issues, Sea Sense NGO has employed the use of community theatre to create learning opportunities around marine turtle conservation issues including consumption of turtle meat, egg poaching, bycatch, marine pollution and the impact of weak governance. 'Theatre for Development' (TFD) is a form of educational entertainment that utilises the concept of peer to peer learning. Members of the community are trained as TFD 'artists' to develop skills in story-telling, role playing, singing, scripting and creation of drama pieces incorporating specific messages. Performances are staged before the targeted community and are purposefully designed to explore community perceptions towards marine turtle exploitation and stimulate dialogue about value systems related to marine turtles. Sea Sense first implemented TFD in Choba and Sange villages in Pangani District in 2011 where there were high levels of turtle meat consumption. The drama performances led to extensive community debates about the right to consume turtle meat and eventually ended in a consensus that slaughtering marine turtles damaged the very ecosystem on which community livelihoods depended. Due to this initial success, the TFD project was scaled up and has now been implemented in 19 coastal villages in four districts. TFD has contributed to some notable attitude and behavioural changes including a number of village councils taking action against turtle poachers, citizens reporting illegal fishers and demanding greater accountability from their leaders and the establishment of community fisher associations to conserve and protect marine resources. TFD is an invaluable tool for initiating discussions on issues of environmental, social and cultural concern as it attracts large audiences and provides an opportunity for all community members, including women and youth, to communicate as a large group in a participatory way. TFD performances usually spark extensive debates indicating that the issue of marine turtle conservation is quite divisive with many opposing views about the right to exploit marine turtles. Open dialogue encourages communities to find common solutions from within, which ultimately leads to greater community stewardship of natural resources including marine turtles.

HOW THE SEA TURTLE ATE MY TRASH? EDUCATING CHILDREN ABOUT THE GLOBAL IMPACT OF THE LOCAL TRASH

Camila Poli, Carlos Eduardo S. Rocha, Caroline Zwirtes and Daniela S. Schneider

Colégio Murialdo, Porto Alegre, Rio Grande do Sul, Brasil

The problems caused by the marine debris ingestion by sea turtles are widely known in the scientific world. However, there are a large number of people that ignores this fact and, obviously, do not include themselves as a part of the problem or the solution. A survey performed with 206 kids and teenagers from a school in Porto Alegre, a Brazilian capital located 95 km from the coast, confirmed this information. The results demonstrated that 73.7% respondents did not consider the trash produced in their city as a possible source of marine pollution, once the city is not located on the coast. Furthermore, 86% declared do not have any knowledge about the ecological importance of the sea turtles. Given this panorama, we selected 23 children who, during the search, proved enthusiastic about the idea of "saving the turtles" and created a multidisciplinary team in order to increase the awareness about the trash problems for these species. First we use resources like photos and videos to demonstrate the turtle's importance and the trash interaction consequences. Then, the kids received important information about their city and discovered that Porto Alegre is more connected to the coast than they thought. Across a stream that crosses the city, about 50,000 m3 of debris is taken annually by the Guaíba, a lake located on the city shores. The Guaíba waters flow into the Lagoa dos Patos, a coastal lagoon that forms an estuary. In the Lagoa dos Patos estuary there are occurrence records of *Chelonia mydas* and *Caretta caretta* species. Thus, it became very clear that the interrelation of water systems, associate with the overproduction of trash and the poor garbage disposal represents a serious threat to marine and aquatic species in general. At the end of the activities the kids were sensitized and concluded that it was necessary to rethink their attitudes and their lifestyle. To minimize the impact caused by trash, it was proposed that they applied in their daily life the five R's: Rethink, Refuse, Reduce, Reuse and Recycle. Were performed collection campaigns of recyclable trash, artistic workshops of trash reuse and diaries of consumption reduction. Through these diaries, the kids experienced the difficulty of changing consumer habits, but realized that the future of many species depends on such attitudes. When we talk to kids that we need to reduce the trash production, the words seem to have little meaning, but when we showed the trash effects to flagship species such as sea turtles, the result is amazing. Most of these kids have never seen a sea turtle up close, but now they dream of finding these animals living in a balanced environment. The next generation of environmentalists is ready and already planning to prepare a digital booklet about sea turtles preservation.

NEW BOOK: ADVANCES IN RESEARCH TECHNIQUES FOR SEA TURTLES

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Sea turtle conservation and protection initiatives have increased over the last decades. Unfortunately, anthropogenic threats –non-responsible fisheries, seawater pollution and turtle's egg and meat consumption– along with their inherent life history traits have severely precluded their healthy persistence. Moreover, for the major of sea turtle species important ecological features are poorly understood. In this vein, recently, research on sea turtles has unraveled important components of their biology, ecology and behavior using modern techniques. There are several books regarding sea turtles whose aim have been to study their biological aspects, to define the state of knowledge and conservation of some populations, to establish protocols for monitoring and to document some successful strategies for conservation issues. However, there is not a book which review the main research methodologies –scope and limitations. The present novel book "Advances in Research Techniques for Sea Turtles" aims to address the current situation on sea turtle study in order to provide key elements that can be used for conservation proposes. This work includes eight chapters about stable isotope analysis, topological tools, genetics, functional morphology, photo-identification, stranding, disease diagnosis and ecotoxicology. This publication represents an invaluable component to students, professors and researchers interested in applying those tools on studies of these animals.

FORMAL AND NON-FORMAL EXPERIENCES IN ENVIRONMENTAL EDUCATION ABOUT SEA TURTLES DEVELOPED IN THE SOUTHWEST SEA SHORE OF BUENOS AIRES PROVINCE

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The Fundación para la Recepción y Asistencia de Animales Marinos, and environmental education centre (FRAAM), is established in the coastal town Villa del Mar, Coronel Rosales district, Buenos Aires province, Argentina. The Environmental Education is the main pillar on which a varied modality of formal and non-formal experiences are sustained and fortified, including those related to the episodes of assistance and liberation of marine fauna through the calendar year. Specifically, the presence of sea turtles as a charismatic species, used as environmental topic, becomes a high value educational tool, that transcend to the species itself, showing the holistic importance of the coastal system. Understanding that on the extensive coast next to the localities of Villa del Mar, Arroyo Pareja, Punta Ancla, Pehuen Có and Monte Hermoso, public and private institutions interact, by different experiences in environmental education, FRAAM planned a series of strategies, putting together its efforts with governmental organisms to optimize human and economic resources, proposing performance nodes throughout 100 km of beach. A varied range of actions were designed, each one thought for different levels of education, including the Kindergarten, high school, adults school, special schools and university. By interactive experiences in which children and adults participated, the environmental events related to these chelonians and the wetland like part of their seasonal habitat, were used to generate conscience about the environmental value and the impacts to which they are exposed. At the same time, personnel of the Argentinean Coast Guard, Civil defense, Forest Rangers and Lifeguards were trained in the matter. During the summer season, as a pilot experience, beach campaigns were directed toward local residents and tourists who visited the mentioned coastal localities. Since July 2014, FRAAM is working together with PhD Daniel Tanzola and PhD Silvia Guagliardo at the Laboratory of Parasitology of aquatic organisms in the Universidad Nacional del Sur (Bahía Blanca, Argentina), both teachers and researchers at the U.N.S. The intention is to make coproparasitologic analysis that demonstrate the sanitary condition of the animals and infer possible trofic habitat from the identification of parasitic organisms in fecal matter. RESULTS: The Environmental Education used as learning tool in formal and non-formal education had a positive impact on the audience that was aimed to. The common denominator was the great ignorance about the presence of sea turtles in our latitude and the problems that put in risk the conservation of those species; particularly the damages caused to the animals by the incorrect disposition and final treatment of the solid urban waste, like abandoned fishing lines and hooks on the beach. All this, generated much conscience, mobilizing attitudes for personal habits change, as much in general public, students and teachers. The academic field of formal environmental education, also provided extra information to students in related fields, like natural sciences, tourism and economics. Based on the generated information, since last year, several establishments of Bahía Blanca, Villa del Mar and Punta Alta, began to work with the subject as a classroom project from the initial and primary school.

QUICK GUIDE TO THE SEA TURTLES OF MEXICO

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2. Defenders of Wildlife

Sea turtles have been swimming in the oceans of the world for more than 150 million years. The coasts and seas of Mexico are inhabited by six of the seven species of sea turtles of the world and all are classified as endangered. Baja California Sur is home to five species: leatherback, olive ridley and black that nest on its beaches and hawksbill and loggerhead that only come to feed in its waters. Sea turtles use tropical beaches for reproduction but only females come out of the sea to deposit their eggs in the sand. Survivability from hatchling to adult is very low due to natural predation and threats –direct and indirect- caused by humans. It has been estimated that only one of a thousand hatchlings will survive to reach adulthood. Sea turtles are threatened by man through consumption of their eggs, meat and oils, the use of their skin and shell for manufactured goods; direct fishing (all of them illegal in Mexico) and incidental bycatch; loss of nesting habitat by badly planned developments in coastal zones; irregular tourist activities in nesting beaches like vehicle and horse traffic on the beach; consumption of trash and pollution in the sea, among many others. This quick guide presents the illustrations of six species and one subspecies of sea turtles found in Mexico. The guide is the result of the partnership of Defenders of Wildlife, Teyeliz, A.C. with the Goverment State of Baja California Sur and the H. XI Municipality of Los Cabos, BCS through its Sea Turtle Protection Program to promote sea turtle watching and conservation in Mexico.

SEA TURTLE REHABILITATION AS AN INNOVATIVE EDUCATIONAL TOOL

Anthoula Togia, Paul Tsaros and Anna Kremezi-Margaritouli

ARCHELON, the Sea Turtle Protection Society of Greece, Athens, Greece

ARCHELON, the Sea Turtle Protection Society of Greece, operates an Environmental Education Program (EEP) since 1985, of which the main objectives are to inform, sensitize and motivate young generations towards environmental issues and nature conservation. These objectives are attained through using sea turtles as flagship species. Environmental education was implemented through visiting schools around Greece with emphasis on schools adjacent to sea turtle nesting areas. In 1994 ARCHELON established the Sea Turtle Rescue Center (RC) in Glyfada, Athens, where injured turtles from all over Greece were admitted for rehabilitation. As the Rescue Center expanded, some of its facilities were adapted to accommodate school visits and it gradually became the focal area for EEP, with school visits being replaced by on site presentations, guided tours and activities. This move increased the number of schools participating in the EEP because it was combined with the students' opportunity to observe living turtles swimming in tanks. This provides a unique opportunity to explain the conservation problems sea turtles face and to further increase their environmental awareness through discussions and participation in various activities. Currently, the EEP is designed to address pre-school children and students up to 15 years of age and its program is adapted to achieve maximum assimilation of information and inducing appropriate attitudes depending on the participants' age group. The number of school visits at the RC showed an increasing trend over the recent years. Indicatively, in the 2009-2010 school year there were 8,713 participants, in 2010-2011 there were 9,160 participants, and 10,396 participants in 2011-2012. The recent increase of school visits at the RC can be explained by the fact that teachers and students are becoming gradually more conscious on environmental issues and that the school curriculum promotes such outdoor activities. The increased interest provided the opportunity to use innovative approaches like introducing a new interactive slide show, "Peoples' Earth", which focuses on people's attitudes towards nature, the importance of biodiversity, and discusses solutions to environmental problems. This presentation was turned into a theatrical play in cooperation with certain schools and soon it became an important tool in experiential learning. ARCHELON's EEP also uses key calendar days like the World Turtle Day (23 May) as an occasion to invite teachers, students, and parents to participate in special activities organized by a contributing school so as to promote environmental awareness beyond typical school methods through entertainment and team games like "Relocating a nest", "Simulating volunteer work", "Interactions with fishers". Finally, it is widely accepted that we cannot influence the new generations if the people responsible for their education are not properly trained in environmental issues and nature conservation. Therefore ARCHELON organizes annual seminars for teachers who have expressed an interest in participating. As a result, the environmental education work at the RC have accomplished better the EEP's objectives with the assistance of an endangered species which could be observed on site. We thank all students, teachers and parents that participated in the EEP as well as the ARCHELON volunteers. PT acknowledges travel support from Ministry of Environment, Ministry of Forestry, Mugla Valiligi, Mugla Buyuksehir Belediyesi, Ortaca Belediyesi, Pamukkale University, Tubitak, ISSF, Hilton Dalaman, WWF Turkey, Wildlife Computers, and the International Sea Turtle Society.

TEAMING UP WITH NBA STAR YAO MING TO RAISE PUBLIC AWARENESS FOR SEA TURTLE CONSERVATION

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The NBA basketball superstar turned environmentalist Yao Ming has consistently ranked #1 on the Forbes China Celebrity 100 list, and thus his public influence in raising awareness for sea turtle conservation can be tremendous, as China remains the top consumer of endangered turtles worldwide. While sea turtles are iconic species in the ocean environment, the 2.29 meter (7 feet 6 inches) tall Chinese basketball legend Yao Ming is a national icon in China. His high profile status has led him to many honorary roles, such as representing China as the flag bearer in the 2004 and 2008 Olympic Games. Yao Ming is also the Goodwill Ambassador to the United Nations Environment Programme (UNEP) and to many cities, including the U.S. city of Houston, where the mayor has given him the key to the city. Through his international fame, Yao Ming has been a leading voice in China to end the market for illegal wildlife products by campaigning for the ban of elephant ivory, rhino horn, and shark fin soup with the renowned public service message: "When the buying stops, the killing can too." His public opposition to wildlife products has greatly changed the attitudes of people who once consumed endangered species in China. For example, survey reports have estimated that sales in shark fin soup have declined by 70% since 2012 when he started the campaign. In 2014, Yao Ming joined Sea Turtles 911 to release rescued marine turtles back to their ocean home, setting a good example as a public role model. Later that year, Sea Turtles 911 presented educational lessons on marine turtle conservation to Yao Ming, where he also spoke out against sea turtle products to the Chinese public by highlighting the importance of healthy sea turtle populations in the marine ecosystem. Yao Ming's recent support for sea turtle conservation opens a giant door of opportunities for raising awareness on behalf of the international sea turtle community. Thus, drafting Yao Ming to the sea turtle conservation team in China serves as a catalyst for other organizations around the world to leverage his fame to save sea turtles together globally.

FISHERIES AND THREATS

NEW OBSERVATIONS OF SEA TURTLE TRADE IN ALEXANDRIA, EGYPT

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The Mediterranean coast of Egypt, though of minor importance in terms of nesting levels, is considered to host potentially important foraging grounds. Among other threats to sea turtles in Egypt, the trade of sea turtles for consumption is known at least since 1970s, especially in Alexandria. Since 1993 MEDASSET has monitored the turtle trade and carried out awareness and advocacy campaigns that led to law enforcement and conservation initiatives to stop the trade. The current survey is a follow-up of the last study that was conducted in 2007, which was prior to the Egyptian revolution in 2011 that may have had an impact on the trade e.g. in terms of law enforcement due to institutional challenges. Visits were made to Alexandria's public markets in September 2014 – March 2015 in order to record the current status of the trade. Interviews conducted at the markets aimed to track the trade from fisherman to seller and consumer and provide insight into attitudes and perceptions. The survey reveals that there is black market trade as well as public trade of both loggerhead (*Caretta caretta*) and green turtles (*Chelonia mydas*) in open-air markets. Turtles are sourced from fishermen who mostly catch them incidentally, though there are reports of intentional capture at sea. They are mainly sold by fishmongers for consumption of their meat and/or blood. Sale of turtle shells was observed in decoration shops that sell other marine species shells, and in spice and medicinal plant shops. Despite existing laws and previous conservation efforts of governmental authorities and non-governmental organisations, the trade continues mainly due to lack of enforcement measures, low awareness, traditions and poverty. Awareness campaigns and law enforcement at the fishery, market and consumer level is needed to change behaviours and halt the trade. The survey results and recommendations are being communicated to the relevant Egyptian authorities. Acknowledgements: SA thanks the co-authors and MEDASSET for providing guidance and advice on the survey design and implementation, and the ISTS for providing a travel grant to attend the 35th Annual Symposium on Sea Turtle Biology and Conservation. MEDASSET thanks SA for his enthusiasm and dedication as a volunteer, without which this citizen-science survey would not have been possible.

ASSESSING THE EFFECTS OF TIRE RUTS ON THE BEACH DISPERSAL OF HATCHLING LOGGERHEAD SEA TURTLES IN BOA VISTA ISLAND, CAPE VERDE

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Cape Verde archipelago houses the third most important loggerhead sea turtle (*Caretta caretta*) rookery around the world, and the largest loggerhead nesting colony in Africa. Loggerhead females in Boa Vista Island have been largely studied during the last fifteen years, but little attention has been paid on hatchling sea turtles. The time they spent on their way to the sea is crucial for avoiding predators and ensure their survival. Threats like tire ruts on the beach may increase this time and, consequently, reduce survival rates. Although driving vehicles (e.g. quads, 4x4, off-road vehicles) on beaches are forbidden in Cape Verde, tire ruts on sand can be found and they are increasing due to the tourism development. In order to know the features of tire ruts in the island, we carried out a census on several beaches, writing down the number of tire ruts, depth and width, as well as the distance between one track and the following one. Taking account these results, we designed and carried out a field test with five treatments along 15 meters of beach: 1) 14 tracks, 2.5 cm depth 2) 19 tracks, 4 cm depth 3) 20 tracks, 8.5 cm depth 4) control; and 5) management (pave the sand with a rake). The time spent to finish each treatment was registered (n=152). We found significant effects of treatment on time spent, taking into account turtle size and nest. The generalized linear models (GLMs) showed that turtles spent more time on treatments with more tracks and depth. Our results suggested that the use of vehicles on the beach have an effect on the hatchling dispersion. These findings highlight the importance of beach management and the promotion of a sustainable development in Cape Verde Islands. We gratefully acknowledge travel support from international donors and sponsors provided through the Symposium Travel Committee, Marine Turtle Conservation Fund (MTCF) – US Fisheries and Wildlife Service (NOAA, EE.UU) for funding the camps, and volunteers who collaborated collecting data.

BLAST INJURY AND SEA TURTLES

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Sea turtles are under many threats. Underwater blast injuries are one of those risks to sea turtles as for other aquatic animals. Shock-wave pressures in column from explosions can have adverse impacts on nearby submerged structures and on aquatic life. Most of the reports on blast injuries in sea turtles are post mortem reports with comparison to lesions in human beings. To the the best of our knowledge this is the first report on live turtles that underwent blast injury including computed tomography images. Case History: During December 2012 and January 2013, eight turtles (seven loggerhead turtles and one green turtle) were found along the sea shore in different locations. On physical examination there were almost no reflexes. Bloody secretions were observed in one turtle during expiration. Blood results showed no anaemia, normal to high glucose but elevated CK. Following initial treatment, they were scanned by a dual slice helical CT (CT-Twin Flash, Elscint, ISRAEL) in the Veterinary Teaching Hospital. Pulmonary infiltration was observed in all turtles representing pulmonary haemorrhage with different severity. Emphysematotic bullae was observed in one case. Middle ears with different amount of fluids were observed in those turtles. Free celomic fluid was found as well. Unfortunately two turtles died after a few days. Those individuals had the most severe pulmonary findings. Post mortem findings included pulmonary haemorrhage with bleeding and necrotic tissue in the main bronchi. Free celomic blood with blood clot was found in one as well as pericardial effusion. Conclusion: Very little information exists regarding the impacts of underwater explosions on sea turtles. These effects of explosions on turtles often must be inferred from documented effects to other vertebrates, including humans, marine mammals, and fish with lungs or other gas-containing organs. However, impacts to these other vertebrates may not be reliably extrapolated to sea turtles (VIADA *et al*., 2008). Injury resulting from PBI is almost totally limited to gas-containing organs. For sea turtles, this would be primarily the auditory system and lungs

(GERACI and AUBIN, 1985). Severe injuries, even if not fatal, would probably put the animal at increased risk of depredation, secondary infection, or disease. In our collection of cases we found pulmonary haemorrhage in all of the turtles with fluid fill tympanic bullae in most of the turtles. Although computed tomography is not as sensitive as MRI in detection of brain lesion, we suspect that brain injuries are also a serious result in the case of underwater explosions in sea turtles.

UNSUSTAINABLE BYCATCH OF LEATHERBACK TURTLES IN PERUVIAN FISHERIES*

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From December 2013 to November 2014, a combination of onboard and shore-based observers (including self-reporting vessels) monitored for fishery interactions with leatherback turtles. At-sea monitoring was conducted from driftnet vessels from San Jose and Salaverry in northern Peru and shore-based monitoring occurred in San Andres and Lagunillas in central Peru. In this one-year period, 31 leatherbacks were captured of which 13 died. Interactions were most common from Jun to November with 22 bycatch events. Bycatch of 20 leatherbacks (5 dead) were from driftnet vessels from San Jose. It is also noteworthy that all the vessels monitored in Salaverry recorded bycatch of leatherbacks. Bycatch was often very near to the coast, as little as 2.5km offshore. Biometric examination was only possible for some of these animals. The mean CCL was 125.1 ± 14.8 (range: 103.3 to 150.0; n = 9), indicating that interactions are primarily with juveniles and sub-adults. Of additional concern, at least one of the beachcast animals from San Andres was butchered, indicating that even animals that may be caught alive are at risk. Given the rapid decline in nesting of eastern Pacific leatherbacks it is likely that captures and mortality of this magnitude are unsustainable. Moreover, the monitoring effort reported here is of only a small fraction of the approximately 3000 net vessels operating along the Peru coast, suggesting that the actual catch and mortality of leatherbacks is considerably higher. Efforts to mitigate this bycatch are urgently needed. Measures being tested or considered include net illumination to reduce bycatch, net patrolling to enhance safe release, time-area closures, extensive education campaigns, and increased and enhanced regulation and enforcement. There is also a clear need to expand coverage of those fleets operating throughout the SEP, and, at the minimum, determine levels of known fishery mortality, to allow for more accurate estimates of population viability and to better direct regional conservation and management efforts.

PARTICIPATORY APPROACH TO ADDRESSING RESOURCE USE CONFLICTS OF NESTING, BREEDING AND FORAGING HABITATS ASSOCIATED WITH TURTLES NESTING ON MASIRAH ISLAND, SULTANATE OF OMAN

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Surveys of loggerhead turtles nesting on Masirah island were initiated in 1977 and the island is considered to be the largest aggregation of nesting females in the Indian Ocean and among the two largest rookeries in the world. The surveys estimated 20-40,000 females to be nesting on the island. Further studies of beaches revealed the importance of the island to nesting of three other species including green, olive Ridley and hawksbill turtles. In 2006 the development of a multi-faceted inter agency programme was initiated on the island, with the objective of involving the community of the island to engage in conservation efforts through training of local rangers and environmental support staff within the ministry and national NGO, ESO. Field seasons between 2008 and 2013 to study loggerhead nesting beaches were preceded by community wide outreach activities communicating the global importance of turtle resources on the island, and followed up by reporting on the findings of the field studies within schools and to local officials. Having identified fisheries as a central feature of the islands economy and the interaction of related artisanal activities both on beaches and at sea, the programme was expanded to formulate participatory approach to resource use assessment. Further training was provided to document beach

use activities and conduct stranding surveys of beach cast cetacean and turtle species. Informed by additional resource use activities, local stakeholders and national management agencies were engaged to work within a steering committee to guide a 'Sea Turtle Conservation and Sustainable Fishing Project'. With assistance of fisheries and community engagement experts the committee implemented a community wide survey of the artisanal fisheries sector through interview based methodology to establish spatial and temporal characteristics of fishing effort and identify areas where turtles were encountered with active fishing areas. Resulting data enabled mapping of conflict areas on beaches and at sea, and relative levels of bycatch to be evaluated for the four nesting species of turtles associated with the islands. Data was enhanced by overlaying spatial components of mapped interview data with nesting densities obtained from beach surveys and habitat utilization inferred by satellite telemetry projects of three species including loggerheads, olive ridleys and hawksbills. Within the participatory process findings were reported back to the steering committee. The panel was tasked with reviewing subsequent action based on priority evaluation. As work in progress, this feedback review process is expected to direct where research efforts should be targeted for the next stage of the programme and to provide a consensus of management interventions to be made to support future conservation and socio-economic development of the community.

ASSESSING IMPACTS OF CLIMATE CHANGE ON SEA TURTLE NESTING SITES: DISTRIBUTION SHIFTS AND CONSERVATION NEEDS FOR THE MEDITERRANEAN LOGGERHEAD POPULATION

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While female sea turtles come ashore to nest and climate conditions of nesting sites are of critical importance for species viability, climate change poses several threats, probably affecting the suitability of nesting areas. Hence, investigating the adaptive capacity of sea turtles to cope with climate change, and planning conservation strategies in response to changing conditions are considered to be research questions of top priority. In the present study we made an attempt to assess the future climatic suitability of the main nesting sites of the loggerhead sea turtles in the Mediterranean basin, to identify future conservation value of areas that are sporadically used for nesting, and to determine potential favorable sites where future research and priorities of conservation should be target based on plausible range expansions. We initially developed climate suitability maps based on the distribution of the main nesting areas of loggerhead sea turtles (*Caretta caretta*) in the Mediterranean, under current climatic conditions. We used Maximum entropy approach to model nesting sites distribution, using climatic variables extracted from WorldClim database, representing seasonal trends and limiting environmental factors regarding temperature and precipitation. The produced maps were used to evaluate the climatic suitability of sites subjected to sporadic nesting. In order to predict future range shifts in nesting distribution and to evaluate differentiations between patterns of current and future favorable sites under changing climatic conditions, we projected the model onto 2070 climate predictions. To capture for the phenological shifts in the nesting activity that has been reported for the species, future models were also developed by shifting the length of the climatic data used as inputs. We found that overall climatic suitability of the main nesting sites in the Mediterranean will significantly drop within by 2070. In contrast, a significant improvement in climatic conditions is expected for these sites that currently host only a limited number of nesting activities. Although, changes in suitability of the main nesting sites will not occur at a given pattern, the more suitable sporadic sites are expected to be favored by future climate. Our study shows that areas which are currently of a high conservation interest for hosting nesting activities of the endangered loggerhead sea turtles will not necessarily support favorable conditions in the near future. Our study suggests that the increased evidence on the use of sporadic sites by the species could reflect an adaptation regime against climate change. The outputs generated by this study could serve as a guide map for prioritizing research at potential sites and establishing new conservation priorities.The study is conducted in the context of the project "Common plans for the Conservation of Biodiversity under the prism of climate change", co- Financed by the European Union and the Greek State, Ministry of Education and Religious Affairs / General Secretariat for Research and Technology (O. P. Competitiveness & Entrepreneurship (EPAN II), ROP Macedonia - Thrace, ROP Crete and Aegean Islands, ROP Thessaly - Mainland Greece - Epirus, ROP Attica) and the Scientific and Technological Research Council of Turkey (113Z437).

EDUCATIONAL TRAINING FOR FISHERMEN, A BASIC TOOL TO REDUCE SEA TURTLE BYCATCH IN THE SOUTHEASTERN MEDITERRANEAN

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Scientific studies have confirmed high turtle bycatch rates in the Western Mediterranean Sea, with drifting longlines and bottom trawl nets as the fishing gears with the highest impact on sea turtle populations in Spanish Northern Mediterranean waters. Although it is expected that these are also the fishing gears with the highest impact in Southern Spain, an area identified as critical for sea turtles, there is poor current data on the number of turtle captures per unit effort, total annual mortality and percentage of post-capture mortality. Different research centres and conservation organizations are currently studying this situation (with fishermen questionnaires and on-board observer surveys) to assess sea turtle bycatch in the area, and management plans to reduce sea turtle mortality based in these data are expected to continue for a long-term period. In this context, while management plans are not yet being applied, the best way to reduce sea turtle bycatch is the direct implication of the fishermen community. Thus, we designed an Educational Programme, funded by the Spanish Government and the European Fisheries Fund, to train fishermen on the best on-board practices to reduce post-capture mortality, and to raise awareness on the importance of sea turtles and all marine biodiversity. We conducted training talks for fishermen in most coastal towns of Southern Spanish coast (between Cartagena and Huelva, along over 600 km), in collaboration with fishermen associations and the Andalusia regional government, teaching more than 200 fishermen. The educational contents included basic concepts such as the best way to haul a captured turtle on board, how to calm the animal down, highlight the need to cut any fishing line or net before releasing the turtle and even included different ways on how to extract hooks. Moreover, the programme included the distribution of special equipment to extract hooks or cut fishing lines among long-line fishermen. A parallel project is currently also distributing holding tanks in most fishing harbours to help fishers bring back injured turtles to rescue centres. Finally, a DVD with all the information has been published to reach all the Spanish fishing fleet, which will also be used as an educational resource for any organization or professionals interested in the conservation of marine biodiversity (from Administration to NGOs and all citizens). The consequences of this Educational Training Programme and its benefits for sea turtle populations in the Southern Mediterranean have still not been evaluated, although the implication of fishermen is already a real success of this programme.

IMPACT OF POLLUTION ON MARINE TURTLES (*C. CARETTA* AND *D. CORIACEA*) IN NW OF MOROCCO

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The Kingdom of Morocco straddles the Mediterranean and Atlantic Ocean with a coastline of 3,446 km. In Morocco, the two most common sea turtle species are loggerheads (*Caretta caretta*) and leatherbacks (*Dermochelys coriacea*). The impact of marine pollution on marine turtles *Caretta caretta* and *Dermochelys coriacea* were collected from studies of the stomacal contents of these species. Analyses of stomacal contents of 20 *Caretta* (24cm < Curved Carapace Lengh < 80,3cm) and 3 DC (102cm < CCL < 115cm) stranded on NW coast of Morocco showed the presence of organic prey in the intestines of all individuals (mainly crustaceans, molluscs and fish for Carretta and crustaceans for DC). 16 individuals of CC (80 %) and DC (33 %) were fed in addition to the inorganic debris. They are of various kinds: fragments of wood (3/19 individuals or 15.7 %), hydrocarbons (1/19 alive individual or 5.26%), plastic materials (9/19 individuals, or 47.3%) and fish net (10/19 individuals, or 62.5%). The external and internal (stomacal contents) examination of these 23 sea turtles examined showed that pollution could be among the causes of the strandngs of these animals in North West Morocco. Underwater videos confirm the presence of abundant plastic on the coast of Morocco. Sea turtles swallow plastic probably mistaking them for jellyfish.

AN INCREASING TREND ON THE INTERACTION BETWEEN LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) AND MARINE LITTER IN SARDINIA (WESTERN MEDITERRANEAN SEA)

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In the last fifty years, there have been many changes in the oceans, but one of the most important is the presence and accumulation of anthropogenic debris on the sea surface. Plastic debris in the marine environment affects many species that accidentally ingest it. Sea turtles may ingest plastic bags mistaken for jellyfishes when they feed in neritic and pelagic habitats. Plastic fragments and other anthropogenic materials may be directly responsible for the obstruction of digestive tracts and the death of sea turtles. Furthermore, long retention times of plastic debris in the intestine may cause the release of toxic chemicals (e.g. phthalates, PCBs) that may act as endocrine disruptors and therefore can compromise the fitness of individuals. The aim of this study is to evaluate the amount and composition of marine litter ingested by sea turtles in Sardinia and to monitor the trend of interaction for the Western Mediterranean area. In the last 7 years, a total of 137 *Caretta caretta* were monitored and litter in faecal pellets of live individuals (n=101) and in gastro-intestinal contents of dead ones (n=36) was categorized, counted and weighed. Twenty-four of the 137 (17.51%) monitored turtles presented debris in their digestive tracts. Frequency of Occurrence (FO) of plastic debris in the sample of 2008 (n=40) was 2.5%, in 2009 and 2010 (n=45) increased to 4.44%, and from 2011 to 2014 (n=52) the percentage of sea turtles affected by plastic corresponded to 40.38%. This study highlighted the incidence of litter also in live turtles and improved the knowledge about marine litter interactions of *Caretta caretta*. Even if the Marine Strategy Framework Directive (MSFD) has been issued in 2008, and even if EU has banned the production of non-recyclable plastic bags from the 1st January 2010, we highlight an increasing trend in marine litter ingestion by sea turtles, mainly constituted by plastic bags items (USE-sheet). These results strongly support the decision of Western Mediterranean countries to adopt *Caretta caretta* as a bio-indicator of marine litter pollution, an important goal that allows data in all the study area to be standardized. The outcomes of this study contribute also for the Marine Strategy implementation and in pushing for the adoption of common management and control measures for all the European and Extra-European countries, in order to reach a Good Environmental Status for Marine Litter pollution in the Mediterranean.

SEA TURTLE BY-CATCH IN THE INDUSTRIAL TRAWLING FISHERY OF GABON*

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Gabon hosts nesting grounds for several sea turtle species, such as leatherback turtles (*Dermochelys coriacea*), with the largest population worldwide, as well as for olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*). Hence, Gabonese waters represent inter-nesting and likely mating areas for adult turtles and also support foraging areas for juveniles and adults of some of these species. The suspected high numbers of sea turtles occurring in these waters are subject to incidental catch by small-scale and industrial fishing, especially trawling, and possible associated mortalities are a cause for concern. Turtle excluder devices (TEDs) are used by shrimp trawlers, which represent a minor part of the fleet. A monitoring program was launched with onboard observers on industrial trawlers, in order to collect, among others, sea turtle by-catch data. We report on a survey conducted over 281 fishing days by 15

trawlers in the period 2012-2013, providing species composition, size/life stage, catch rates, a likely order of magnitude of the total by-catch level for the Gabonese trawling fishery, and proximate mortality rates. Further monitoring is needed in order to improve estimates and to consider changes in fishing areas, partly due to recent increased levels of marine protection.

CONSISTENCY OF THE GENETIC MAKE-UP OF INCIDENTALLY CAUGHT LOGGERHEAD TURTLES ACROSS FISHING GEARS IN MIXED FORAGING GROUNDS IN THE MEDITERRANEAN SEA

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Fishery interactions represent an important threat for sea turtles and there is a growing interest to understand the effects of bycatch on wild populations. Different types of fishing gear used in mixed foraging grounds have been suggested to differentially impact turtles from different populations. This is not only because different fishing gears differ in bycatch and mortality rates but also because vulnerability to fishing gears varies depending on the patterns of habitat use of turtles across populations. For this reason, neritic fishing gears in the Mediterranean Sea have been proposed to capture primarily loggerhead turtles of Mediterranean origin whereas drifting longlines in the same region have been proposed to capture primarily turtles of Atlantic origin. To assess whether this hypothesis holds true we analysed the genetic make-up of turtle bycatch from drifting longlines and bottom trawling/trammel nets in three different regions (eastern mainland Spain, southern Balearic Islands and southern Italy). We have analysed 176 incidentally caught juvenile loggerhead turtles in these three areas with genetic (mitochondrial and nuclear DNA) markers. No genetic differences were found between turtles caught with drifting longlines and bottom trawling/trammel nets within any of the three regions. However, genetic differences were detected among regions, regardless of the fishing gear. Accordingly, the population make-up of loggerhead turtle bycatch depends on the area where the fishing operations are conducted but not on the fishing gear used. This highlights the need for detailed knowledge on turtle distribution in the ocean to understand the impact of bycatch and to assess whether this affects the smaller and more vulnerable populations.

SEA TURTLES AND BYCATCH IN NORTHERN CHILE: THE NEED TO CREATE MANAGEMENT STRATEGIES THAT ENGAGE THE ARTISANAL FISHERIES*

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Five species of sea turtles have been described in Chile, where *Chelonia mydas* (Black turtle) is one of the most common. In northern Chile, around six foraging grounds have been identified for this endangered species. One of them is Bahía Salado (27°41`08``S; 71°00`32``W), located in the Atacama Desert (Atacama Region), and where bycatch in artisanal fisheries is a potential threat for these turtles. However, few studies have covered this topic in Chile and no studies have been developed in this region. In May 2014, we performed semi-structured interviews with 53 fishermen from seven (of 9) fishing coves present in this area. The objective of this study was to determine if there are interactions between artisanal fisheries and sea turtles in the area, and to determine the level of knowledge of fishermen about sea turtles and their importance in the marine environment. Our results showed that 47 fishermen have detected turtles in the area, most of them (n=34) indicating that even though turtles might be observed year-round, summer is the season with highest

abundance. Furthermore, a high proportion of fishermen (n=36) indicated there has been an important decline in sighting of turtles during the last 10 years. Twenty-nine fishermen identified the presence of black turtles as the most common specie in Atacama and 16 recognized seaweed and seagrasses as the main source of their diet. In relation to bycatch, 26 people declared to have had turtle bycatch with gillnets, from those 18 turtles were released alive, and 8 died in the nets. The species with more interactions with artisanal fisherman were black turtles. Furthermore, 33 fishermen mentioned the consumption of turtle meat, and 22 mentioned the selling of carapaces when the turtles were found dead in the nets. Twelve fishermen said that turtles generate losses of time (releasing turtles) and 9 indicated economic losses (nets ruptures). Although the interviewed fishermen did not show clarity about the role of turtles in the marine ecosystem, 48 people declared their importance as a component of local biodiversity and 17 fishermen mentioned that turtles arrived to the Chilean coast to feed. Furthermore, 50 people indicated that it is necessary to protect them (n=42 are interested in participate in workshops related with this issue). Our results show that bycatch is occurring in the area, and that the knowledge on sea turtles by fishermen is low, a situation that is triggering, death of some individuals, and economic losses on fishermen. However, these local communities are motivated to learn about these species and look for alternatives to protect them and coexist. This situation highlights the need to formulate an action plan for these events that engage the local fishermen and develop educational campaigns including basic aspect of these species, and techniques for fisherman to facilitate the release of turtles from the nets in order to decrease the conflict and losses.

TURNING THE TIDE: CONVERTING ARTISANAL FISHERMEN TO SEA TURTLE CONSERVATIONISTS IN WESTERN GHANA

Neil Davis

Wildseas/Bahari Karuna - Sea turtle and shark conservation

Over the last 4 years Bahari Karuna, a WILDSEAS project, has been working closely with local fishermen in the Western Ghanaian fishing port of Axim, the land of 1000 canoes. Through the hard work of local community liason officers we have had great success in changing the behaviour of local fishermen, who would usually catch and kill turtles along with their normal quarry of fish and sharks. With education and support given to the fishing community Bahari Karuna succeeded in gaining the help and support of over 150 fishermen. Incentives such as giving out all weather gear, fisrst aid kits and emergency lights once the fishermen signed agreements to not kill turtles has proved extremely fruitful. These fishermen have now become a major part of our tag and release program and have received training on turtle identification and on how to take biometric data. Most of the turtles are now released at sea or brought back to shore to be tagged by local coordinators and then released immediately. The numbers are increasing year on year and so far we have recorded 4 species of both sexes, the most common being olive ridley, followed by green, leatherback and the occasional loggerhead.

WHY DO TURTLES INGEST PLASTICS?: CREATION OF A NOVEL CLASSIFICATION METHOD

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Plastic pollution is now widespread in the marine environment. The ingestion of such plastic pollution by sea turtles is now a global phenomenon, causing a number of harmful lethal and sub-lethal effects such as obstruction, dilution and decreased physical health. Plastics may also be carriers of persistent organic pollutants (POP's) or polychlorinated biphenyls (PCB's) which may sorb onto the surface of these ingested plastics. However current outlined classification methods on ingested plastic fragments are lacking in detail on key features such as colour and dimensions. Sea turtles are primarily visual feeders, the ability to discriminate between colour and shape being shown to play a role in feeding choices. Monitoring these aspects in plastics may offer insight into why or if turtles are selectively ingesting them. Furthermore having 3D measurements may aid in calculations of surface area for sorbed contaminants. Here is a proposed new classification method for ingested plastics found within stranded sea turtles within the Mediterranean, using data from stranded green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles from Northern Cyprus. Building upon methods outlined in the MSFD's "Monitoring Guidance for Marine Litter in European Seas" and the Fulmar protocol data on dimensions, 3D shape and colour of plastic fragments is proposed to be added to number, type and weight recordings. This classification method will aid in building a more detailed picture of the individual plastic fragments being ingested. Allowing for modelling of selectivity and the investigation into differences due to life stage, diet or species. A clear and ubiquitous classification method will provide unity within data collection on plastic ingestion allowing to basin wide analysis leading more effective to conservation and management recommendations.

FISHERMEN ATTITUDINAL SURVEY TO ASSESS SEA TURTLE BY-CATCH IN GULF OF MANNAR, NORTHWEST, SRI LANKA

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Of the seven species of sea turtles in the world, five come ashore to nest in Sri Lanka. Furthermore, their feeding habitats and migratory routes are located around the island. Sea turtles are protected in Sri Lanka under government legislation since 1972 by Fauna and Flora Protection Ordinance. But, still there are many threats that occur including turtle egg poaching, killing for meat etc. One of the least understood and possibly most serious threats that marine turtle populations face in Sri Lanka is by-catch in fishing gears. A survey conducted in 2009 reported that 45% of the villagers at Kandakkuliya (Kalpitiya area) had recently consumed turtle meat. Recent interviews conducted with fishermen in Kandakkuliya confirmed (November 2014) that still turtle by-catch and eating turtle meat occurs in Kalpitiya area. Some fishermen are willing to rescue the entangled turtles while some do not. There was a fishing restriction in some areas of the island during the civil war. However, the armed conflict was over and tourism, fishing and other industries are booming along the coastline. The purpose of this study is to assess the current status of sea turtle by-catch in the North-Western coast of Sri Lanka from Chilaw to Kalpitiya. This is a ongoing study initiated in October 2014 and will be conducted until March 2015 during the flying fish season which causes more olive ridley turtle by-catch and mortality. The study includes a fishermen attitudinal survey on sea turtle by-catch and also a beach survey (to visually assess the abundance and distribution of dead turtles / discarded shells on beaches) from Kalpitiya to Chilaw area. The attitudinal survey includes collection of information about traditional knowledge and fishermen experiences to trial some solution to reduce turtle by-catch as long-term sustainability for both turtles and fishermen. The data and research findings generated by the project will be used by Bio Conservation Society (BCS) to further the implementation of the "Marine Turtle Conservation Strategy and Action plan for Sri Lanka (2005)", in particular for the conservation of sea turtle population and mitigate turtle by-catch. Furthermore, the results will be submitted to the Department of Wildlife Conservation Sri Lanka for long term policy planning. Acknowledgements: We would like to acknowledge the Prince Bernhard Nature Fund for the funding support and BCS volunteers for their valuable contribution to conduct these programmes. Further we would like to acknowledge the International Sea Turtle Society, travel committee and all the donors for there generous support to attend this symposium.

MARINE DEBRIS PRESENCE IN LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) FROM THE CENTRAL TYRRHENIAN SEA

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One of the most important threats for the marine environments is the accumulation of marine debris in the oceans, product of intense human activities and inappropriate waste management. In this context sea turtles have become one of the most threatened groups of marine vertebrates by the proliferation of marine debris, due to their ecological and biological characteristics. This study evaluates the quantity and composition of marine debris ingested by loggerhead sea turtles (*Caretta caretta*) in the coasts of the Campania region, Italy during the period of 2010-2011. Marine debris were present in 11 out of 21 individuals, representing the 52.3% of specimens, and were classified following the guidelines of the "Marine Strategy Framework Directive Protocol for the monitoring of litter ingested by sea turtles (*Caretta caretta*)". *User Plastics* (USE) was the most prevalent category of ingested debris with a weight of 18.03 g (94.4%) from the 127 items (94.78%) found; in terms of number of items observed the most frequent subcategory was *sheet* (she) with 65 items (48.51%) and in the case of weight the most observed subcategory was *fragments* (fra) with 9.02 g (47.26%). The results contribute to the knowledge about marine debris interaction with loggerhead turtles and underline the importance of this species as a good bio-indicator of marine debris presence within the Marine Strategy Framework Directive (MSFD) of the European Union. A special thanks to the Mexican Council of Science and Technology (CONACYT), without whose support this work would not have been completed. The opportunity to present this work is thanks to the support of the 35th Annual Symposium on Sea Turtle Biology and Conservation as well as the sponsors of the event.

PROPOSING A FRAMEWORK FOR ASSESSING RESILIENCE TO CLIMATE CHANGE: A CASE STUDY OF MARINE TURTLES IN BOA VISTA ISLAND (CAPE VERDE)*

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The future persistence of biodiversity is likely to be affected by global climate change. We propose a qualitative framework for assessing the resilience of marine turtle species to climate change, incorporating current and likely future breeding success, the availability of temporal and spatial climate refugia, the effect of future sea-level rise, behavioural plasticity and the level of other specific threats. We test this framework using one of the world's largest nesting rookeries of loggerhead sea turtles (*Caretta caretta*) in the island of Boa Vista (Republic of Cape Verde, West Africa). We measured air, sand and nest temperatures across more than 50 km of nesting habitat and four years to model the likely sex ratios produced and predicted what future sex ratios might be under one conservative future climate change scenario (B1). We assessed the relative threat of sea-level rise, and other threats including beachfront construction, pollution and human harvest as well as to estimate the level of foraging behaviour plasticity observed for this population. Sex ratio over the study period was 79.15% female and while an increase of 2 ºC air temperature would lead to 99.86% female production, incubation temperature is unlikely to be lethal even in the hottest part of the year. Only half the total suitable length of coastline is currently used for nesting and there is a size-linked dichotomy in foraging strategies of loggerhead turtles of both sexes. Under our qualitative framework, we make the surprising observation that this population of conservation concern should have remarkable resilience to climate change due to some unique features of their habitat use and preferences. This may be compromised by high levels of human harvest and planned and on-going coastal development.

BYCATCH ON JAPANESE POUND NET FISHERY (TEICHIAMI) AND ITS MITIGATION MEASURES*

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Bycatch and mortality of sea turtles in Japan's coastal fisheries is an obstacle to the recovery of sea turtle populations. In particular, sea turtle bycatch in coastal Japanese teichiami fishery are a concern. Teichiami is a kind of set nets and generic term of a huge variety of pound nets, fyke nets and many other trap nets with leader net. Teichiami are configured in multiple ways, with one configuration that has underwater traps and another that has traps open to the water's surface. Recent observations compared sea turtle capture and mortality rates between open versus closed traps. During the 5-year monitoring period, a total of 1487 sea turtles composed of 907 loggerhead, 533 green, 6 leatherback were caught in the observed teichiami traps. Sea turtle mortality rates in the open traps ranged from 0% to 3%. In contrast, mortality rates in the closed traps ranged from 65% to 96%. Over the last 4 years, our research group has developed several turtle escape systems (TESs) for these closed underwater teichiami. In collaboration with fishermen, sea turtle biologists, government officers, net manufacturers, and other industry members, workshops were held to develop, test, and refine these TESs. Our TES designs use only net fabric and short ropes so that Japanese fishermen can easily manufacture them with inexpensive materials already available to them. Based on the characteristics of the materials, we call our devices "soft TES". The basic concept of soft TES are: 1) sea turtles can escape by themselves, 2) fishes remain in the fish trap, 3) soft and simple design that does not disturb fishing and maintenance, 4) developing multiple TES designs to provide fishermen with options based on their particular needs and 5) low expense. TESs are attached to the roof of teichiami to enable turtle escape when they come up to breathe. The top four TESs, named static tube, double tube, corner flap, and tunnel flap, out of 26 prototypes were designed in 4 workshops held from 2009 to 2013. The 4 TESs were tested 12 times each and quantified the number of escape attempts and mean interaction time. All of the turtles involved the trials were able to escape from the static tube, double tube, and corner flap, and 75% of the turtles escaped from the tunnel flap. In addition to testing turtle escape rates, target fish retention trials were conducted using juvenile yellowtail. In a total of 48 trials, none of the fish escaped from the teichiami trap during a TES trial series. In contrast, target fish escaped from the teichiami traps during control trials

without a TES in place, suggesting that TESs are capable of retaining target fish. In 2014, these TESs tested in 10 days of field trials on a commercial teichiami operation. Using underwater video systems placed next to the TES to show how the TES responded to water currents and also monitored fish escape. Video analysis showed that no fish escape and confirmed the practical application in a commercial setting.

INTERACTION OF MARINE TURTLES WITH TRAMMEL NETS IN THE GULF OF GABES (TUNISIA)

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Sea turtle by-catch data in the Mediterranean indicate high number of captures reaching about 150000 per year, with more than 40000 incidental deaths per year, while many others are killed intentionally. Small vessels using set net, demersal longline or pelagic longline represent most of the Mediterranean fleet and likely cause more incidental or intentional deaths than large vessels typically using bottom trawl or pelagic longline. In Tunisia, the studies to date have considered benthic trawls, longlines and gillnets mainly in the gulf of Gabès, a wintering and foraging ground in the Mediterranean for the loggerhead turtles. They showed also a high level of interaction. In order to complete these studies and to have a more comprehensive view on the interaction with different fishing gears in the area, we assessed the level of the interaction of trammel net with loggerhead. We conducted specific interviews in two big ports in the area, that of Sfax and Chebba. The interviews concerned 20 boats from the two ports in 2013. Results show a very important interaction with a catch rate estimated at 3.71 turtle by boat by year and a total catch estimated at 24334 turtles/year for all the fleet operating in the zone. Mortality is estimated at 0.11 turtle/year corresponding to a total mortality of 2676 turtles/years.

RESULTS OF SEVEN YEARS OF FOLLOW UP OF MARINE TURTLE STRANDINGS IN THE GULF OF GABES (TUNISIA)

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The National Stranding Network of turtles and cetacean was launched in 2004. Part of the work was focused in the research of the turtles stranded along the southeastern Tunisian coast (the Gulf of Gabes). For each stranding, we registered mainly morphometric data and the condition of the specimen and we collected the gut contents and the epibiotic flora and fauna for later identification. We also took samples of tissue for genetic and toxicological analyses, and performed post-mortem examinations to determine the cause of the death. This work provides Results of seven years of follow up of marine turtle strandings in the Gulf of Gabes (southern Tunisia) from 2004 to 2010. We analyzed a total of 583 sea turtles have stranded in the Gulf of Gabes. Of this total, approximately 98 % were loggerheads, 2 % were green turtles, and 2% were leatherbacks. Analyses of data reflect spatial and seasonal patterns of strandings with annual variations according to mainly fishery activities. Documented causes for strandings of loggerheads include: boat collisions (2%), fisheries interactions (4%), marine debris (0.5%) and shark attacks (0.5%). Nearly 93% of sea turtle strandings were due to undetermined causes. The notch-tip Curved Carapace Length CCLn-t indicates that the majority of the stranded individuals were sub-adults. According to the stomachs and intestinal tracts of sampled animals *Caretta caretta* seems to use both neritic and oceanic habitats. The occurrence of tag recoveries and epibiont species recorded may ultimately help to clarify certain questions about sea loggerheads movements and confirm the importance of the Gulf of Gabes for the loggerhead turtles in the Mediterranean Sea. I would like to thank the Sea turtle Society, the Sea turtle Symposium and all the organizations for the Travel Grant that have helped my participation in the ists35th in Dalaman, Muğla, Turkey.

250-YEAR RECONSTRUCTIONS OF INCUBATION TEMPERATURES: PREDICTING CLIMATE CHANGE IMPACTS ON THE VIABILITY OF MARINE TURTLE POPULATIONS*

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Climate change challenges conservation efforts worldwide. Different aspects of climate change are affecting sea turtle populations across the globe. For example, rising sea levels are putting nesting beaches at risk of being lost and this could push local turtle populations over the brink unless new suitable nesting beaches are found. Moreover, rising temperatures are an obvious problem for a species with temperature-dependent sex determination where warmer incubation temperatures produce female hatchlings. A warming world would thus cause a female-bias in sea turtle populations. Our research aims to identify the environmental factors that drive the incubation temperatures of sea turtle nests in a changing world. We focus our research on two study sites, the Cape Verde Islands (North Atlantic) and Sint Eustatius (West Indies). The Cape Verde Islands are a globally important loggerhead rookery. We combined in situ sand temperature measurements with air temperature records since 1850 and predicted warming scenarios from the Intergovernmental Panel on Climate Change to derive 250-year time series of incubation temperatures, hatchling sex ratios, and operational sex ratios. We estimate that light-coloured beaches currently produce 70.10% females whereas dark-coloured beaches produce 93.46% females. Despite increasingly female skewed sex ratios, entire feminization of this population is not imminent. Rising temperatures increase the number of breeding females and hence the natural rate of population growth. For many rookeries, as we found in our study, rainfall is minimal during the incubation season and so does not compromise the strong relationships between sand and air temperatures. But at some sites (including Sint Eustatius) rainfall is important in influencing incubation temperatures. In a warming world it is not just temperature that may change but also other components of the climate (for example, rainfall or hurricane frequency) and so there needs to be continued consideration of the suite of environmental conditions that ultimately drive sand temperatures. We are currently improving our model by incorporating a range of different environmental variables. We are able to assess which of the variables are most important in driving incubation temperatures and estimate how incubation temperatures will vary in the future based on the most recent climate predictions. Predicting climate change impacts across hatchlings, male-female breeding ratios and nesting numbers provides a holistic approach to assessing the conservation concerns for sea turtles in a warming world. These approaches are being used to assess risks of extinction for sea turtles across the globe. Jacques-Olivier Laloë would like to thank Hilton and Wildlife Computers for their generous support concerning conference attendance.

CLIMATE CHANGE VULNERABILITY OF MARINE TURTLES NESTING IN VANUATU*

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The South Pacific Island archipelago of Vanuatu has nesting rookeries of Leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and hawksbill (*Eretomochelys imbricata*) marine turtles. These three species sometimes nest on the same or adjacent beaches allowing a comparison of their vulnerability to climate change related threats. Examination of data from beach monitoring collected by "Vanua-Tai" community resource monitors give an initial indication of how vulnerability to climate change affects the three species differently and in doing so directs priority areas for further research and monitoring. Two rookery areas are examined. Votlo, Epi Island is a long four km black sand beach. It is the major nesting beach for leatherback turtles in Vanuatu with as many as 40 nests being recorded in one year, both green turtles and hawksbill turtles also nest along this beach. The second nesting rockery is Bamboo Bay on the west coast of Malekula Island in which a number of separate nesting beaches occur that range from a two km black sand beach to smaller white sand and coral rubble beaches. Green and hawksbill turtles nest on these beaches but are generally spatially segregated among the beach types. Nesting beach data includes nest location by beach sector, date of nesting, number of nests that hatched, and hatching rate of the hatched nests, along with additional spatial surveys of the nest locations. Preliminary analysis suggests that leatherbacks and green turtle nests may be the most vulnerable to climate change threats such as increased storms and sea level rise, and increased temperature. While hawksbill nests may be more resilient to climate change threats but they are more vulnerable to anthropomorphic related dog depredation. In light of this preliminary data analysis the addition of the following parameters to the current nest monitoring protocol: beach and nesting temperature; nest depth; and the spatial relationship of nests to high tide and beach morphology; would allow further exploration of

these issues. A high priority strategy for mitigating the effect of climate change on leatherback turtles is reforestation of the foreshore on the nesting beach on Epi to increase beach stabilisation and lower sand temperature.

MASSIVE SEA TURTLE EGG MORTALITY DUE TO FREQUENT EXTREME HIDE TIDES IN THE IMPORTANT LOGGERHEAD ROOKERY OF CAPE VERDE

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All global warming scenarios predict the rise of sea levels and increasing storm frequency as well as intensity. These environmental changes will most probably increase the impact of beach flooding on sea turtle nests. Flat beaches are especially vulnerable to flooding due to extremely high tides. In the important loggerhead turtle rookery of Cape Verde, more than 60 % of nests are concentrated in the Reserva Natural das Tartarugas (Boa Vista Island, Cape Verde). This protected area is also a RAMSAR site, with wide wetlands immediately adjacent behind the beaches. Most of the nesting beaches have very small slopes and extreme high tides that frequently inundate them during the nesting season. On these flat beaches an average of 8,000 loggerhead nests are laid every season. Previous studies have shown a high nest mortality in this area. We studied the impact of extreme high tides on turtle egg mortality on a 5 km sector of these beaches during the 2013 and 2014 nesting seasons. Nesting season in Cape Verde starts in mid-June and extends until mid-October. During 2013, a total of 2,400 nests were laid in the 5km study area and the average nest mortality was 73.5%. However, there was a strong variability in mortality throughout the season. An extreme inundation occurred in the second week of August, coinciding with the midpoint of the nesting season. Mean nest mortality before the extreme high tide was 92.3%. The vast majority of nests died before the beach inundation. However, the survival of loggerhead nests significantly increased after the inundation. Mean mortality during the second half of the nesting season was of 52.8%. A similar pattern was observed during the 2014 nesting season. A total of 1,400 nests were laid in the study area and the average nest mortality during the entire season was 79.2%. In this year the extreme high tides that inundated the nesting beaches occurred in the third week of August. The mean mortality of nests laid before the beach inundation was 88.3%. The first nests laid early in the season had already hatched by then, thus slightly increasing survival compared to 2013. Nests laid after the beach inundation had an average morality of 56.6%. The main cause of nest mortality after the beach flooding in both study seasons was due to depredation by ghost crabs (Ocypode cursor). Given the fact that beach inundation is a common event during the summer in this important and at-risk loggerhead rookery, the relocation of nests to safe locations is recommended in order to increase productivity, and thus contribute to the recovery of this loggerhead RMU which is the nesting site for one of the 11 world's most endangered sea turtle populations. Predictions of sea level rise severely threaten the viability of this important loggerhead rookery.

ASSESSMENT OF SEA TURTLE BYCATCH IN CAPE VERDE USING QUESTIONAIRES TO FISHERMEN

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Artisanal fishery bycatch on sea turtles has received an increasing amount of attention in recent years due to the high impact it causes on these species. This type of fishery operates mainly in developing countries where it very often comprises the basis of the fishing sector, where enforcement capabilities and protective measures are limited and where many remote landing ports are difficult to access. To quantify the threat it presents to sea turtles, an intensive study was conducted in all the main ports and fishing communities of the island of Santiago and Fogo and in the entirety of artisanal ports of the islands of São Vicente, São Nicolau, Sal, Boa Vista and Maio in the Cabo Verde Archipelago (West African region) from 2011 to 2014 during the sea turtle nesting season which begins at the end of May and extends until October. The study was done by visiting the ports and conducting questionnaires on the fishermen who work there. All questionnaires included mostly closed questions and were carried out by marine biologists with previous training for this study. Illustrations of sea turtles were used for species identification. This effort has provided the first characterization of fisheries in the Cabo Verde Archipelago and has managed to reveal the widespread impact of artisanal fisheries on sea turtle bycatch and poaching. A total of 683 fishermen surveys were filled and the information provided suggests that for

the Cabo Verde Islands the annual number of sea turtles by-caught in artisanal fisheries is 1.3 turtles/boat/year. Considering the census of artisanal fishing boats in the Archipelago, more than 2000 sea turtles could be caught per year, with 52% of all poached turtles detected on Santiago Island. 227 fishermen (33.2 %) identified among turtle species on their by-catch. The 80.6% of fishermen had captured loggerheads (*Caretta caretta*), 28.2 had captured greens (*Chelonia mydas*), 7.9 % had captured leatherbacks (*Dermochelys coriacea*), 14.5 % had captured hawksbills (*Eretmochelys imbricata*) and only 3.5 % had captured olive ridleys (*Lepidochelys olivacea*). It is possible that the capture of sea turtles occurs throughout the year, however more captures are produced from June to September (92%). Recommended measures to reduce sea turtle capture in the Cabo Verde coastal areas include: revising current legislation for fisheries, the supervision and control of landings especially in the most remote ports of the Archipelago, and awareness-raising activities in fishing communities. Cabo Verde Archipelago harbors the largest loggerhead turtle rookery in the Eastern Atlantic and constitutes an important foraging habitat for juvenile hawksbill and green turtles in the region. We consider it a huge responsibility, and it is entirely up to us, to protect these species throughout the region.

LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) AS BIOLOGICAL INDICATOR FOR IMPACT OF MARINE LITTER IN MEDITERRANEAN SEA

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Marine litter is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. It means that items that have been made or used by people and directly or indirectly discarded into the sea with rivers, sewage, storm water or winds, or accidentally lost at sea, are Marine Litter. Plastic items are the most abundant type of anthropogenic debris on a global scale and plastic is also the most frequently reported material in encounters between debris and marine organisms. The European Commission developed the 2008/56/EC Marine Strategy Framework Directive with the aim to achieve a Good Environmental Status, and Marine Litter has been chosen as Descriptor 10, analogous consideration has been made in the Barcelona Convention for the protection of the Mediterranean Sea. In the Northern sea, *Fulmarus glacialis* (Linnaeus, 1761), has been chosen as a biological indicator to evaluate marine environmental status, with the aim to reach the state in which not more than 10% of stranded *Fulmars* have more than 0,1g of plastic in their stomachs. An Italian network has been created to find and test a biological indicator for litter in the Mediterranean Sea and the loggerhead sea turtle *Caretta caretta* (Linnaeus, 1758) has been chosen as indicator species. In order to obtain the maximum results, a consortium of Public Research Institutes, Universities, Regional Environmental Agencies and Veterinary Public Health Institutes, has been established since 2012. In this work we analyze litter impact on biota, testing the protocol adopted in the MSFD for stranded sea turtles. The categorization of marine litter is derived from OSPAR methodology, implemented and adapted to the Mediterranean Sea. From 2011 to 2014, 102 dead sea turtles were collected from the Italian west coast and stomach contents were analyzed from 9 animals from Sardinia, 17 from Tuscany, 28 from Lazio and 48 from Campania. Sea turtle carapaces ranging from 21cm CCL to 82.7cm CCL with an average of 60.62 cm CCL and presence of marine litter was investigated using the same protocol (Litter in Biota) for necropsies and lab analysis. The collected items were subdivided into the main categories (Industrial plastic; User plastic; Non-plastic rubbish, Pollutant), frequency of occurrence was calculated on the entire sample showing local diversity (62.5% Campania; 92.8% Lazio; 88.23% Tuscany; 62.5% Sardinia). Number of items subdivided in color categories, showed significant abundance of transparent items followed by white and black items.

AN ASSESSMENT OF MARINE TURTLE BY CATCH IN THE TUNA GILLNET FISHERIES OF PAKISTAN*

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Gillnets are commonly employed to capture tuna in Pakistani waters.This fleet consists of about 500 tuna gillnetters that operate in the offshore waters of Pakistan and beyond its EEZ. Limited information was previously available on the incidence of bycatch associated with tuna gillnet operations in this region. In order to assess the extent of turtle bycatch in gillnet operations, four observers were posted onboard tuna gillnet vessels to document catch composition over a period of 15 months which included collection of data throughout the year covering the 2013 nesting season. A very high incidence rate of turtle entanglement was observed in the tuna gillnet operations among which 2.5 % of the turtles entangled died. The olive ridley (*Lepidochelys olivacea*) turtle was observed to be the most dominant entangled species followed by the green turtle (*Chelonia mydas*). Both species of marine turtles are protected under the Sindh Wildlife Act. Interestingly, no olive ridley turtle nesting was observed along the coast of Pakistan for the duration of this study, but the high capture rate of about 24,600 indicates a large population exists in this area. To address this issue, an awareness campaign was initiated by WWF-Pakistan which entailed training fishermen how to safely disentangle and release turtles. Thus far, this program has proven successful with most turtles carefully removed from the gillnets and released at sea.

THE COLLABORATIVE FISHERIES RESEARCH SESSION, ISTS NEW ORLEANS 2014

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The capture of marine turtles in fisheries is one of the most significant threats to marine turtles (MT) today. Every year hundreds of thousands of MT die through bycatch in fishing gear worldwide. Today scientists and conservationists have learned that one of the best ways to find solutions that both reduce MT bycatch and maintain the livelihoods of fishers is by working together. At the 2014 ISTS meeting in New Orleans Louisiana (LA) a special capacity-building training session on how to achieve such solutions through the Collaborative Fisheries Research (CFR) method was sponsored, organized and offered by Virginia Sea Grant and WWF. This session was designed to: • introduce and connect well-established scientist working on different MT bycatch issues all over the world to up and coming scientist. • develop general research questions pertaining to of MT bycatch and longlines, trawls, gillnets, time/area management and human dimensions • develop an address book of MT bycatch scientist for the ISTS • share fishing industry perspectives, improve CFR skills and capacity, enhance professional CFR mentoring networks, and foster new CFR projects. The training consisted of two parts, an open morning plenary session and a closed afternoon working session. The working session was over subscribed, illustrating the immense interest among the MT community in how to work constructively with the fishing community on bycatch reduction issues. In the morning, leading practitioners and academics in the field of fisheries, science, bycatch and the collaborative approach discussed research on the CFR method and provided examples of conservation achievements that have been realized in partnership with the fishing industry—innovations that have benefited MT and also sea birds, marine mammals and people. The afternoon working session focused on how MT scientist, in all regions of the world wishing to engage in MT bycatch solutions, can develop constructive working relationship with fishermen. The afternoon included a facilitated working lunch, four presentations and a panel. Participants were encouraged to share lessons learned, concerns, and questions on CFR projects that illustrate different degrees of collaborations. During the panel, five shrimp boat captains from four US states along with two long time shrimping experts shared their individual perceptions on TED use and on what is appealing or disagreeable about working with scientists. They offered insight for researchers to consider when working with the fishing industry to reduce MT bycatch. Additional data from surveys conducted prior to the training session are being analyzed and will be presented, including data on the breadth of CFR experience among the MT community, attitudes toward CFR, capacity-building needs, and other lessons learned. The session sponsors, VASG and WWF, hope that additional capacity-building training sessions can be offered at future ISTS meetings.

INGESTION OF MARINE DEBRIS BY LOGGERHEAD SEA TURTLES, *CARETTA CARETTA*, IN PORTUGUESE CONTINENTAL WATERS

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The accumulation of marine debris in marine and coastal environments is a major threat to marine life. Sea turtles may be impacted by marine debris in various ways, but all fall under two main categories: entanglement and from ingestion. The loggerhead sea turtle, *Caretta caretta*, seems to be one of the two sea turtle species that ingest more marine debris, in all its life stages, most likely because of its habitat and feeding behavior. The aim of this study is to evaluate the quantity and composition of marine debris in the gastrointestinal tract of stranded dead loggerhead sea turtles found along Portuguese continental waters between 2010 and 2013. We analyzed the gastrointestinal tract of 95 loggerhead sea turtles (range of curved carapace length, CCL: 25.5 – 75.5 cm) and marine debris was present in 55 individuals (57.9%). A total of 869 pieces of debris were found, corresponding to a dry weight of 132.92g. For most of the individuals, total items found ranged between 1 and 10 items (52.7%), and total dry weight was lower than 5 g (89.1%). User plastics was the main category of ingested debris with a frequency of occurrence of 90.9%, while sheet (78.2%) and thread (40%) where the most relevant sub-categories. No significant correlations were found between CCL and the number or dry weight of marine debris items. This study reveals for the first time the presence of marine debris in the digestive tracts of sea turtles in Portuguese continental coast. Plastic, in particular sheet plastic, was the most reported, probably due to its higher abundance at sea compared with other types of debris and to its particular suspending pattern and associated resemblance to jellyfish. Although the frequency of occurrence of marine debris was significant, the amount of debris found was small in the majority of sea turtles. This fact, associated with the lack of apparent lethal effects related to debris ingestion suggested that this, in most cases, was not the main cause of death. However, sub-lethal effects of marine debris in sea turtles such as dietary dilution, disruption in energy metabolism or absorption of toxins, cannot be ruled out. These results highlight the use of loggerhead sea turtles as a suitable bio-indicator to measure trends in marine litter, especially to monitor the efficiency of the mitigation measures proposed in the Marine Strategy Framework Directive (MSFD) of European Union.

MARINE DEBRIS: AN IMPORTANT IMPACT ON MARINE LIFE ADJACENT TO A WORLD HERITAGE SITE IN SOUTHERN BRAZIL

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Marine debris is any kind of manufactured product that is inappropriately discarded and pollutes the oceanic and coastal zones, being a threat to the marine fauna. They cause death by asphyxia and lesions to the marine animals due to its ingestion or changing the animals' buoyancy and their chance to be caught by fishing nets. Paraná coast is 100 km length, are composed by two estuaries and comprises a port, intensely urbanized areas and commercial fisheries along the year. All these activities threaten the animals. Conversely, 80% of its area is composed by conservation units and it is a nursery or core feeding area for endangered species such as fishes, birds, turtles and dolphins (*Pontoporia blaivillei*, *Epinephelus itajara* and *Chelonia mydas*). Since August 2013, beach monitoring have been made twice a month, along 5km at the mouth of an estuarine complex, a biodiversity hotspot and a world heritage site. This area was divided into 5 linear transects (1000 × 2 m each or 10 km2). Marine debris between 2 and 20 cm of size are frequently ingested by marine animals and only items between this size were registered. They were separated by type: in simple and rigid plastic, ribbons, nylon, straws, balloons, fishery debris and others; and by color also: black, white, transparent and other colors. In the first four samples, fishery debris were classified only about presence or absence, but for all the other they have been quantified and qualified also. Between August and January of 2013, and August and November of 2014, 22.714 items were found, with the simple plastic (44.4%; n= 10.106) and the rigid plastic (39.7%; n=9030) being the most frequent type of debris. For the months of October and November of 2014, fishery debris composed 3.7% (n=293) of the whole sample (n= 7903). The occurrence frequency of balloons and straws were 1.6% (n=129) and 7.5% (n=593), respectively. About color separation, the "other colors" debris were the most frequent ones (n=10.476; 46.1%). It was found a 500 debris average by each linear transect monitored per day (±287.5; 0.25 debris/m2). The values were higher in the days after holidays (Media 1218.5;

±122.33) with an amount of 1305 debris in one transect after the Brazilian Independence Day (0.65 debris/m2). These are partial results, but the items by type and colors found washed up along the beaches are comparable to debris ingested by juvenile green turtles stranded at Paraná coast. Along this area more than 75% of all dead green turtles and 30% of loggerhead turtles had ingested debris. The high rates of debris per area show the impact of the anthropogenic actions over the environment and the need of interaction among politics, social-economic and environmental units, seeking to reducing, recycling and correctly discarding debris, reaching a sustainability of Paraná coast.

TOURIST IMPACTS OVER THE NESTING HABITAT OF THE THREATENED LOGGERHEAD AND GREEN TURTLE IN KANZUL, RIVIERA MAYA-TULUM (MEXICO)

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This study shows the habitat degradation by strong tourism pressure, and how it might be related to nesting selection areas and productivity nests. The studied area is a 5.2 km beach at Kanzul (Mexico) protected by the Riviera Maya-Tulum Sea Turtles Conservation Program. We studied the nesting of loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) in 11 zones of 500m each (except the last zone which have 200m) during the nesting season (May to October 2014). We found 88 buildings in the area, which includes private houses and small hotels. Despite the presence of these buildings we detected 1425 nests; 369 loggerhead and 1056 green turtle nests, respectively. Nevertheless, 17.82 % of the turtles did not spawn (61 loggerheads and 248 green turtles). We identified the anthropogenic impact in all the terrestrial life stages (nesting, incubation and hatching) of the two studied marine turtles. Our results show that from all nesting attempts, 14.19% suffered some anthropogenic threat during the nesting period, of which 41.06% of the turtles abandon nesting because they found terrestrial obstacles and 34.15% withdraw nesting by direct pressure of tourists. Only 0.77% of the nests suffered some anthropogenic threats during the incubation period and 4.7% during hatching, of which 94.03% was due to offspring disorientation produced by lights. Impact indexes according to the most significant threats (presence of bunks, tourism capacity and artificial light source) of the 88 studied buildings, distributed in 11 areas, were created. We considered the impacts in high (June, July and August) and low (May, September and October) tourist seasons. Indices classified threats as extreme, high, moderate, low or not harmful. Our results show that 11 hotels had an extremely harmful impact in high season and 2 in low season. Zone 8 produces the strongest pressure, and was classified as very harmful. Nesting preferences areas were detected, loggerhead has less preference for zone 2, and zone 8 in high and low season, respectively. Green turtle has less preference for zone 8 in both high and low seasons. Hatching success was higher in zone 1 and 6 for loggerhead and green turtle, respectively. Hatching success was lower in zone 8, than in test of zones. All these result, might be taken into account in further conservational plans and management, in order to prioritize actions that eliminate or reduce anthropogenic threats, and avoid the habitat nesting loss of loggerhead and green turtle. Acknowledgments: We thank the committee of the International Society Turtles (ISTS) and the sponsors for scholarship assistance / eligibility in this Congress to the first author.

HOOK, LINE, & THINKERS: UNDERSTANDING COMPLEX PERCEPTIONS OF FISHER-TURTLE INTERACTIONS IN CONTEXT (CRETE, GREECE)*

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Interactions between sea turtles and small-scale fisheries can negatively impact all involved. For sea turtles, such interactions can lead to high associated mortality as a result of long soak duration, and/or intentional killings, possibly due to frustration with turtle-related damage to equipment. For fishermen, encounters with sea turtles and other large marine vertebrates can result in loss of fishing income via damaged gear and lost fish. Such losses can act as 'last straw' irritants in contexts of declining fish stocks and/or increasing fishing effort. Increases in effort can lead to more interactions with turtles and may intensify such interactions. Focusing on such relationships, this paper is part of a greater effort to identify effective management measures for loggerhead turtles nesting in Rethymno, Greece. We investigated small-scale fisher perceptions of sea turtles, their impacts on fisher's livelihoods, and possible ways to improve problematic relations. The lead author visited 18 fishing ports around the island of Crete and conducted 101 interviews using questionnaires (May-June 2013). 95% of respondents report interactions with sea turtles. Mostly, they report gear damaged without turtles

caught. Additionally, 78% of respondents admitted accidental turtle catches as occurring, but only 41.5% indicated catches in the 12 months prior to survey. Most describe turtle-caused damage as small rips and 1-5 holes made in nets, understood as resulting from turtles pulling fish off nets. Fishers using long lines described gear damage as negligible, but gillnet users reported spending 800-3000€ annually to replace damaged gear and about 60 workdays/yr fixing nets. Sea turtles were not perceived as the biggest threats, however. Respondents viewed dolphins, monk seals and pufferfish as worse offenders. Sea turtles are considered to interfere with their work a little bit (55.4%) or not at all (18.8%). They were also qualified as posing limited (52.5%) or no threat (21.2%) to the local fishery. Cumulatively, however, interactions with large marine vertebrates were considered problem, with 66% of the respondents including it among the 'top three challenges' faced. They also indicated that the government should provide compensation in the form of subsidies to replace gear, tax deductions or annual stipends. Some respondents suggested compensation as indispensible in terms of preventing intentional killings of animals seen as threats. Respondents also discussed establishing MPAs or areas closed to fishing as favorable interventions for regenerating fish stocks. They also suggested that closures would be favorable, especially if temporary and when combined with compensation for curtailed fishing access. Compensation may therefore offer multiple benefits as a conservation intervention—from reducing by-catch of protected species, to increasing support for MPAs. Thus, it may represent a good first step towards reducing mortality of turtles at sea. Respondent pairing of conditions and combinations for preferred interactions suggest that further restrictions of fisher activity in Crete should only be contemplated after genuine deliberations with the fishing community. Acknowledgements: This project was funded by the Betz Chair endowment and the Claudio T. Elia Memorial fellowship. Special thanks to ARCHELON's project team on Crete and all fishermen who participated in this research.

BLACK AND HAWKSBILL TURTLE STRANDINGS IN ESTUARINE WATERS IN THE PERUVIAN NORTHERN COAST

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Sea turtle strandings in Peru have been documented since the 1980s, however, these records were mostly opportunistic. Nevertheless, they have been helpful to identify areas with high rates of incidental, directed and illegal catch. Given that systematic information of strandings are needed, we conducted six surveys in the Virrila estuary margins, located at Piura región in the northern coast of Peru (05º48 ', 80º51' S); which is the unique ecosystem of estuarine waters in the Peruvian coast and constitutes an important aggregation area for black turtles. The aim of this study was to estimate the mortality of sea turtles along the Virrila estuary and identify the main causes of mortality; also analyze whether there is a relationship between strandings and environmental variability at seasonal scale. We registered 389 stranded turtles from September 2011 to November 2014, of which the 99.5% were black turtles *Chelonia mydas agassizii* and 0.5% were hawksbills *Eretmochelys imbricata*, which are listed as Endangered and Critically Endangered respectively. The average curve carapace length (CCL) for black turtles was 59.2±10.2 cm (range 30.9-89.7 cm) and were mainly represented by juveniles (62.6%), followed by subadults (35.3%) and adults (2.1%). On the other hand, all of the hawksbills were juveniles. We determined that 8% of the strandings were caused by some kind of anthropogenic interactions such as boat strikes and illegal catch (butchered carcases), while 92% was undetermined. It is necessary to continue recording sea turtle strandings in the Virrila estuary and also we recommend to invest more effort monitoring other coastal areas along the Peruvian coast. As further goals, we plan to implement a health assessment program of the turtle population in the estuary, discard fibropapilloma and quantify the levels of heavy metals in order to identify other causes of mortality and thus contribute to enhance the management and conservation plans of these endangered species.

THE EFFECTS OF ARTIFICIAL LIGHTS ON LEATHERBACK HATCHLING BEHAVIOUR

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Leatherback turtles (*Dermochelys coriacea*) face many threats from anthropogenic effect such as light pollution. Coastal areas are being increasingly occupied by human settlements causing light pollution. Because of development of nesting beaches is linked to light pollution and other coastal changes, it is important to assess its impacts on sea turtle nesting habitats. Little is known about the specific effects of artificial lights on leatherback nesting beaches. We therefore studied the effect of artificial lights and nearby towns on leatherback hatchling orientation along the season 2013 at Pacuare Nature Reserve in Costa Rica. We used hatchlings from relocated hatchery nests and tested their response to 6 colored sources of light (orange, red, blue, green, yellow and white). Hatchling orientation towards the sea was always better under control dark conditions. However, light pollution from Limón disrupted sea-finding under control and all light treatments. In absence of moon, orange and red lights caused a lower attraction than other colors but still disoriented hatchlings. Orange lights produced the lowest disrupted orientation. In nights with presence of moon, hatchlings were only attracted to blue and white artificial light treatments. Crawling duration was high for hatchlings under orange and red lights producing long disrupted movements, although under orange light treatment hatchlings showed less disorientation than under the red one. In conclusion, sea-finding orientation of leatherback hatchlings can be affected by artificial lights with wavelengths from UV to red. We recommend maintaining nesting beaches in darkness and using of orange lights by conservationists when strictly necessary. Strategies to mitigate artificial lighting from nearby cities should be incorporated by management programmes.

GLOBAL EFFECT OF CLIMATE CHANGE ON THE HATCHLING OUTPUT OF LEATHERBACK TURTLES AT DIFFERENT NESTING SITES*

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Current climate models project a global increase in temperature and regional changes in precipitation by the end of the 21st century. Leatherback turtles (*Dermochelys coriacea*) nest in tropical and subtropical areas where local climate conditions differ from each other. Local climate conditions influence egg development and hatchling emergence and therefore, the overall hatchling output depends on the prevailing conditions in the nesting beaches. We compared the effects of precipitation and air temperature on the hatchling output at four nesting sites of leatherback turtles around the World. Precipitation accumulated over time was the most important climate driver on the hatchling output, but its effect varied among sites, and was not significant at the most temperate site. Air temperature affected hatchling output to a lesser extent than precipitation and its effect was only significant at sites where climate conditions were dry. Climate projections showed and increase in air temperature and a mild decrease in precipitation for all sites by the end of the 21st century. However, the effect of climate change on hatchling output will likely be milder in subtropical areas if turtles can switch to nesting during the months that will become most favorable for development by the end of the 21st century. Under future conditions, there may be larger differences in air temperature among months that could act as barriers, shrinking nesting seasons. Climate change can negatively affect all populations included in this study, but its effects will likely be exacerbated in populations that nest in areas where conditions are already warm and dry.

EXAMINING THE EFFECTS OF CLIMATE CHANGE ON A SEA TURTLE NESTING POPULATION ALONG THE PAKISTANI COAST

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Marine turtles face a myriad of anthropogenic threats in their natural habitat including beach modification and encroachment, bycatch, and climate change.Increasing ambient temperatures, sea level rise and shifts in ocean circulation patterns threaten marine turtle survival, as these abiotic factors may alter migration routes, affect prey abundance, skew sex ratios, limit suitable nesting habitats, and decrease hatching success. To predict the effects of climate change, sea turtle nesting populations of green (*Chelonia mydas*) and olive ridley sea turtle (*Lepidochelys olivacea*) at Sandspit and Hawkesbay beaches, located near Karachi, are being studied during the entire nesting period (August-January for greens and July-September for olive ridleys. This study encompasses known factors influencing nesting behavior and embryonic development, including severe climatic events, ambient temperature, beach topography, sand characteristics (moisture content, sand grain size), and tidal oscillations, which are being monitored year-round. Coupled with air and sand temperature recordings, these data will elucidate spatial and temporal shifts in nesting behavior and sex ratio composition in response to thermal fluctuations. To augment beach sampling, remote sensing data sets and a nesting habitat suitability GIS analysis are being incorporated in the assessment. Suitable nesting habitat is being lost due to recreational use of the nesting beaches and a higher frequency of severe climatic effects. Climatic effects are more pronounced where nest cavities are located about 2 meters from the high tide water mark. During the recent cyclone Niloofar storm surge alone,16 nests were inundated and destroyed. It is expected that conditions of the current and future nesting seasons will pose even greater challenges for female turtles.

AN OVERVIEW OF CONSERVATION ENGINEERING OF TRAWL NETS AND DEEP SEA RESEARCH IN NIGERIA: A BOAT WILL MAKE THE DIFFERENCE

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In multi-species tropical waters, the reduction of incidental catch of sea turtles and unwanted fish in shrimp trawls is regarded as a priority issue in the global effort to develop more responsible fisheries as promoted by Food and Agriculture Organization (FAO), United Nations Environment Programme (UNEP) and Global Environment Facility (GEF). Turtle Excluder Devices (TEDs) installed in the codend extension (CE) of shrimp trawl nets in Nigeria recorded compliance level of 68.2% up from 63.3% in 2013. Two options of By-catch Reduction Devices (BRDs) i.e. Square mesh window (SMW) and 90 degree/T-turned gentle codend have been adopted to complement the TEDs with adoption rates of 76% and 24% respectively in favour of the former. The regulation on the use of TEDs and other BRDs in shrimp trawl nets which was ratified and came into force on 22nd August 2006 contained design details and specifications in line with standards stipulated by USA, as well as offences and penalties which have been strictly enforced. The inshore coastal waters (< 75m depth) overcrowded with over 352 licensed trawlers in 2004, has 125 licensed trawlers in 2014, which is an indication of overcapitalization/overexploitation. Therefore there is the urgent need for diversification such that the excess fleet can venture into deeper waters (>100m up to 1,500m depth) in order to give respite and minimize the trawl fishing intensity in the inshore waters and thereby prevent the fishing industry from total collapse. Under the auspices of the Federal Government of Nigeria, Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos has acquired in 2014 'RV Bayagbona' a new Poland built, 36.30m length over-all (LOA) deep sea fisheries and oceanographic vessel which is fully rigged for mid water/pelagic and demersal trawling operations in order to explore those resources of economic importance, that have remained largely unexploited. In addition, this intervention will facilitate resources survey and estimation of by-catch and vulnerability of the endangered and highly migratory species including sea turtles, marine mammals and cetaceans as an integral part of biodiversity maintenance as well as information on illegal, unreported and unregulated (IUU) fishing practices which are very rampant in the EEZs of most West African countries.

HIGH NUMBERS OF OLIVE RIDLEY TURTLES (*LEPIDOCHELYS OLIVACEA*) ENTANGLED IN GHOST NETS IN THE CENTRAL INDIAN OCEAN

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Lost, abandoned or discarded fishing nets, otherwise known as "ghost nets", pose a serious risk to marine fauna throughout the world's oceans, including in the Indian Ocean. Between July 2013 and July 2014, 61 olive ridley sea turtles (*Lepidochelys olivacea*) were recorded entangled in ghost nets in Maldivian waters. A total of 74 separate ghost net conglomerates (multiple nets tangled together) were recorded from the Maldives, Sri Lanka, and India over the same 12-month period. 28% (n=21) of these nets had one or more turtles entangled in them. (n= 15, 71%) of olive ridley entanglements were associated with large conglomerates of multiple fishing nets. Others were associated with single nets or Fish Aggregating Devices (FADs). Individual samples from nets entangling turtles had stretched mesh sizes ranging from 35 mm to 590 mm and all were constructed of knotted, multifilament polypropylene twine, a material that floats in seawater. Entangled olive ridley turtles were most often encountered in the Maldives during the Northeast and following inter Monsoon (from December to April) and sexually immature individuals made up the majority (n=47, 77%) of entanglements. The Northeast Monsoon coincides with the olive ridley's arribada nesting season in eastern India. Given that the predominant fishing techniques used in the Maldives are net-free (pole-and-line and hand-line), the majority of ghost nets must have drifted with oceanic currents from neighbouring countries and international waters. A major challenge continues to be identifying from which countries, and which fisheries, specific nets are originating. Our data suggest that nets may be coming to the Maldives from India, Sri Lanka, or further afield in Southeast Asia during the Northeast Monsoon, and from the Western Indian Ocean during the Southwest Monsoon. Several FADs recovered from Maldivian waters in the Southwest Monsoon were traced to the Western Indian Ocean purse seine tuna fishery. Ghost nets pose a serious risk to populations of the vulnerable olive ridley sea turtle in the Indian Ocean as these open ocean-dwelling turtles often enter the nets looking for food or shelter. In order to reduce the number of ghost nets generated in the Indian Ocean, we are facilitating capacity building and education amongst Indian Ocean coastal communities, including training citizen scientists how to remove and collect data from the nets. A partnership between the port authorities and the recycling industry could result in a successful net recycling program, as has been developed in other parts of the world. To reduce the generation of derelict fishing gear, we recommend a reduction in gillnet fishing capacity in the region; the implementation of improved net disposal facilities in ports; a system of no-blame gear loss reporting; and a centralised database of Indian Ocean fishing net construction parameters.

UPDATE OF GREEN TURTLE INTERACTIONS WITH MARINE DEBRIS IN URUGUAYAN COASTAL WATERS

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Anthropogenic debris accumulation in marine environments has become a serious problem in the last decades. There are multiple pollution sources, such as fishing gear, beach contamination, and effluents of rivers or estuaries. Anthropogenic debris can interact with marine organisms in different ways. Plastic represents the most ingested debris by marine fauna. This is highly persistent in the environment due to its long disintegration rate. Green turtles interact with marine debris in all their life stages and in different geographic areas. In the Southwestern Atlantic Ocean the ingestion of marine debris is one of the main threats for immature green turtles when they reach neritic habitats after their oceanic life stage. The aim of the present work is to update previous studies about the interaction of immature green turtle with marine debris in Uruguayan coastal waters. Stomach contents samples were collected from the carcasses of dead turtles, which stranded along the Uruguayan coast from 2005 to 2013. These stranded turtles were found during beach surveys conducted by technicians of the Marine Turtle Stranding Network run by the NGO Karumbé. For each stranded turtle, Curve Carapace Length (CCL) was measured using a flexible tape. The digestive track content was collected and was separated into esophagus, stomach and intestine sections. Diet items, including marine debris, were separated and identified to the lowest possible taxonomic level. Each diet item was quantified by frequency of occurrence (FO) and relative volume (RV). This update includes three studies from different authors; [1] The first study analyzed stranded green turtles along the Uruguayan coast through 2005 to 2007 (n=56), all the turtles were immature size with mean ± SD curved carapace length

(CCL) = 39.7 ± 6.0 cm (range 32.3 - 61.5 cm). Marine debris were present in 73% of the analyzed turtles. [2] The second one analyzed stranded green turtles along the Uruguayan coast through 2009 to 2013 (n=54), all the turtles were of immature size with CCL = 40.0 ± 7.0 cm (range 29.8–62.0). Marine debris occurred in 72.2% of the stomach contents analyzed. [3] The last study was performed during 2010 (n=23) just in the Marine Protected Area Cerro Verde and adjacent areas, the turtles were of immature size CCL = 39.4 ±7.8 cm (range 29.8 – 58.5 cm). Marine debris occurred in 82.6% of the turtles. In the three studies, the presence of marine debris decreased according to the turtle growth rate, with a remarkable peak in study [2] from 80% in turtles shorter than 35 cm CCL to 58.8% in larger than 40 cm CCL.In the last 10 years the presence of plastic in green turtles has increased in great numbers in Uruguayan coastal waters. This update represents the first step for a comprehensive review of the impact of marine debris for the green turtle stock located in the Uruguayan coast, and for the developing of future actions to mitigate this threat.

THREATS FACING THE SEA TURTLES IN THE GULF OF CALIFORNIA – MEXICO

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Sea turtles are affected by human and natural threats throughout their lifecycles. Sea turtles have a long history in relation to humans in the Gulf of California and threats related to human activities are extensive. Besides natural mortality, human interactions pose the greatest threat to the survival of sea turtles. It should be recognized, even though Mexico has signed and ratified the conservation agreements which regulate international trade in CITES species and has decreed a ban on consumption and total and permanent use for all species of sea turtles, there is currently an illegal meat, eggs and products market derived from marine turtles. Despite national bans, continued poaching and turtle meat is a dish much appreciated. To the above, various factors that compromise recovery and survival of sea turtles are added. There are a variety of wild and domestic animals that are predators of turtle eggs. Natural phenomena such as hurricanes and tropical storms that cause flooding in nesting beaches is another factor that negatively influences hatchling success. When finally the hatchlings come out of their nests, they are easy prey for terrestrial and marine predators. Juvenile, subadult and adult stages of Sea turtles are preyed upon by sharks and orcas, among others.On the other hand, in their aquatic life cycle, the sea turtles are affected by a variety of diseases as Fibropapilloma and parasites.Tropical storms and hurricanes, also contribute to the mortality of sea turtles in shallow water.The Gulf of California is considered a paradise for its beautiful scenery, beaches and the diversity of species that live there.This has driven the development of tourism as a major economic activity mainly south of the Gulf of California. This has resulted in extensive loss of nesting beaches that have been modified by the construction of hotels, restaurants, marinas, etc. causing negative changes in sea turtle nesting beaches. To this adds pollution, the use of all terrain vehicles and human impact on the shore. Other activities that adversely affect nesting are: tourism, uncontrolled and unguided, lighting on the beaches, crowds of people during nesting and contact with turtles, all cause nesters to return to the sea without laying their eggs. One more factor considered the most impacting in the survival of sea turtles are fisheries.The present study aims to identify the threats to sea turtles in the Gulf of California, the information presented is compiled from field studies, unpublished data, government reports, literature review, interviews and personal observations, all to perform an analysis in order to identify threats, and a total of 16 threats to sea turtles of which 12 were of human origin and 4 of natural origin were identified.These threats are described to finally propose some solutions and conservation measures.

THE SEA TURTLE STRANDING NETWORK IN NORTH TAIWAN

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Sea turtle stranding have become a major source of mortalities in recent years. Hundreds of sea turtles strand each year due to the marine pollution, ingestion of anthropogenic materials, cold-stunned, human activities etc. Most stranding occurs in the nearshore waters where the human activities concentrate. Live-stranded turtles need rehabilitation while dead ones need necropsies to determine the cause of death. There are five species of sea turtle in Taiwan: green, loggerhead, hawksbill, olive ridley and leatherback turtles. Many sea turtles strand each year. Due to the lack of an effective standing network, little did we know the number of turtle stranded each year, not to mention how to rehabilitate them or determine the cause of death. In view of this shortfall, in 2007 a sea turtle stranding network was established. The system covers the 439 km coast area from Miaoli to Hualien Counties in Northern Taiwan. From 2007 to 2014, we have received 77 stranding

cases. Most stranded sea turtles were green turtles (n = 60, 79%). Most stranded turtles are juveniles, straight carapace length ranged from 30 to 50 cm (n = 44, 60%). Among 77 stranding, 26 were alive (34%). They were treated by veterinarians at National Taiwan University Animal Hospital. Five were dead due to the serious injuries. There are two main stranding seasons; March to May (n = 28; 36%) and September to November (n = 26, 34%). One stranding hot spot; Longdong Bay was identified, with 21% reported cases. In order to improve the rehabilitation facilities, National Taiwan Ocean University establish a "Sea Turtle Rehabilitation Center in Northern Taiwan" at Gongliao County, northeast tip of Taiwan in 2014. A series workshop will be held to encourage residents and the Coast Guard to engage actively in the sea turtle stranding network.

INCIDENTAL CATCH OF SEA TURTLES IN THE CENTRAL MEDITERRANEAN BY THE LAMPEDUSA FISHING FLEET AND POSSIBLE TRENDS

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Lampedusa island (Italy) is located in the middle of an area highly frequented by Mediterranean loggerhead sea turtles (*Caretta caretta*). The marine area south of the island represents one of the most extensive neritic foraging areas for this species in the region, while the northern zone is an important oceanic foraging ground as well as an obligate corridor between the western and eastern basins. These two areas are fishing grounds for vessels based in Lampedusa, with a high turtle by-catch recorded in the past. This study aims to describe the local fishery and turtle by-catch and compare the current status with data collected several years earlier. In the period 2012-2013, we collected information on the local fishing fleet and interviewed fishermen about the spatio-temporal distribution of the fishing effort and turtle by-catch of 26 fishing vessels using different fishing gears, representing more than 50% of the total fleet. Through a voluntary logbook program we also monitored 11 fishing vessels using trawl nets, pelagic and demersal longlines and set nets, for a total of 667 fishing days and 57 turtles caught. The results (i) inform on the location of the main fishing areas of different fishing gears around Lampedusa island and the associated turtle captures, (ii) show that pelagic longlines have the highest catch rate, although (iii) bottom trawling represents the main fishing activity of the fleet, (iv) show a marked decrease in turtle catch rates in comparison to past data, although (v) most fishermen declared that turtle catches have been stable or increasing in the last decade.

A SMALL FISHERY WITH A HIGH IMPACT ON SEA TURTLE POPULATION*

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This research reveals that approximately 3,000 green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) sea turtles are caught yearly by Israel's licensed active fishing fleet as by-catch along the Mediterranean coast line. A fishermen questionnaire we conducted in most of Israel fishing harbors showed a pattern similar to the temporal sea turtle stranding distribution along the coast with high mortality during reproduction season and the majority of turtle catch by the gill net and trawling fishing methods. The turtle mortality rate from trawling was calculated using marine observers and the mortality rate of other fishing methods was roughly estimated by comparison with the literature. Approximately 1,500 turtles die each year due to Israel's fishing fleet. The yearly average of over 200 strandings each year on Israel's 200 km coastline is the highest stranding rate in the Mediterranean Sea. It is likely that the strandings represent only 7-14% of turtle mortality in the region. This paper points out that Israel's fishing fleet can be a major threat to Mediterranean Sea turtle populations in the vulnerable stage of reproduction and emphasizes the need for conservation programs and fishing limitations in the region to enable the sea turtle populations to re-establish the major rookery it was, until the 1930's.

STRUCTURE FROM MOTION – AN ACCURATE, LOW-COST AND USER-FRIENDLY NOVEL TECHNIQUE TO ESTIMATE THE SEA LEVEL RISE IMPACTS ON NESTING BEACHES

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Sea turtles are particularly vulnerable to the effects of climate change, due to their temperature dependent sex determination and their need for sandy beaches to lay their eggs. By the year 2100, sea levels around the world are expected to rise on average between 0.09m and 0.88m. As a result, nesting habitat may be severely reduced or become completely unsuitable for nesting. Accurate predictions of Sea Level Rise (SLR) impacts on nesting beaches will further empower conservationists to tailor their approaches to protecting sea turtle populations facing the greatest threat. In order to estimate the impacts of SLR on nesting beaches biologists must assess beach topography and typically opt between two solutions: expensive – high resolution, or inexpensive - low resolution methods. Currently, high-resolution surveying technology such as differential GPS means heavy equipment, high costs, and challenging logistics rendering them impractical for sea turtle conservation. The Abney Level method has been used as an inexpensive solution. Although this method allows the creation of a Digital Elevation Model (DEM) and calculates beach profiles even in inaccessible beaches, the technique has considerable negative aspects; It is time consuming, the accuracy is subjective, and it lacks the visual impact of higher resolution techniques. 'Structure-from-Motion' (SfM) is an accurate, low-cost, and user friendly technique enabling us to obtain high-resolution datasets at remote and inaccessible nesting beaches. SfM software matches features in multiple overlapping photographs to create a high-resolution DEM from extensive photosets obtained from a variety of heights and angles using a consumer-grade digital camera. The DEM model of a beach can then be exported to GIS and populated with nests coordinates and allow testing of different SLR scenarios. A comprehensive introduction to the technique is presented, followed by an outline of the methods used to create high-resolution DEMs. We report SfM, Abney level and DGPS models for nesting beaches and propose this method as a reliable means to obtain DEMs of sandy beaches due to its high accuracy and revolutionary visual representation while capturing complex topography.

GENETICS AND POPULATION BIOLOGY

SEA TURTLE SITUATION IN OMAN SEA AREA

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The Sea of Oman accommodates important feeding grounds for green turtles, of different life stages, all year long. There are also a few important nesting sites for the green turtle. Olive ridley turtles have also been reported in the area. Despite the fact that the area includes some suitable nesting sites for the hawksbill turtle and reports of its nesting been recorded in the past, there have been no signs of turtles nesting there in the past years.Taking into account the long shoreline of the Sea of Oman and the existing lack of facilities, it is difficult to cover the enter area annually, but regular surveys are thought to have identified the main nesting sites and feeding grounds for the green turtle in the Sea of Oman. Ahmad Rizeh, Karatti, Kachoo, Kohpansar and Tang may be considered as the main nesting grounds for this species in the area, while Tang, Pozm, Miami and Djodd serve as feeding grounds. The sea turtle populations are faced with different threats in the area. Egg collection for traditional usage and even for aphrodisiac purposes occurs at most of the nesting sites. In some places, turtle meat is occasionally used by coastal residents for the same purpose. By catch of sea turtle apart from these threats from humans, different kinds of pollution are common -- such as debris, oil and artificial light. By catch of turtles in fishing gear is also very common and may be the most serious problem, related to important fishing activities in the area. Natural predators, such as mammals, birds, crabs and insects, are another threatening factor for turtles as in other parts of the world.

FIRST REPORT OF HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA*) IN EASTER ISLAND (RAPA NUI), CHILE

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The Hawksbill Sea Turtle (*Eretmochelys imbricata*; Critically Endangered by IUCN) has a circumglobal distribution in tropical and subtropical waters throughout the Atlantic, Indian, and Pacific Oceans. Its worldwide population has declined severely during the last decades due to intense exploitation of eggs and turtles for food and tortoiseshell together with bycatch, marine pollution and fragmentation of nesting and foraging areas. In the Pacific Ocean, the Hawksbill turtle ranges from the coast of North America down to Peru and in several islands of the Indo-Pacific Region. In Polynesia the species is present in the waters of a great number of islands including Hawaii, Cook Islands, French Polynesia, Samoa, Tokelau, Tonga, Niue, and Pitcairns. However, up to date there were no records of this species for Easter Island. In Chile four sea turtle species have been described: *Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea* and *Lepidochelys olivacea*. In this work, we document the first report of *E. imbricata* in Easter Island and Chile throughout underwater and coastal sightings in 2013 and 2014. The presence of Hawksbill turtle in Easter Island constitutes a relevant finding since this extends the distribution range for this species in the Indo-Pacific Region and also increases the number of sea turtle species recorded for Chile. In the same way, this finding highlights the need to begin research on this critically endangered species in order to establish appropriate management and conservation strategies, especially considering the growing tourism and fishing efforts that exist today in Easter Island.

NESTING SEA TURTLE POPULATION TRENDS BASED ON THE APPLICATION OF SATURATION TAGGING EFFORTS AT PLAYA TORTUGA, OJOCHAL THE OSA, COSTA RICA

Oscar Brenes Arias

Reserva Playa Tortuga, Ojochal de Osa, Puntarenas, Costa Rica

Identifying sea turtles by applying flipper tags and/or Passive Integrative Transponder (PIT) tags have been a common practice among Costa Rican sea turtle nesting beach projects over the last 30 years. Despite this, not all sea turtle nesting beach tagging projects have been executed with the necessary effort and consistency to accurately represent all aspects of the nesting population, such as number of individual females, nesting frequency, and remigration intervals. Night patrols have incorporated the use of metal Inconel® flipper tags on Playa Tortuga since 2011. Like many other beaches in Costa Rica, the nighttime beach monitoring had been previously conducted based on tidal phase, patrolling both three hours before and three hours after high tide. Due to factors such as low nesting density (81 nests per season on average), low turtle encounter rate, and the short length of the beach (1km), it was decided that saturation tagging efforts would be implemented. Beginning in 2013, patrols are now conducted every night independent of tidal phase, from 18:00 until 05:00 hours. Based on the tagging data from the years 2011 and 2012, the encounter rate (for both nesting and non-nesting emergences) was 50% for both seasons. Upon the implementation of saturation tagging efforts in 2013, the encounter rate increased to 86%. So far, the 2014 nesting season (July-November) has resulted in an encounter rate of 96%. The objective of the study is to show that, with the application of an intensive sampling method on a beach with a similar length and nesting density as Playa Tortuga, it is possible to obtain a much more representative sample of the nesting population during one specific season.

FIRST DOCUMENTED RECORD OF OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) NESTING IN CAPE VERDE ARCHIPELAGO - BOA VISTA ISLAND

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Although olive ridley is the most common marine turtle in the world, the World Conservation Union guidelines for Red List Assessment categorize *L. olivacea* as vulnerable (2014). This species is one of the five species of sea turtle found in Capeverdean waters, but so far, it was believed that their activity was only as migrants. Olive ridley has a circumpolar distribution, with nesting occurring throughout tropical waters and a complex migration as well, with routes changing annually. Until now, all the information collected about this species in the archipelago was obtained through stranded, dead, sick individuals or remains. Here, we report the first confirmed case of olive ridley nesting activity in whole Cape Verde. In the early morning of the 10th August 2014, during a daily track survey along one of the north-west coasts of Boa Vista Island, an olive ridley sea turtle emerged from Atlantic Ocean for nesting, after two attempts. All de biometric data and DNA samples* were successfully collected after a total of 125 eggs were laid. The nest was marked and daily checked as well. After the incubation period, DNA samples* of hatchlings (dead and alive) and eggs not hatched were taken in order to be analyzed. Surprisingly, most of hatchlings were morphologically loggerheads (*Caretta caretta*), which is the main nesting species on Cape Verde. On the other hand, a few individuals presented different number of scales on the carapace (more than five), which is typically of *Lepidochelys* spp. but the rest of the morphological characteristics of these hatchlings reminded of a loggerhead. Hybridization has occurred among all species of the shelled marine turtles (Cheloniidae), this indicates that lineages have differentiated from each other over 10-75 million of years of evolution. It is believed that sea turtles may be among the oldest vertebrate lineages capable of producing viable hybrids in nature. DNA samples* of both, olive ridley nesting female and hatchlings, will give answer to so many questions and will bring us the opportunity of starting pointing some hypothesis about the origin of this unique nesting case of *L. olivacea* in Cape Verde. Due to the maternal transmission of mitochondria, the mtDNA sequence will reveal if female parent of the olive ridley found in Cape Verde was an olive ridley as well. Anyways, an American origin for this *L. olivacea* individual.

FROM ACCIDENTAL NESTERS TO POTENTIAL COLONISERS, THE SEQUENCIAL COLONISATION OF THE MEDITERRANEAN BY THE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*)*

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Previous genetic and tagging-recapture studies have demonstrated that the loggerhead sea turtle (*Caretta caretta*) is a highly philopatric species, thus allowing further exploitation of nesting areas that succeed in the past. However, this reproductive strategy difficulties the colonisation of distant nesting beaches, decreases the adaptability to changing environments and hardly explains the worldwide distribution of the species. For instance, the colonisation of the Mediterranean Sea by Atlantic individuals implies that a species, that hardly nests a few hundreds of kilometres from its beach of origin, has surpassed a gap of some thousands of kilometres of deep sea. Furthermore, this colonisation has been sequential with at least two independent colonising events from Atlantic individuals, one during Pleistocene that originated the populations nesting in eastern Mediterranean beaches and another more recently that originated the populations nesting in southern Italy. During the last decade, the number of accidental or sporadic nests recorded in the western Mediterranean has increased, and almost all of them yield viable hatchlings. These nests raised some questions like where these new nesters originated and whether could be potential colonisers. To answer these questions, we compiled nesting data (21 nests), we analysed a fragment of the mitochondrial DNA (15 nests) and we simulated the probability that these sporadic events generate future populations under different incubation temperature scenarios, considering the temperature-dependent sex determination of the species. Our results indicated that the nesting females of these events originate both in the Atlantic and Mediterranean nesting beaches, associated to the composition of the nearby developmental foraging grounds inhabited by juveniles and subadults. Furthermore, we concluded that these nests produced generally a low proportion of females, thus making difficult the proliferation of a new population, but that a colonisation may succeed under temperatures slightly warmer than those actually found on these new nesting beaches. We thus hypothesize that accidental nesting events in beaches close to developmental foraging grounds, even at small frequency, may be a mechanism to overcome philopatry limitations thus increasing the dispersal capabilities of the species and the adaptability to changing environments, like the predicted global climate change.

HOW MANY TURTLES IN THE SEA? A STATIONARY AGE DISTRIBUTION MODEL OF THE MEDITERRANEAN SEA TURTLE POPULATIONS*

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The Mediterranean populations of the loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) are considered as regional management units (RMU). They are subject to several anthropogenic threats, with documented mortality induced by incidental capture in fishing gear. However, how such mortalities actually affect the interested populations is uncertain without an estimate of population size. We derived a theoretical demographic structure assuming a stationary age distribution, i.e. stable population and constant proportions of turtles in each life stage, and incorporated uncertainty of the main vital rate parameters to identify a likely order of magnitude of turtle abundance in different life stages. Through this approach, we aim to (i) provide an estimate of all population stage classes, particularly the juvenile classes that are most subject to fisheries interactions, (ii) provide an estimate of reproductive life span, based on estimates of adult annual survival (iii) identify and review the key demographic parameters, and (iv) identify the priority gaps in our information in need of further investigation. When we calculated the potential biological removal (PBR) for the part of the population at

risk of fisheries capture, our estimates were comparable to or lower than the estimated bycatch levels in fisheries, suggesting that current bycatch rates exceed the recommended values for endangered species. Although the model assumes a stable population and provides only a rough estimate of abundance, these results suggest that the current bycatch level should be regarded as unsustainable for the Mediterranean turtle populations, and efforts to reduce bycatch mortality and fisheries interactions are needed.

PHOTOGRAPHIC IDENTIFICATION OF GREEN TURTLES (*CHELONIA MYDAS*) AT CHAGAR HUTANG, REDANG ISLAND, MALAYSIA

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The implementation of photographic identification (photo-ID) as means for recognizing sea turtle individuals in a population has been explored in increasing studies over the years. Utilizing the distinct facial scute patterns, this method of identification is non-intrusive and requires little to no physical handling of the turtles. Previous studies have focused on juvenile and mature turtles at foraging grounds and through in-water surveys. The Chagar Hutang Turtle Sanctuary, located at the northern part of Redang Island, Malaysia, is an important nesting beach for green turtles and a small number of hawksbill turtles. Since 1993, the Sea Turtle Research Unit (SEATRU) of Universiti Malaysia Terengganu had embarked on a long-term tagging and monitoring program at this site. In this study, we attempt to use photo-ID on nesting and newly hatched green turtle hatchlings. Photographic images of the left and right facial scute profiles were collected for nesting green turtles intermittently during the 2010, 2013 and 2014 nesting season. Based on previous studies, two methods were used for analyzing the images captured from nesting turtles: (i) visual comparison of images based on facial scute patterns drawn using photoshop and (ii) assigning unique identification codes to each individual. The photo-ID results were validated by checking the corresponding flipper tags. Out of the 133 individuals analyzed, 131 of them were successfully identified using both methods. An exception was in the case of two nesters (one tagged in 2010 and the other 2013) displaying similar left and right facial scute patterns and profile codes. Based on the results, we assume that these two turtles are the same individual which may have lost both its flipper tags. However, as there is no concrete evidence to support this finding, further studies is required. Visual comparison of the 12 newly hatched green turtle hatchlings (from two nests) raised for one year in captivity showed stability in the facial scute patterns with no changes detected. Moreover, the patterns were observed to be increasingly distinct. Our findings signify the potential of implementing photo-ID as a feasible method to complement flipper tagging. Besides that, photo-ID may serve as a method for tagging green turtle hatchlings. This research was sponsored by Universiti Malaysia Terengganu. Expenses to attend this conference was sponsored by Universiti Malaysia Terengganu, the International Sea Turtle Symposium and the generous donors of the 35th Annual meeting.

SPATIO-TEMPORAL DISTRIBUTION OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) IN THE PELAGIE ISLANDS ARCHIPELAGO

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The Central Mediterranean, and in particular the Sicilian Channel, is a junction area between the western and eastern basins of the Mediterranean Sea and have a special relevance for the loggerhead sea turtle (*Caretta caretta*), which breeds in the eastern basin (Greece, Turkey, Libya, and Cyprus) but distributes widely in the whole Mediterranean. The southern portion of the Central Mediterranean includes the most extended part of the North African continental shelf and is an important neritic-demersal feeding area for turtles, whereas the northern area is an important oceanic feeding ground. At the neritic/oceanic border lies the Pelagie Islands archipelago, with a marine protected area. There is a lack of knowledge on the fine-scale distribution of sea turtles in this region. To fill this gap, we monitored the activity and turtle sightings of 27 tourists boats based in Lampedusa Island in 2012 and 2013, with 12007 trips and 611 turtles reported. Maps by 26

fishermen interviewed on turtle bycatch provided additional information on distribution. The study area was divided into 12 quadrants and sighting. Results show seasonal and geographic differences of loggerhead turtle distribution in the archipelago that can inform conservation programs in the area. The peculiarity of the archipelago makes it a valuable index site for studying several aspects of Mediterranean loggerhead turtles.

BLACK SEA TURTLE POPULATION IN MICHOACAN: BACK TO THE 60S?*

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Since the late 70s have taken steps to recover the population of black turtle in Michoacán, after being one of the sea turtle populations most at risk of extinction in the decade of the 80s and 90s, after nearly 35 years of conservation efforts, the population of black turtle shows significant signs of recovery. In 2013 a record high was observed in the number of nesting females. Only Colola Beach, were achieved protect more than 22,000 black turtle nests, of which 80% of nests were protected as nests "in situ" which generated a huge recruitment of hatchlings into the sea. These 22,000 nests represent a total of + -7.500 nesting females, which according to the 1965 base line, representing nearly 30% of the population of nesting females observed in the mid-60s before his dramatic decline in late of the decade. In 2014 black turtle nesting in the first four months of the season nesting beach Colola exceeded the expectations of the number of nesting females in Colola. In an unprecedented move, on September 14 and 15, 2014 a massive black turtle nesting beach Colola during these two days, more than 1,500 nesting females, something not seen since the mid 60s. Until the first half of the nesting season more than 12,000 black turtle nests have been protected in Colola: 4000 nests in protected hatcheries and more than 8000 nests "in situ" and waiting for months more anidatoria activity and black turtle in December and January. The big black turtle nesting activity in Colola in 2013 and 2014 and the occurrence of massive nesting synchronized as occurred in September suggests substantial progress towards recovery of the population of black turtle to its historical levels in Michoacan in 60s.

WHY SO MANY FATHERS FOR SUCH A SMALL OLIVE RIDLEY POPULATION IN HONDURAS?*

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Female sea turtles are known to be polyandrous and lay egg clutches that show multiple paternity. Varying rates of multiple paternity have been found in all seven species of living sea turtles. Differences in the frequency of multiple paternity also appear among populations of the same species. In the olive ridley sea turtle (*Lepidochelys olivacea*), multiple paternity levels correlate with the abundance of individuals in the mating system, being much higher at arribada rookeries than at solitary nesting sites. We used two highly polymorphic microsatellite markers (Cm84 and Or1) to assess the level of multiple paternity in an olive ridley solitary population nesting in the Gulf of Fonseca, Honduras. We found evidence of multiple paternity in 6 out of 8 clutches (75 %), with a minimum number of two fathers in four clutches, and a minimum of three in the remaining two clutches. This level of multiple paternity, which would correspond to a large population of almost 40,000 females, was unexpectedly high for the Honduran population, whose estimated number of nesting females is below 2,000. Higher than expected rates of multiple paternity found previously in small sea turtle populations have been explained by the high densities of animals reached in specific sites due to geographic constraints. However, this does not appear to be the case for the Honduran olive ridley population. Instead, historical evidence and recent flipper tag and satellite telemetry data suggest that these high rates of multiple paternity may be the result of some nesting females coming from proximal Nicaraguan or Costa Rican arribada beaches.

HAWKSBILL TURTLE TERRA INCOGNITA: NESTING STOCK STRUCTURE, GENETIC DIVERSITY, EVOLUTIONARY HISTORY AND CONSERVATION IMPLICATIONS IN THE EASTERN PACIFIC OCEAN*

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Considered functionally extirpated as recently as 2008, information on hawksbill turtles (*Eretmochelys imbricata*) in the eastern Pacific Ocean remains scant, hindering management of the population. The use of molecular genetic techniques plays a critical role in the understanding and management of global sea turtle populations. Due to strong philopatry demonstrated by the taxon, matrilineally inherited mitochondrial DNA (mtDNA) continues to be a preferred 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 252 tissue samples collected between 2008 and 2014 from nine nesting rookeries across the region. Our results provide novel insights into population structuring and the evolutionary origins of hawksbill turtles in the eastern Pacific. Three previously identified haplotypes and four new haplotypes were found with overall frequencies of 61.9% and 38.1%, respectively, the latter only evident in Central American nesting rookeries. Significant differentiation was found between the four nesting rookeries for which we had sufficient sample sizes ($n \geq 10$), providing evidence for stock structuring in the eastern Pacific for rookeries separated by as little as 100 km. We also found evidence for fine scale genetic segregation between nesting ecotypes (mangrove versus open-coast nesters), possibly maintained by behavioral differences in nest site choice. From a phylogeographic perspective, our findings suggest that eastern Pacific populations radiated out of the western Pacific, an assertion previously postulated, but which has remained unconfirmed until now. 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.

PRESENCE OF OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) IN URUGUAYAN WATERS. THE RECORDS FURTHER SOUTH IN THE SOUTH WEST ATLANTIC

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Olive ridley turtles (*Lepidochelys olivacea*) occur in tropical and subtropical waters globally.This species is considered the most numerous sea turtle in the world but the least abundant marine turtle in the South Western Atlantic (SWA). Regular nesting occurs primarily in Guyana, Surinam, French Guiana and Brazil and the bulk of the foraging grounds are considered nearby into the SWA region. The presence of olive ridley turtles in Rio de la Plata and adjacent waters have been considered as rare. However, new insights from stranding and fisheries data may indicate this area supports certain densities of foraging olive ridley. Karumbé NGO has reported a total of nine olive ridleys turtles (N=9) in Uruguayan waters in the last 16 years. The records mentioned are listed below according with the research sources; i) The stranding network run by Karumbé NGO registered five stranded turtles in the Uruguayan coast (n=5). All the turtles were considered adults according with their carapace length measures (LCC). Four of them were founded dead on the beach in different stage of decomposition. Skin samples were collected from these three turtles in order to do a PCR analysis. We found F haplotype in two of them (in the other one was impossible to perform the analysis due to its skin sample was damaged). The fifth turtle was founded alive with the front flippers amputated. This individual kept alive for 6 months in a proper tank at Karumbé Rehabilitation Area.Finally it passed away due to its physical condition and different healthy problems. ii) Karumbé NGO, through exhaustive investigations, found two olive ridley carapaces (n=2), one in a local market in Montevideo (Montevideo, UR) and the other in a restaurant in Punta del Este (Maldonado, UR). The carapaces didn't reach the adult size. Thus these individuals were considered as juveniles. The information obtained from the owners indicated these individuals come from incidental captures in the Uruguayan coastal area. iii) The two remaining turtles were incidentally captured by the artisanal fisheries in Uruguayan waters (n=2). They died entangled in the nets. Karumbé NGO registered these cases in its own bycatch program. Both were considered as adults according with their LCC measures. The Rio de la Plata and adjacent waters are considered as a high biological productivity system and foraging area for many marine species. Probably these turtles reached the Uruguayan offshore waters searching for feeding areas. Favorable thermal conditions may be supporting the presence of these turtles in Uruguayan waters. These conditions are produced by an intrusion of warm oceanic waters advected southward by the Brazil Current. Olive ridley turtle was previously recorded in this SWA zone. The records appear as bycatch in commercial fisheries (n=2) and as decorative items in private collections (n=2). Thus, theses new insights support and reinforce the presence data of *Lepidochelys olivacea* in the Uruguayan waters, considering these as the records further south in the South West Atlantic. These evidences altogether affording a new evaluation of the distribution of this species in the SWA. Understand the spatial distribution and different habitats of this species is essential for its protection and conservation.

POPULATION RISK TO CLIMATE VARIABILITY FROM LIFE HISTORY*

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Most studies of climate change impacts to biodiversity emphasize ecological shifts to habitat and not traits the organisms themselves possess. Geographic range, phenological mismatches, habitat tolerances, niche drift – these are the commonly examined factors in assessing the impacts of climate change. But climate variability, and climatic change, will affect different species through life history traits (and the ensuing demographic processes) over and above habitat shifts. Here we examine how demographic traits may act as buffers or conversely predispose certain life history strategies to climate forcing. We develop an analytical tool to quantify population risk to climate variability that arises from life history traits, and we apply it to a variety of well-studied taxa. Sea turtles feature prominently in this discussion, as their combination of life history traits (high fecundity, low offspring survival) means that their population growth is regulated primarily through early juvenile survival and the factors modulating this. These traits bear many similarities to fish, mollusks, cephalopods, and insects. By contrast, the population dynamics of African elephants and other species with low fecundity and high offspring survival are more sensitive to fluctuations in adult survival. All species are affected by climate. However, certain

life history approaches are more sensitive to environmental variability, and therefore more exposed to climate change. We discuss the implications of our results for developing modeling approaches that appreciate both demographic and environmental forcing and for recent debates about the impacts of climate to the long-term dynamics of sea turtle populations.

THE FRAGILITY OF RECOVERY: KEMPS RIDLEY NESTS ARE DECLINING*

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In the years since 2010, our once rebounding population of the world's most endangered sea turtle has taken a dramatic turn, from a 15-18% per year increase to a 5% per year decrease. The nest number dropped more dramatically in 2010 than had ever been recorded, but the population was expected to rebound quickly. Instead, the nest number has become much more variable, with decreases in 2013 and 2014. Nest numbers are now lower than they have been since 2006. The probability of reaching our initial goal of 25,000 nests, which should have been reached this year, is currently zero. While there are many factors that may have contributed to a reduction in the rate of recovery, a sudden reversal of the population growth rate is unexpected due to "population momentum", where the number of nests should continue to be fueled by large cohorts of hatchlings produced in the early 2000s. Even if carrying capacity has been reduced since the 1940s, when population estimates were much greater, it is unlikely that a long-lived species would experience such dramatic and rapid changes in population growth and variability in response to density. However, because only the number of nests and hatchlings are monitored thoroughly, it is difficult to determine if the change is due to an increase in mortality and/or a decrease in the reproductive rate, where the latter could be a reduction in nesting frequency or nests per female. There is a desperate need to measure the annual survival rate of adult turtles and recruitment to the nesting population through tagging and monitoring on the nesting beaches. Likewise, better estimates of growth and mortality of juvenile turtles over time could help us diagnose changes in population recovery when they occur. For now, funding should be re-instated for the bi-national recovery project, with an emphasis on vital rate research and nest protection throughout the species' range.

POPULATION GENETIC STRUCTURE IN THE MARINE TURTLE EMBEDDING BARNACLE, STEPHANOLEPAS MURICATA

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Stephanolepas muricata is a cheloniid embedding barnacle. Previous reports have suggested that in large numbers it may be detrimental to marine turtle health. Despite being believed to be restriced to the Indo-Pacific, *S. muricata* was found in the Atlantic Ocean in 2011. In cases of low level infestation, *S. muricata* could be easily overlooked by field biologists examining marine turtles. Oversight combined with a relative lack of understanding of the dispersal behavior of the species, makes it difficult to determine whether it is a recent invader to the Atlantic Ocean or if it has simply gone unnoticed. Understanding transmission and potential gene flow in these barnacles between populations and across host taxa may prove informative for conservation managers. While analyses of genetic population structure in sea turtles has provided a firm understanding of patterns of gene flow between nesting populations, additional connections between populations are likely to exist (e.g., at feeding grounds or along migratory routes). These connections may provide transmission pathways for both diseases and epibionts. In addition, these connections are potential routes of marine turtle male-mediated gene flow. Therefore, understanding the population structure of epibionts as it compares to that of the host species may reveal non-reproductive connections between nesting sea turtle populations. Here we expand on our previously reported data and provide an investigation of global population genetic structure in *S. muricata* using 16s mitochondrial DNA analyses. Initial data suggest a recent Atlantic invasion and relatively strong north-south population structure in the Pacific.

GREEN TURTLE (*CHELONIA MYDAS*) MIXED STOCKS IN THE CELEBES SEA

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Green turtle migrate between nesting and feeding grounds, but it is uncertain which nesting colonies supply the feeding aggregations in Celebes Sea. To address this gap, natal origins of green turtle mixed stocks in the east coast of Sabah, Malaysia were assessed based on analyses of mtDNA control region sequences from the Tun Sakaran Marine Park and Sipadan Island feeding areas (n= 90). Ten mtDNA haplotypes were revealed, including one previously undescribed haplotype. Of these, CmP57 (38%), CmP49 (24%) and CmP20 (21%) were dominant, the remaining haplotypes presenting low frequencies (<4%). Haplotype and nucleotide diversity was 0.7563 ± 0.0262 and 0.027462 ± 0.013971, respectively. Exact tests of differentiation reveal significant differences between the Celebes Sea and the Australasian feeding aggregations. Mixed Stock Analysis, incorporating a total of 22 genetically distinct breeding populations in the Pacific and Eastern Indian Ocean regions as possible sources of individuals, indicated contribution from Micronesia to the feeding aggregation in Celebes Sea. Estimated mean contributions from rookeries in Sulu Sea and Southeast Sabah were relatively high, but confident intervals are large. However, regional group estimation indicates that the the Celebes Sea aggregation is contributed by the Indian Ocean and Southeast Asian rookeries, including rookeries in Sulu Sea and Southeast Sabah, as well as the Western Pacific rookeries, including Micronesia. The Celebes Sea is indicated to provide a feeding ground for remote Western Pacific green turtles, therefore, because of natal philopatry in green turtles, effects on the Celebes Sea feeding aggregation could affect nesting populations in other countries.

MITOCHONDRIAL DNA CONTROL REGION POLYMORPHISMS OF LOGGERHEAD AND GREEN TURTLES NESTING ON TURKISH BEACHES: QUICK RESULTS WITH RESTRICTION FRAGMENT LENGTH POLYMORPHISM (RFLP) ANALYSIS

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The genetic structures of two sea turtle species (*Caretta caretta* and *Chelonia mydas*) nesting along the Turkish coast, were analysed using tissues (kidney, liver, gonad, muscles etc.) from dead hatchlings and embryos. We collected tissues 31 different (14 *C. caretta* and 17 *C. mydas*) dead hatchlings from11 different nesting beaches and preserved in absolute alcohol. We used AluI, HindII, HindIII, HaeIII and SmaI restriction enzymes for digestion in PCR-RFLP analyses. The SmaI and HindIII enzymes were not digested the mtDNA from both species. We detected five polymorphisms (in three *C. caretta* and two *C. mydas*) on four different beaches of Turkey (produced by the digestion of AluI and HindII enzymes). These results showed that there are genetical diversities of the sea turtle population on Turkish beaches.

INCREASING NESTING ACTIVITY OF LOGGERHEAD TURTLES (*CARETTA CARETTA*) ON DALYAN BEACH, TURKEY DURING 2008-2014 NESTING SEASONS: AN ENCOURAGING TREND

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Dalyan Beach is one of the most important nesting beaches in Turkey for loggerhead sea turtle (*Caretta caretta*). This research provides information on the nesting activities such as spatial and temporal distribution of nesting, nesting success, nesting density, hatching success, incubation period, clutch size, tagging and predations over 7 nesting seasons. A total of 6664 emergences occurred over 7 years of which 2496 nests were recorded and the overall mean of nesting density was 554.6 nests/km. The pick of nesting emergences were determined mainly in June. According to 7 years examined in this

study and past year's data demonstrate that there is a linear trend in the annual number of nests on Dalyan Beach. An overall 76.3% of laid were hatched, with an average clutch size of 69 and hatching emergence success of 60.3%. The shortest and longest incubation period in these seven years ranged from 40 to 72 days with a mean of 52 days. A total of 440 new turtles were tagged during seven years, showing the recruits involvement into the nesting population as a result of long-term conservation studies. Number of predated nests were decreased when compared to previous years by screening of nests on top and sides. There is also a remarkable increase in the number of the sea turtle nest on Dalyan Beach and the average nesting effort here (mean 357 nests/season) confirm that Dalyan Beach is one of the most important nesting site for loggerhead turtles both of Turkey and Mediterranean.

FACTORS AFFECTING THE LONG-TERM POPULATION DYNAMICS OF GREEN TURTLES (*CHELONIA MYDAS*) IN OGASAWARA: INFLUENCE OF NATURAL AND ARTIFICIAL PRODUCTION OF HATCHLINGS AND HARVEST PRESSURE

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The Ogasawara Islands in Japan are globally recognized as a rookery of the northern end extremity of green sea turtles (*Chelonia mydas*). Japanese Ministry and Agriculture and Commerce undertook a 'Hatch and Release Project' to recover a nearly depleted stock of the green turtles from overharvesting which had occurred since 1830. The project began in 1910 as the world's first trial of a sea turtle hatchery. A total of more than 251,116 hatchlings were released into the wild but the project was terminated in 2008 due to the lack of any observable positive effects of the artificial hatching on abundance. The continuous nesting surveys from 1975 revealed that a depleted population has recovered gradually and an upward trend of migrating females has been observed in recent years. The rise in migrating females may be attributed to the temporary suspension of the turtle harvest and reduction of catch from 1942 to 1968, which allowed for a stable production of hatchlings from natural beaches. Long-term data on nesting activity and catch records also indicate that estimated pressure from harvest on breeding females was at the highest at 82.3% in 1978 and harvest pressure gradually declined in subsequent years. The continuous datasets also support a hypothesis that Ogasawara's turtles take about 50 years to reach sexual maturity. However, further studies are necessary to estimate the age at maturity and to further verify the effectiveness of artificial hatching programs. Such evaluation will also contribute to a better understanding of appropriate conservation and management of sea turtle populations around the world.

EVALUATING THE RELATEDNESS OF HAWKSBILL TURTLES NESTING AT JUMBY BAY, ANTIGUA, WEST INDIES*

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Hawksbill sea turtle (*Eretmochelys imbricata*) populations have declined by more than 80% in the last century, leaving remnant populations scattered throughout the world's tropical and subtropical oceans. Chronically small effective population sizes and the inbreeding depression that might ensue leave these fragmented populations less equipped to adapt and further endangered with extinction. Despite considerable efforts focused on marine turtle biology, many details remain unknown about their life history, breeding behavior and fine-scale population structure. Whereas natal-homing is a well-established behavior for marine turtles, the precision of homing behavior remains unclear. The long-term mark-recapture program at Jumby Bay (JB), Antigua, presents a unique opportunity to investigate fine-scale population structure in a stable nesting aggregation of hawksbills. The primary objective of this study is to evaluate the relatedness of hawksbills nesting at JB using polymorphic microsatellite markers to assign first and second order genetic relationships. By combining these data with maternally-inherited mitochondrial DNA and individual mark-recapture histories, we will estimate mother-daughter pairs and assess the likelihood of natal homing to JB's 650m beach. We anticipate significant fine-scale structure (i.e. first order relationships such as mother-offspring, full-sibling and half-sibling pairs) within the nesting aggregation due to the high degree of inter-annual nest-site fidelity exhibited at JB based on tag returns. Preliminary results and future directions will be presented, including the use of a genetic network analysis to better characterize and visualize the genetic associations within the nesting population. The network analysis will also facilitate incorporating individual characteristics, such as nesting experience or extent of nest-site fidelity, with these genetic associations. In addition to

shedding light on natal-homing at a fine scale, this study will provide information on levels of inbreeding and recruitment rates in this remnant nesting aggregation – necessary to better understand the ability of fragmented populations to recover from a recent bottleneck event and to inform comprehensive management strategies.

KYPARISSIA BAY VS ZAKYNTHOS: RECENT DATA ELEVATE KYPARISSIA BAY TO HOST THE LARGEST NESTING AGGREGATION OF LOGGERHEADS IN THE MEDITERRANEAN

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As shown from the 31-year monitoring work of ARCHELON the largest nesting aggregations of loggerhead turtles in the Mediterranean are found in Greece and specifically in Laganas Bay, at the southern coast of Zakynthos Island, and in Kyparissia Bay located in western Peloponnese, about 90km south east of Zakynthos. From 1984 until 2007 Laganas Bay hosted on average 1,244 nests per year which accounts for about 36% of all nests in Greece and 17% of all loggerhead nests in the Mediterranean, while in the same period Kyparissia Bay hosted on average 621 nests per year. The nesting habitat in Zakynthos has a total length of 5.5km, spread over 6 discreet beaches, while the nesting habitat of Kyparissia Bay comprises a 44km continuous beach. Despite their proximity the two areas have important differences. Laganas Bay faces southwards so it is not much affected by inundation while the western oriented Kyparissia Bay is impacted by the predominant in summer north westerly winds; nests in Kyparissia Bay are affected by severe canid predation while on Zakynthos such a threat is negligible. Further, Laganas Bay is characterized by intense tourist pressures whereas Kyparissia Bay still enjoys at its greater part relatively low tourism and coastal development. The ARCHELON long-term project, consisting primarily of locating and monitoring nests, covered all Laganas Bay beaches while in Kyparissia Bay the whole area was monitored only in the period 1984-1989 and then turtle work was restricted to the southernmost 9.5km where about 84% of all nesting concentrates and thus this part of beach has been characterized as the core area. The differences between the two areas have shaped differently the field methodology at each area. In Kyparissia Bay the high levels of nest predation and inundation resulted in a great amount of nests being protected by fencing or relocation. Examination of population trends over the last 21 years (1994-2014) shows a significant decline in Zakynthos and a significant increase in Kyparissia Bay, to the effect that in 2013 and 2014 the number of nests at the core area of Kyparissia Bay surpassed those at Zakynthos by about 21%. In order to assess how this increase relates to nesting distribution along the whole Kyparissia Bay, since 2012 ARCHELON has surveyed parts of the northern section. These surveys indicated that the proportion of nests in the northern section is larger than previously assessed. Current data clearly indicate that Kyparissia Bay hosts the largest nesting aggregation of loggerheads in the Mediterranean making it imperative that a proper protection scheme, similar to the National Marine Park of Zakynthos, is instigated. Nevertheless, recent developments in Kyparissia Bay have shown that a gradual degradation of the coastal ecosystem is taking place through destruction of dunes, deforestation, beach front building, and unregulated beach use. A grand conservation scheme would be to combine these two major nesting areas into one vast marine park, incorporating the adjoining marine area. We thank all field assistants and the many hundred volunteers without whom the above long-term work would not happen. AFR acknowledges travel support from Symposium sponsors and the International Sea Turtle Society.

GENETIC CHARACTERIZATION OF *CHELONIA MYDAS* FROM CYPRUS: PRELIMINARY RESULTS*

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Cyprus is one of the main nesting grounds of *Chelonia mydas* in the Mediterranean Sea. This species, listed as endangered by the International Union for Conservation of Nature, finds suitable foraging grounds along the coast of the island. Here we present the preliminary results of mitochondrial DNA analysis from green turtle nesting grounds (n=73) and strandings (n=38) from Cyprus. Following a non-invasive sampling protocol, dead hatchlings and embryos were collected during four nesting seasons (2009-2012) mainly from the Lara/Toxeftra Reserve in the Akamas peninsula. Samples were also collected from individuals stranded along the coast of Cyprus from 2006 to 2013, mainly from Chrysochou Bay. Genomic DNA was extracted and genetic analysis was carried out by sequencing mitochondrial genome. Two loci were tested: 817 bp of the mitochondrial control region and mitochondrial short tandem repeats (mtSTRs), previously used in the Mediterranean Sea on this species. Control region sequences were compared with green turtle mtDNA haplotypes available online at the Archie Carr Center for Sea Turtle Research website. Most of the samples, both from nests and from strandings, shared the 490 bp control region short haplotype CM-A13 (n=97), the most common in the Mediterranean. Three other

haplotypes were detected, CM-A60 (n=12), CM-A14 (n=1) and CM-A27 (n=1), all previously reported for the Mediterranean Sea. Contrary to other studies on marine turtles the analysis of a longer 817 bp fragment of the control region did not reveal new variants of the short haplotypes in our samples. In fact, all the CM-A13 individuals shared the long 817 bp version of the haplotype, CM-A13.1. However, the analysis of the mtSTR sequences resulted in the subdivision of the haplotype CM-A13.1 into 17 mtSTR haplotypes. All the individuals carrying the short haplotype CM-A60 carried the same mtSTR haplotype. All the samples from nesting grounds were analysed in order to search for rare haplotypes. Statistical analyses were carried out using both the complete dataset and a subsample of hatchlings from clutches laid within a 10-day window over three consecutive years in order to avoid pseudoreplication. Stranding samples were analysed separately. Measures of genetic diversity were obtained using each locus (the 817 bp fragment of the control region and the mtSTR sequences) and a combination of both. More information is needed from other Mediterranean rookeries in order to determine the usefulness of the combination of the 817 bp fragment of the control region and the mtSTRs in the assessment of population structure and possibly the origin of stranded individuals. The comparison between Akamas and other Mediterranean rookeries using only the short 490 bp control region sequences, for which published data is available, revealed that the Akamas peninsula possesses the highest gene diversity (He= 0.3238). Besides, the population pairwise genetic differentiation (Fst) revealed significant differences (P-value always <0.05) between Akamas and the other rookeries, highlighting the importance of this nesting ground in the Mediterranean Sea. Acknowledgements: We are grateful to Myroula Hadjichristophorou and Andreas Pistentis for their invaluable help in the field. Project funded by the Cyprus Wildlife Society.

CHALLENGES IN USING DNA EXTRACTED FROM SEA TURTLE FIELD SAMPLES IN GENOMICS STUDIES

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Next-generation sequencing (NGS) is bringing new and innumerous possibilities for studying non-model organisms from the Genomics point-of-view. For many years molecular studies involving sea turtles have been dominated by the amplification of a limited number of loci via PCR. NGS allows for many different types of high-scale and unbiased analysis of non-model species, including those with little or no molecular data available. However, DNA samples that successfully work with targeted amplification often present new challenges when novel methodologies are introduced, and strategies have to be carefully designed in order to ensure financial and time feasibility for a project. Here we analyze NGS population data of several individuals from two sea turtle species (*Caretta caretta* and *Eretmochelys imbricata*) in Brazil from a quality and metagenomic sample composition perspective. DNA was extracted from nesting females' skin using the biopsy dart punch method. Non-targeted sequencing was performed using Illumina technology and revealed different sorts of contamination sources apart from other limitations. We expect to give the first overview of challenges involving sea turtle populational samples using NGS data and will discuss possible solutions for different problems that researchers would potentially face depending on their goals in studies involving next-generation sequencing of sea turtles.

STRANDINGS ANALYSIS OF SEA TURTLES IN BEACHES OF SINALOA, MEXICO DURING 2012-2013

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Analysis of sea turtle strandings is a tool that lets us know about the biology of the species and ecosystems they inhabit, such as aspects of distribution or diseases caused by pollution and fishing activities of the environment in which they live. On the coast of Sinaloa, each year several stranding of these species are recorded, caused both anthropogenic and natural factors, causing a problem for the populations of these organisms. It is important to identify the most frequent causes of death and from this information to improve processes to protect and conserve these species. This study analyzed sea turtle strandings presented during 2012 and 2013 on the beaches of Sinaloa: Meseta de Cacaxtla, Playa Ceuta, Ensenada de Pabellones and Bahía de Santa María. The olive ridley turtle (*Lepidochelys olivacea*) was the species that recorded the highest number of strandings (191 stranded individuals). These were recorded between July and November both years; while the leatherback (*Dermochelys coriacea*) turtle was the species that recorded the lowest (only two stranded

individuals). The beach with the highest number of strandings was Playa Ceuta and poaching was the most frequent cause of death. the age structure size (LCC), are located in the range of adults for the olive ridley and subadults for black turtle.

SEA TURTLE´S STRANDINGS IN CHILEAN COAST: RARE OR COMMON EVENTS?

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Five species of sea turtles have been described in Chile: *Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata* and *Lepidochelys olivacea*. Although anciently there was the belief that sea turtles were rare in Chilean waters, today there is evidence that Chile is an important foraging habitat for these species. We performed a review on cases of sea turtle`s stranding in Chile over last 23 years (1991-2014). The information was obtained from formal (government authorities) and informal (citizens and press) sources. We registered 110 sea turtle`s stranding records, including all five species. The records include status of individuals (alive or dead), date and place of each stranding, cause of death and final destination of some of the records. The vast majority of stranded turtles recorded were *Lepidochelys olivacea* (n=62), which records were documented between Arica (18°28′30″S 70°18′52″W) and Ancud (41°52′00″S 73°50′00″W). The second species on number of strandings was *Chelonia mydas* (n=39), which records were documented from Arica (18°28′30″S 70°18′52″W) to Chiloé (42°40′36″S 73°59′36″W). The remaining (4.54%) comprised *Dermochelys coriacea* (n=4) and *Caretta caretta* (n=2), while two carcases (1.82%) were not definitively identified. *Dermochelys coriacea* cases were documented in Quintero (32°47′00″S 71°32′00″W) and Santo Domingo (33°38′00″S 71°39′00″W) and *Caretta caretta* cases were documented in 100 km at SW of Tocopilla (21°55′00″S 69°48′00″W). To date, only 1 *Eretmochelys imbricata* has been reported from Easter Island (27° 7′10″ S, 109°21′17″W). Geographic analysis showed that 55% of the cases occurred in the north region of the country, 40% occurred in the central region, 8.18% occurred in the south region, while the remaining (1.82%) lacks of information. Temporal analysis showed that most of the cases were documented during the last five years (57.27%). No registers were found between years 2001-2006. Most of the strandings occurred during spring (34.55%), being summer the second season of importance (28.18%). From all the strandings, 60% (n=66) were found alive and 38.18% (n=42) were found dead, while for the remaining 1.18% (n=2) there is no information. From the alive turtles, 6.36% enter to rehabilitation process, 50.91% didn't go into rehabilitation and for 42.73% there is lack of information. 13.24% of the cases died after being rescued and 22.06% were released. From the dead turtles found, just 4.08% were necropsied. About the stranding cause, 1.1% of the stranded has signs of human use (carcass extraction), for 2.73% the stranding cause was attributed to bycatch and the remaining (96.37%) lacks of information. Our results indicate that sea turtle´s stranding are common events in Chilean coast and probably an important number of non-reported cases exist, having an underestimate value of sea turtle´s stranding in Chile. The reports have been documented primarily in north and central Chile on *L. olivacea* and *C. mydas*, both species occurring in neritic environments; nevertheless in the most of reports the cause of stranding or death was not indicated. This situation highlights the need to establish a stranding´s network along the country involving different social actors and including both governmental and private organizations.

GENETIC DIVERSITY OF TURTLE BARNACLES (CHELONIBIA TESTUDINARIA) WITHIN A HOST SEA TURTLE

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Sea turtles host a range of epibionts including barnacles. The turtle barnacle, *Chelonibia testudinaria*, is an epibiont on sea turtles and utilizes sea turtles as breeding ground. Long-distance migration of sea turtles is hypothesized to make sea turtles act as dispersal vectors of *C. testudinaria*. In fact, previous study indicated relatively high gene flow of *C. testudinaria* by geographical genetic structure. However, because barnacles are confined to mating only with neighbors, genetic variation of barnacles within one host sea turtle is necessary to be elucidated for understanding their gene flow. In this study, therefore, we revealed the genetic variation of barnacles within one host by analyzing DNA sequence variation of the mitochondrial-encoded cytochrome c oxidase subunit I gene (COI) sampled from total of 74 samples of *C. testudinaria* obtained from two green turtles and one loggerhead turtle nesting in Japan. The results indicate that most *C. testudinaria* attaching to one sea turtle have different haplotypes. All nine barnacles had different haplotypes in one green turtle, and only two of eight and maximum of six of 57 barnacles had same haplotypes in another green turtle and a loggerhead turtle,

respectively. Genetically divergent *C. testudinaria* within one host sea turtle may result from their almost random attachment to sea turtles. The results indicate that sea turtles facilitate gene flow of *C. testudinaria*. Whereas most haplotypes detected in this study were included in the Indo-Western Pacific clade, haplotypes in the Eastern Pacific clade were observed in two barnacles settling to the loggerhead turtle. This probably reflects the migration of loggerhead turtles in the North Pacific. In conclusion, this study presents the evidence of gene flow of *C. testudinaria* on sea turtles. Although epibiosis may be costly for sea turtles, sea turtles are estimated to play an important role in dispersal and gene flow of barnacles. The presentation is supported by travel grant provided by the Internationl Sea Turtle Symposium and sponsors.

EVIDENCE ON A LOW CLIMATIC NICHE CONSERVATISM OF DISTINCT SEA TURTLES POPULATIONS – IMPLICATIONS FOR THE USE OF SPECIES DISTRIBUTION MODELS

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Understanding the factors that determine species range limits and affect ecological niche and distribution patterns of species is a fundamental issue in ecology and evolution. The investigation of the patterns of ecological differentiation is even more critical in order to predict the impact of climate change on species distribution. This is especially the case for endangered species like sea turtles that their biology, behavior and viability persistence is strongly related to climate conditions (e.g. temperature, precipitation). In the present study we examined the relationship between climatic conditions and niche conservatism of distinct green turtle (*Chelonia mydas*) population as these defined by combining various types of information (e.g. genetic, demographic information, satellite telemetry). We use 935 georeferenced records of green turtle nesting sites that are embedded within eight wider population units distributed around the oceans of the planet. We assessed niche conservatism comparing the overall climatic niche of different population segments taking into consideration the current climatic conditions. Our results provide some evidence on a limited climatic niche conservatism among the distinct geographical units of green turtles. Environmental determinants that have been widely recognized as critical for nesting vary significantly across the studied population units. Our findings raise some concerns on the misuse and the uncertainty of the predictions of species distribution models aggregating data from various populations and including only climatic variables. On the basis of our results, we suggest that the identification of suitable habitats for a species, the description of climate widths and the study of plausible differentiations due to climate change should take into consideration studies on climatic–niche evolution and divergent ecological selection mechanisms. I would like to acknowledge the International Sea Turtle Symposium, the Ministry of Environment and Urban Planning (Republic of Turkey), the Ministry of Forestry and Water Affairs (Republic of Turkey), Muğla Valiliği, Muğla Büyükşehir Belediyesi, Pamukkale Üniversitesi, Ortaca Belediyesi, Tübitak, International Seafood Sustainability Foundation, WWF, Istanbul Akvaryum, Hilton Dalaman Sarigerme Resort & Spa and Wildlife Computers for supporting my participation in the ISTS 2015, through the Travel Grants.

FROM EAST TO WEST: NEW INSIGHTS OF THE TRANSOCEANIC MIGRATION OF GREEN TURTLES IN THE SOUTH ATLANTIC USING GENETIC MARKERS*

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Green turtles are highly migratory marine turtles that establish multiple connections between distant coastal areas, through oceanic migration corridors. To improve the knowledge of connectivity between Atlantic rookeries and foraging areas we analysed the genetic composition and contribution to juvenile foraging aggregations of the third largest Atlantic green turtle rookery, at Poilão Island, Bijagós Archipelago, Guinea-Bissau. We amplified long sequences (850 bp), of the mitochondrial DNA (D-loop) control region that contain the short (390 bp) haplotypes used in previous studies. As previously described, haplotype CM-A8 was dominant and we found two long variants of this haplotype: CM-A8.1 (97.4 %) and CM-A8.3 (1.3 %). However, we also identified in Poilão the haplotype CM-A42.1 (1.3 %), which was considered an orphan haplotype, to date found only in juveniles from Argentine and Brazilian foraging aggregations. A mixed-stock analysis (MSA) revealed the foraging grounds used by the green turtle population of Poilão. Our results confirm the connectivity between South America and West Africa, which had been proposed as a hypothesis in previous studies. Thus,

some hatchlings born in Poilão would migrate westwards, potentially associated with the South Equatorial current and then south, with the Brazil current, reaching foraging grounds in the south of Brazil and Argentine. Our study expands the knowledge on migration patterns and connectivity of green turtles in the southern Atlantic, evidences the importance of using more resolute markers (i.e. long sequences) and larger sample sizes, and emphasises the need for more genetic sampling at West African foraging and nesting grounds to further resolve the connectivity puzzle.

MONITORING STRATEGY EVALUATION: USING VIRTUAL TURTLES TO IDENTIFY PRIORITIES FOR SEA TURTLE POPULATION MONITORING

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Multiple working groups, recovery teams, and modelers have strongly urged a need for monitoring the vital rates of sea turtle populations in addition to nest and nesting female abundance. However, many vital rates such as annual survival and recruitment to the nesting adult population are difficult to monitor without extensive tag and recapture efforts, which are expensive and logistically difficult. We cannot monitor every aspect of sea turtle populations, due to limitations of time and resources. Sensitivity analyses of life cycle models can help us identify which demographic parameters have the largest impact on population growth rates, but are not always useful for short term monitoring and diagnosis of population change. We propose the use of individual-based population models as "true" populations (= operating models) to evaluate which vital rates provide the most helpful information about population change. Using appropriate levels of uncertainty that mimic measurement error and process error (variability caused by environmental changes), we can "sample" a stochastic, virtual population of turtles to see if evaluation of the "data" provides a correct diagnosis of population change. Our preliminary model is a simple one with only nesting females, where recruitment and remigration interval are variable. Successful monitoring of recruitment (proportion of the nesters that are breeding for the first time) greatly improves our ability to detect a true population decline (Type I error) while moderately improving our ability to avoid incorrectly assessing that a stable population is in decline (Type II error). The analysis also provides a sort of power analysis for the length of time it takes to detect a decline in the virtual population. A more elaborate operating model could include the entire sea turtle life cycle, and allow evaluation of monitoring programs for juvenile survival and other demographic rates. Our framework is designed to provide an evaluation of monitoring program effectiveness that will assist managers and conservation groups in planning future programs.

GLOBAL PHYLOGENOMICS OF PLANES CRABS, A COMMON SYMBIONT OF SEA TURTLES*

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Crabs of the family Grapsidae are common and conspicuous inhabitants of rocky shorelines and mangrove forests across the tropical and subtropical oceans. However, one lineage – three species in the genus *Planes* – occupies the open ocean, where crabs recruit to floating debris or pelagic animals and spend the rest for their lives rafting at the surface of the ocean. Among living substrata, *Planes* crabs are frequently found associated with oceanic-stage sea turtles. Currently, there are three described species of *Planes*: *Planes minutus* (N. Atlantic and Mediterranean), *Planes* major (worldwide, except N. Atlantic), and *Planes marinus* (worldwide, except N. Atlantic). While *P. marinus* is morphologically distinct, *P. minutus* and *P. major* show very subtle morphological differences. Genetic differentiation among *Planes* species and widely distributed *Planes* populations has never been evaluated. In this study, we performed restriction-site associated DNA-sequencing (RAD-seq) based population genomic analyses to (1) test the validity of current species designations and (2) quantify genetic connectivity of globally distributed populations. Firstly, we predict that *P. marinus* is genetically distinct and that *P. minutus* and *P. major* are a single, globally distributed species. Secondly, we predict that populations of *P. minutus*/*major* display high connectivity within ocean gyres, within ocean basins, and between the Atlantic and Indian oceans, but low connectivity between the Atlantic and Pacific oceans. Results of this study are not only important for understanding the ecology and evolution of *Planes* crabs, but also for understanding rafting dispersal and the role that sea turtles play as dispersal vectors of symbiotic species.

COMPARING DISPERSION OF LEATHERBACK (*DERMOCHELYS CORIACEA*) WITHIN FROM MANAGEMENT UNITS (OBTAINED BY MTDNA HAPLOTYPES) IN NORTHWEST ATLANTIC BY OCEANOGRAPHIC DATA

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The leatherback turtle (*Dermochelys coriacea*) rookery that exists in mainland Puerto Rico and surrounding islands hosts about 1400 nests per year (according nests recorded in 2011 - 2013 seasons) and is the largest rookery under U.S. jurisdiction. This contrasts with other locations such as Dominican Republic, Saint Croix or Colombia, where rookeries are concentrated in one or a few nearby beaches. Here, except for the south coast, females laid the clutches in almost all beaches appropriate for this species. The wide distribution of nesting activity provides an opportunity for testing hypotheses about the genetic structure and connections between rookeries within and outside of mainland Puerto Rico and if they conform a single or multiple management units (MUs). We investigated the genetic diversity and structure along 5 wide nesting grounds from Puerto Rico based on a 763bp fragment of the mtDNA control region. We found significant genetic differentiation among several wide rookeries of leatherbacks from Puerto Rico. An analysis of molecular variance and an exact test for population differentiation based on haplotype frequencies indicated that the Eastern (EPR) and Western (WPR) pooled haplotypes compared to the North (NPR) Puerto Rico rookeries were genetically differentiated (FST = 0.059, P = 0.01; exact test P = 0.02). Furthermore, EPR and WPR rookeries were genetically indistinguishable of St. Croix rookery (P = 0.8, exact test P = 0.8; P = 0.7, exact test P = 0.7, respectively), while EPR and WPR were genetically differentiated of Dominican Republic (P = 0.04 exact test P = 0.01; P < 0.01, exact P < 0.01, respectively). In contrast, NPR and the Dominican Republic rookeries were genetically indistinguishable (P = 0.3, exact P = 0.1), while NPR and St. Croix showed low but detectable genetic differentiation (P = 0.04, exact P = 0.04). Our results suggest that EPR, WPR and St. Croix rookeries are part of a regional population and considered a MU, while NPR and Dominican Republic are considered other MU. In order to detected if our genetic outcomes are feasible explain by oceanographic features in the nesting months. We used our genetic data to investigate the connectivity between rookeries that conform a single (MU) compared to oceanographic studies using dispersion modeling and drifter buoy data. Comparative analysis between mtDNA control region sequences and oceanographic studies represent a powerful approach for understanding how sea turtles are distributed and dispersed in space and time and for testing hypotheses not only about genetic structure but also to shed light about the role that marine currents and other oceanographic features have on the structure and connectivity of populations. [Note: Results between genetic and oceanographic data will be presented but the abstract deadline is before the completion of data analysis.]

WHAT ARE YOU DOING HERE? FIRST REPORT OF A *LEPIDOCHELYS OLIVACEA* INSIDE THE MEDITERRANEAN SEA

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The olive ridley sea turtle (*Lepidochelys olivacea*) is considered the most abundant sea turtle species in the world. The species has a circumtropical distribution, occurring regularly in the Pacific and Indian oceans and less frequently in the South Atlantic. Data on olive ridleys in the eastern Atlantic are sparse with main nesting areas located throughout the west coast of Africa, between Guinea Bissau and Angola, with no 'arribada' detected in nesting beaches of this ocean. The northernmost sightings of the species in the eastern Atlantic have been reported from Senegal, Madeira and from the Canary Islands. The presence of the olive ridley inside the Mediterranean has never been reported before. On 8 May 2014, the carcass of a dead stranded sea turtle was found in the town of Oropesa del Mar (40º05′32″N, 0º08′02″E) in the Mediterranean coast of Spain. The specimen was transported to the University of Valencia facilities for its examination and necropsy. In the western Mediterranean about 99% of sea turtles recorded are loggerheads (*Caretta caretta*), with limited reports of green turtles (*Chelonia mydas*), Leatherbacks (*Dermochelys coriacea*) and Kemp's ridley (*Lepidochelys kempii*). The presence of 7 costal scutes per side and inframarginal pores in this stranded turtle leaded us to perform genetic studies to correctly identify the species. The specimen had a sequence that matched the 470 bp *Lepidochelys olivacea* haplotype F (Genbank accession number: AF051773), found at the Atlantic populations of Guinea Bissau, Suriname and

Brasil, thus indicating that this stranding is the first confirmed report of *Lepidochelys olivacea* within the Mediterranean. Besides of being the first report of this species in the entire Mediterranean Sea, this is also one of the northernmost occurrences of olive ridley in the world. Based on genetic analyses including ~800 bp sequences, we discuss the possible origin of this specimen and evaluate the consequences of the extended range for the species, considering interaction with other sea turtle species and local anthropogenic threats, in a global warming scenario.

GENETIC DIVERSITY IN KEMP'S RIDLEY SEA TURTLES*

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Over the last two decades, upward trends in Kemp's ridley nesting at the species' primary nesting beach in Rancho Nuevo, Tamaulipas, Mexico have been viewed with optimism as evidence of recovery and hope for eventual downlisting of the species. Unfortunately, recent nesting numbers are drastically down and updated life history models indicate a much more complicated and delicate status (Heppell, 2014, Second International Kemp's Ridley Sea Turtle Symposium). Currently, Kemp's ridley sea turtles are managed as one, panmictic, population. However, some evidence suggests that this approach should be reevaluated. While the vast majority of the international recovery efforts have been rightly focused on the important nesting beach at Rancho Nuevo, there is some limited historical evidence suggesting that Kemp's ridley sea turtles were more widespread at one time, potentially having significant nesting numbers in the southern Gulf of Mexico. Kemp's ridley nesting can be found stretching over approximately 1,000 km of coastline around the western edge of the Gulf of Mexico. Rancho Nuevo occurs in the northern half of the nesting area while the largest nesting population outside of the Rancho Nuevo area occurs in the southern half. Southern Gulf of Mexico beaches potentially have reduced connectivity to northern beaches presenting the potential for some degree of population differentiation (north Gulf vs south Gulf) and unique genetic lineages. We present mitochondrial haplotype data addressing the genetic diversity of the nesting population at Tecolutla and preliminary analyses of population structure by comparison with published haplotype data from Texas nesting beaches (Frey and Dutton, 2014). Despite the nesting turnaround at Rancho Nuevo, Kemp's ridleys remain the most endangered of all sea turtle species (NMFS *et al*., 2011; Márquez, 2001), and the total impact of the Deepwater Horizon oil spill on the species is still unclear (Campagna *et al*., 2011). This is especially true in the light of recent drastic reductions in nesting numbers at both Tecolutla and Rancho Nuevo. This project will increase our understanding of genetic differentiation between nesting beaches, and potentially allow for an increased understanding of the connections between nesting beaches and our previously reported in-water subadult aggregations. Understanding these patterns will allow for more informed management decisions, which may be crucial given the uncertain future of Kemp's ridley turtles.

ANALYSIS OF THE MEDITERRANEAN GREEN TURTLES POPULATION COMPOSITION AND DYNAMICS, USING THE MITOCHONDRIAL DNA STR HAPLOTYPING

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Green sea turtle (*Chelonia mydas*) living in the Mediterranean are endangered species. There are only a few hundreds of nesting females, all in the eastern shores of the Mediterranean. The attempt to evaluate their genetic variation using the common haplotyping system, based on sequence analysis of a segment of the mitochondrial DNA (mtDNA) control region (D-loop) as an indicator, revealed very little polymorphism. Almost all of the turtles have the CM-A-13 haplotype, and the only other detected haplotype, CM-A-14, is very rare. Polymorphism is therefore detected only when repeat sequences, like STRs are used for analysis. Mitochondrial DNA STRs proved to be the perfect tool for such an analysis, as they reveal polymorphism and allow for understanding of maternal lineages of the nesting females. We have looked at mtSTR haplotypes of 238 nesting females from different regions: Turkey, Cyprus and Israel as well as 200 stranded turtles from Israel. We have constructed a phylogenetic tree containing all the different haplotypes. Our results support historical documentations implying that that the current Mediterranean population is the remnants of a much larger population. A look at the stranded turtles from the Israeli shore gives another perspective of migration patterns supported by satellite tracking.

SPATIO-TEMPORAL PATTERN OF SEA TURTLE PRESENCE AND HUMAN INTERACTION IN THE CENTRAL TYRRHENIAN SEA, WESTERN MEDITERRANEAN: EVIDENCE FROM THE STRANDING AND SALVAGE NETWORK

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Monitoring strategies of endangered marine species must combine ecological significance, statistical credibility and cost-effectiveness for long term sustainability. Stranding and salvage networks provide excellent results in cost-effectiveness, but their ecological significance and statistical credibility may be disputed because stranding probabilities are influenced by several factors such as sea surface currents, meteorological conditions, human presence along the coasts or at sea, etc. Therefore only data gathered by trained personnel participating to formal and well established stranding and salvage networks provide the necessary guarantee in terms of data quality and should be used to inform wildlife managers. Here we report results of the activity conducted in the period 2007-2013 by the Sea Turtle Stranding and Salvage Network operating in the central Tyrrhenian Sea along the south Italian coasts (from 41.22°N, 13.76° E to 40.04°N, 15.64° E). This is an important index area for the presence of sea turtles in the region and has been intensively monitored since 1991. A total of 623 loggerhead turtles were recorded of which 233 were alive and 390 were dead. Mean turtle size was comparable between live and dead turtles (60.4 ± 11.7 cm and 61.9 ± 10.2 cm, respectively; Kolmogorov Smirnov D-value= 0.084, $p < 0.05$). Temporal patterns were different with dead turtles occurring mostly in late spring/early summer while alive individuals were regularly found all year round (chi-sq = 61.36, $p < 0.001$). Spatial analysis using kernel density estimation indicates that turtles tend to concentrate along the sandy coasts of the region where the continental shelf is wider. These are also the most productive areas and, thanks to the heavy nutrient enrichment from fresh water input, they sustain rich benthic communities. All live sea turtles were taken to the rehabilitation facility of the Stazione Zoologica Anton Dohrn to receive the required treatments. The success rate of rehabilitation was above 85%. The vast majority of live individuals presented traces of human interactions such as injuries caused by entanglement in fishing lines or nets, collisions with vessels, direct contact with pollutants or ingestion of marine litter. Dead specimens were taken to appropriate facilities for biological sampling and necropsy. Complete post mortem examinations were conducted at the Istituto Sperimentale del Mezzogiorno (N = 41). 10 individuals presented evidence of fisheries interactions (hooks and fishing lines). The following zonotic agents were found: *Samonella* sp (1 individual), *Vibrio fluvialis* (1 individual), *V. vulnificus* (1 individual), *Vibrio alginolyticus* (9 individuals), *Aeromonas hydrophila* (6 individuals), *Aeromonas sobria* (2 individuals). Sex ratios, foraging ecology and demographic composition of the aggregation are also monitored as part of the ongoing research

activities and will be discussed. The data presented here demonstrate that systematic data collection from stranded sea turtles can provide useful biological information, such as seasonal and spatial patterns in their occurrence and mortality, age structure, sex ratio and diet, as well as possible mortality causes, but the use of standardized approaches, the adequate training of the personnel and the efficient coordination of network activities among partners are critical for its success.

USING NEXT-GENERATION SEQUENCING TO ENLIGHTEN THE HYBRIDIZATION PROCESS OF *CARETTA CARETTA* AND *ERETMOCHELYS IMBRICATA* IN BRAZIL*

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Nesting areas of Bahia state in Brazil have the largest known rate of hybridization in the world, reaching 43% of the *E. imbricata* nesting females. The main hybrid type found in this region is the one between *C. caretta* and *E. imbricata*, with negligible rates of other species hybrids. Previous studies have investigated this hybridization using mitochondrial and few nuclear sequences and microsatellite markers, and were able to give insights into this hybridization process, such as the presence of preferential hybrid backcross with *E. imbricata*. To further investigate this hybridization/introgression in Brazil, we have used high throughput sequencing for samples already published and as well as for new *C. caretta* and *E. imbricata* samples from Bahia. We have standardized the double-digest RAD (ddRAD) sequencing, which consists in sequencing a reduced-representation of a species genome. We developed a pipeline for selecting a suitable enzyme combination to be used in sea turtles with in silico analysis. All samples were sequenced in the Illumina MiSeq using an adapted ddRAD protocol. The sequenced libraries resulted in thousands of new loci, giving us the opportunity to look with more detail into the genome of the hybrids and of *E. imbricata* and *C. caretta*.

COMPARISON OF RECENT AND HISTORICAL SURVEYS OF NESTING BY LOGGERHEAD TURTLES ON BEACHES OF MASIRAH ISLAND, SULTANATE OF OMAN*

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Surveys of loggerhead turtles nesting on Masirah Island were initiated in 1977. Initial nest counts and estimates of nesting females from these surveys showed that Masirah Island was the largest aggregation of nesting loggerheads in the Indian Ocean, and possibly the largest loggerhead rookery in the world. The surveys estimated 20-40,000 females to be nesting on the island annually based on track count surveys and a nesting frequency value of 4.0 per season. A standardized monitoring program for the Masirah rookery was established in 2008 by an interagency partnership, resulting in data that allows for the evaluation of long-term nesting trends. The survey data were generated by trained environmental support staff from the local community, including MECA rangers and ESO field assistant personnel with the assistance of regional and international turtle experts. Standard survey methods were implemented to conduct daily track count surveys of 23km of beach at the northern end of the island, and bi-monthly surveys of the remaining 60km of nesting shoreline to the south. The survey period was limited to a 20-week period starting on the 1st of May, with additional nightly surveys conducted on selected beaches to establish nesting success ratios. Data were analyzed from historical (1977-2007) and recent surveys (2008-2014) to allow comparison between the annual number of nests. Nesting frequency data from satellite tracking was also used to calculate a revised estimate for the total number of females nesting on the island on an annual basis. Results indicate a significant decrease in the number of nests per year between historical and recent survey periods. Furthermore, the total number of nesting females was estimated to be significantly less than previously thought due to a revised value for the nest frequency of 5.5 (derived from the satellite telemetry work). The revised reduced population estimate together with the downward trend in nesting effort are of sufficient magnitude to warrant a review of our understanding of the global population status of this species and its conservation needs. Whilst monitoring in Oman continues, increased efforts are recommended at a regional level to investigate and respond to causal factors related to the declining trend in nesting.

IN-WATER BIOLOGY

SATELLITE TRACKING OF HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) IN SECHURA BAY, PERU

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ProDelphinus, Enrique Palacios 630 Dpto.204, Lima 18, Peru

Since 2011 we have been monitoring interactions of small-scale fisheries with hawksbill turtles (*Eretmochelys imbricata*) in Sechura Bay, Piura, northern Peru. In 2014, we deployed four satellite transmitters on hawksbills incidentally caught in this bottom set net fishery targeting guitarfish (*Rhinobatos planiceps*), rays (*Myliobatis spp*) and flounder (*Paralichthys adspersus*). Curved carapace lengths (CCL min) of captured hawksbills ranged from 36.0 to 46.4 cm (mean ± SD); indicating that all were juveniles. Platform transmitter terminals (Wildlife Computers SPOT 293A) were attached to the carapaces using a two-component epoxy. Devices have been transmitting from 47 to 295 days, with two PTTs still active. The maximum distance travelled by an individual was 280 km. However, three of four individuals remained in bay, displaying strong site fidelity, suggesting that Sechura Bay is important as a foraging area. This is of concern given the intense fishing activity in Sechura Bay. One tracked hawksbill was recaptured after 208 days, and was later released in good conditions by the fishermen. There are also indications from two of the tracks that they ended in capture by fishing vessels. This study will provide information on habitat use of hawksbill turtles in northern Peru and the overlap with coastal fisheries.

ASSESMENT OF A HAWKSBILL TURTLE *(ERETMOCHELYS IMBRICATA)* FORAGING POPULATION IN THE DERAWAN ARCHIPELAGO, EAST BORNEO, INDONESIA

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The Derawan archipelago off the east coast of Borneo is the largest nesting site of the green turtle in Indonesia. It is less well known that its extended coral reefs also house an important foraging population of the critically endangered hawksbill sea turtle. Unfortunately, hawksbills are regularly hunted for making turtle shell products that are sold to tourists. To raise governmental and public awareness for the situation of the archipelago's hawksbill turtles, and to create a scientific basis for a hawksbill turtle conservation and management strategy, we initiated a research program addressing crucial questions about the turtle's population status and biology. A pilot study was started in September 2014 on the inhabited island of Maratua, and consisted of three parts planned to be continued and extended during the next years: 1. In-water mark and recapture study: Hawksbill turtles rarely nest on the archipelago's islands, thus, their nesting rookeries must be searched elsewhere. Further, we want to obtain morphometric data to calculate individual growth rates and the population's age structure. DNA samples should reveal the relation of the archipelago's hawksbills to other populations. Our first catching initiative in September 2014 was primarily targeted to test catching methods for safeness and efficiency. We obtained the best results with a team of local scuba divers, who searched the reef slopes with torches at night for resting turtles, caught them with their hands, and moved them on board of our expedition ship for tagging and measuring. Since we were able to catch five hawksbills in one night, this will be the method of choice for more extended capturing campaigns. 2. Interviewing campaign among locals: Most coastal and island people of the archipelago depend from fisheries, and their lives are strongly interconnected their marine environment. Thus, we created a questionnaire to ask local people about frequencies, locations, and times of their sea turtle encounters. Additionally, we asked them about social conditions, fishing practices, and attitudes toward conservational measures. In our first campaign in four villages on Maratua lasting for six weeks, we interviewed 187 persons (about 6% of the island's total population). We obtained much information about the occurrence of hawksbill turtles in the waters near Maratua, about the social and economical situation of the local people, and found a surprisingly high appreciation of conservation measures under the premise that they are conducted in strong collaboration with the local population. 3. Interviewing campaign among dive tourists: In three dive resorts on Maratua, questionnaires asking for locations, quantities, and times of their turtle encounters were handed out to divers who were interested to participate in our study. The study is still ongoing, but already revealed valuable data about hawksbill turtle frequency in distinct dive locations off the coast of Maratua. To our knowledge, our study is the first of its kind carried

out in the waters of Southeast Asia, and will be the starting point for a comprehensive conservation and research program for the hawksbill turtles of the Derawan archipelago.

AGE AND GROWTH OF JUVENILE GREEN TURTLES, *CHELONIA MYDAS*, STRANDED DEAD IN PARANÁ COAST, SOUTHERN BRAZIL

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The Paraná coast, southern Brazil, represents an important area for the development and feeding of juvenile green turtles that originate from various nesting sites. However, these animals are threatened by anthropogenic impacts and high levels of bycatch. Thus, efforts for the conservation of this area are essential for the species' maintenance and for genetic variability. Understanding life history parameters, such as age structure and growth rates, habitat-use patterns and migration, are essential for conservation efforts and mitigation measures. This study used the skeletochronology technique to analyze the age and growth of green turtles stranded dead along the Paraná coast. Green turtles were sampled between 2008 and 2013. Each animal was measured for curved carapace length (CCL in cm), before the humerus was collected and, when possible, sexual identification was made. Sixty-three green turtles sampled (CCL range: 30.0 cm - 58.0 cm; SD: 39.8±5.5) were estimated to be between two and eight years old. Eleven of these specimens were males (CCL range: 31.5 cm - 43.0 cm; SD: 37.6±4.1) with an average age (±s) equal to 3.5 ± 1.3 years (2 to 6 years), while 10 were females (CCL range: 36.5 cm - 58.0 cm; SD: 42.4±6.6) and an average age equal to 4.4 ± 1.8 years (2 to 8 years). The average CCL and age did not differ between males and females ($p>0.05$). Using the humerus maximum length and its average width, a proportional relationship with the increasing of CCL and age was identified. However, observed differences about CCL were restricted to green turtles older than six years. There were no significant differences between the age and CCL of sampled animals among the annual seasons (Age: d.f= 3; F= 1.98; q= <3.74; $p>0.05$/ CCL: d.f= 3; F= 0.59; q= <3.74; $p>0.05$) and the years of analysis (Age: d.f= 5; F= 0.40; q= >0.41; $p>0.05$/ CCL: d.f= 3; F= 1.82; q= >4.1; $p>0.05$). A constant growth rate k= 1.14 was derived from the von Bertalanffy model and with growth rates between 0.03 and 2.90 cm/year. The Paraná coast is a recruitment area for juvenile green turtles that migrate from the oceanic to the neritic zones, as well as a developmental and foraging area. Thus, this is an important region for the conservation and maintenance of this endangered species in the Southwestern Atlantic Ocean. The authors would like to thank the ISTS and its sponsors.

WHETHER CLIMATE? DECADAL CLIMATIC MODULATION OF NEONATE LOGGERHEAD TRAJECTORIES IN THE NORTH PACIFIC*

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There is a growing appreciation for the significance of oceanographic dynamics to sea turtle populations, and recently there has arisen debate as to whether climate can be applied to interpret historical abundance trends or to forecast future trajectories. Here, we use the eddy-resolving ocean circulation model OFES (OGCM for the Earth Simulator) to generate neonate turtle trajectories for loggerhead turtles in the North Pacific. Using a supercomputer cluster, we release 2,600 trajectories at the peak emergence season, with a time step of 6 hours, run the trajectories for one full year, repeating this for each annual cohort over the period 1950-2010. Neonate trajectories are computed from OFES, with the addition of random swimming behavior. From these model results, we run a series of analytical routines and examine a number of hypotheses as to how climate may influence the fate of neonate sea turtles. First, we find the axis of the high-velocity Kuroshio Current is consistently proximate (< 10km) to the major loggerhead rookeries in Japan, facilitating the rapid transport of neonates from neritic to oceanic habitats. Second, we find the range of neonate temperature experiences is bimodal with one group being at 20-22 °C and the other at 25-27 °C at the end of one year. This dichotomy is also decadal, consistent with the Pacific Decadal Oscillation, where cooler trajectories occur in a positive PDO and warmer trajectories occur in the negative phase. We compare our results to the known physiology of neonate sea turtles and discuss the implications for long-term climatic forcing of loggerhead populations in the North Pacific.

PHOTO RECOCOGNITION FOR IN-WATER IDENTIFICATION OF HAWKSBILLS IN A MARINE PROTECTED AREA OF HONDURAS*

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The hawksbill sea turtle (*Eretmochelys imbricata*) can be found in the Atlantic, Pacific and Indian Oceans. As with other sea turtle species, hawksbills have a cluster of scales on the dorsal and lateral surfaces of the head that form unique scale patterns. Following a previous study using Interactive Individual Identification System (I3S) Spot, we used the Pattern version of I3S to compare and identify in-water photographs of turtles within the Roatán Marine Park (RMP) on the western end of Roatán, Honduras from May to September, 2014. The Pattern program is designed to annotate individual 'fingerprints' for species with complex markings by identifying key points and assigning a descriptor area around each point using the Open Source Computer Vision (CV) implementation of Speeded-Up Robust Features (SURF). Points and areas are delineated within a user specified polygon using an automatic key point extraction algorithm. The 'fingerprint' on one photograph is then compared to 'fingerprints' on other photographs in the database and potential individual matches are selected, thus reducing the number of photographs that require review by manual comparison. Through daily underwater dives, we photographed turtles on 78 occasions and created a database of 182 photographs. New photographs were then cross referenced with photographs in the I3S photo database to determine whether turtles had been previously encountered. We visibly assessed potential matches for similarities and successfully identified 68 different hawksbill individuals. Nine individuals were re-identified from pictures on later dives and one individual was re-identified twice. I3S Pattern failed to recognize actual matches (false negatives) four times (40%), and identified two (20%) false positives. However, these false matches may have been dependent on the quality of the photographs used. We were unable to use I3S Pattern to match any dorsally oriented photographs and recommend that future studies use I3S Spot, rather than the current version of I3S Pattern, to match photographs taken of the dorsal view of the head. The I3S Pattern program successfully aided our research by facilitating accurate counts of hawksbill sea turtles re-sighted in the RMP over the period of the study. Automated photo identification can help provide long-term data on turtle migrations, movements, and life-history stages, and can thus be a valuable tool for conservation of marine turtles.

SHIPS OF OPPORTUNITY: RELEASING SATELLITE-TAGGED LOGGERHEADS ON THE HIGH-SEAS TO STUDY THEIR PELAGIC ECOLOGY

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Life on the high seas is one of the last great frontiers for sea turtle exploration, inquiry, and discovery. In the Pacific Ocean, significant progress has begun in understanding the ecology and oceanic movements of juvenile pelagic loggerheads in northern and southern hemispheres comprising distinct genetic stocks derived from nesting beaches in Japan and New Caledonia/Australia respectively. Our advances in knowledge to date have been made possible by the availability of smaller satellite-linked tracking tags and the enhanced sensitivity of CLS Argos receivers on board orbiting satellites. We have overcome the immense challenge of directly capturing immature loggerheads on the high seas by substituting robust aquarium-reared turtles transported by ship for offshore release. Trained shipboard observers have also satellite-tagged and released pelagic long line by-catch turtles on the high seas. Turtles incidentally taken in offshore commercial pound nets targeting pelagic fish have also contributed to our international research partnership program. From 1997-2012, 523 loggerheads with satellite tags have been released, 374 of which were aquarium reared involving 14 deployments >2003 from eight different ships, including cargo vessels, fishery training ships, a passenger liner, a French Navy ship, a fishing vessel, and a whale-watching tour boat. Eighty-eight turtles from the New Caledonia Aquarium des Lagons were released south of the equator, and 286 from the Port of Nagoya Public Aquarium Japan were released in northern latitudes. Carapace lengths ranged from 23-75 cm. Deployment locations included: the Kuroshio Current off Japan (30-35°N, 131-141°E); the Sea of Japan (37°N, 136°E); midway between Japan and Hawaii (33°N, 176°E), midway between New Caledonia and

New Zealand (30°S, 171°E); and 200nm southwest of New Caledonia (25°S, 163°E). Tracking lasted up to 1434 days in the northern hemisphere and 764 days in southern latitudes. Maximum distance traveled by a northern-stock turtle was 25,900 km and 15,290 km for a southern-stock turtle. Three overall conclusions can be drawn from the success of our work: 1) International partnerships of mutual understanding, trust, and goodwill are essential to study sea turtle populations that span an ocean basin; 2) Aquarium-reared loggerheads released into appropriate high-seas habitats are acceptable replacements for the research of wild-captured turtles; and 3) Our voluminous archive of tracking data constitutes a significant resource for additional analytical approaches involving collaboration. Detailed findings to date of our pelagic loggerhead investigations are presented in 12 journal publications available at: http://akepa.hpa.edu/~mrice/sop/Pelagic.html.

POTENTIAL HAWKSBILL PREY ITEM DISTRIBUTION AMONG DIVE SITES IN A MARINE PROTECTED AREA IN ROATÁN, BAY ISLANDS, HONDURAS

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The Bay Islands of Honduras consist of three different islands, one of which is the island of Roatán on which the Roatán Marine Park (RMP), a marine protected area, is located at the west end. The RMP has only recently become an important area for sea turtle populations. The marine park is patrolled daily by park rangers to prevent illegal fishing practices and the take of sharks and turtles, creating safe foraging areas for many marine megafauna. Hawksbills have been observed foraging within the park, yet the prey species they utilize are essentially unknown. We observed hawksbill foraging behavior for 15 – 20 min intervals and collected small samples of prey we observed turtles ingesting. Potential hawksbill prey items were surveyed by random transects over the reef at 13 individual dive sites. Six to seven transects per site were conducted by laying a 30-meter rope marked every five meters with colored string and a number, over a section of the reef. We placed a 1m2 quadrat at each of the six markers, taking photographs from approximately one meter above each quadrat. Photos were sorted by dive site and transect number, taken into Photoshop CS6 for editing, and then imported into Coral Point Count with Excel extensions (CPCe) to identify presence/absence of species of coral, gorgonians, macroalgae, sponges, and zooanthids. Within the RMP, 13 individual dive sites have been analyzed to date and revealed a combined average mean of 13.44% ± 3.93 SD for the presence of hard and soft coral, 5.09% ± 2.17 SD gorgonian, 27.60% ± 7.54 SD brown, green, and red macroalgae, 2.14% ± 1.21 SD sponge, and 0.26% ± 0.36 SD zooanthids. Also within our study transects, we found 19.91% ± 6.51 SD dead coral with algae, and 0.01% ± 0.02 SD diseased corals. Thirty-five individual turtles were observed foraging, and of these, 14 (40%) were recorded eating only algae during the time observed, while 11 (31%) were observed eating only sponge, and 10 (29%) were observed eating both sponge and algae. We suggest that due to the high percent presence of macroalgae, the low percentage of sponges, and the high percentage of turtles observed consuming algae among the six dive sites, macroalgae may be an important prey item for turtles at this location. A possible cause for this may be the high percentage of dead corals within our study sites on which macroalgae are growing. Continued management of the RMP through daily patrols may facilitate reef habitat improvement and potential hawksbill population recovery in this area.

DO POST-HATCHLING LOGGERHEAD SEA TURTLES HAVE PERSONALITY?

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Animal personality (behavioral syndrome) is defined by individual differences in relationships between behavioral responses in various contexts across time. These relationships between behaviors can limit the adaptability of behavioral responses relevant to survival and could therefore have significant implications for endangered species. Hatchling loggerhead sea turtles (n=14) were obtained from nests deposited on several beaches in North Carolina and transferred to the University of North Carolina at Chapel Hill where they were kept in separate tanks. To investigate whether animal personality exists in post-hatchling loggerhead sea turtles, we will compare individual predator escape, exploratory, feeding, and social behavioral responses in various contexts across time. To test predator escape responses, we will time

the duration of tuck behavior in response to handling, light and shadow stimuli. To test exploratory and feeding behavior, we will videotape and track the activity of individuals in their tank. To test social behavior, we will place a mirror on the inside of one of the tank walls. To determine whether personality exists, we will look for relationships between these behaviors in individuals in various contexts across time. This novel research approach in the behavioral ecology of sea turtles could provide important insight to the survival strategies and behavioral adaptability of a vulnerable life stage in sea turtles.

WHAT THE TURTLES HEAR: ACOUSTIC ECOLOGY OF THE LEATHERBACK SEA TURTLE*

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Awareness of marine noise, and potential associated impacts, is increasing. There is, however, a paucity of empirical research on the effects of noise on free-living animals. Using tracking and acoustic monitoring technologies deployed in tandem, we collected fine-scale data on the behaviour and acoustic ecology of the leatherback turtle (*Dermochelys coriacea*), nesting in Gabon, Central Africa; a country which supports the largest leatherback nesting population in the world and 60% of all nesting leatherbacks in the Atlantic. A SPLASH10-AF satellite transmitter (Argos tracking), DSG-OpenTag (acoustic) and VHF transmitter (for relocating individuals) were attached to four female turtles using direct carapacial attachment. Data were gathered throughout an entire internesting interval (n=4, average±SD=9.6±0.18days), on depth-use, sound and location. The acoustic environment was sampled for 30 seconds every 10 minutes (n=5562, representing 3188 MB of data), within an effective frequency range of several Hz to 12.5 kHz; adequately encompassing the range at which marine turtles are thought to be sensitive to sound. Recorded sounds, with known location and depth, include rain, flipper beats, boat engines and cetacean vocalisations. We discuss the potential effects of anthropogenic sound sources on this species. Our findings provide one of the first examples of animal-borne soundscape monitoring over extended periods (multiple days).

YOU ARE WHERE YOU EAT; STABLE ISOTOPE RATIOS ELUCIDATE GREEN TURTLE FORAGING GROUNDS WITHIN THE EASTERN MEDITERRANEAN*

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Satellite telemetry can be an important tool allowing the investigation of cryptic migratory patterns in long ranging marine species, such as sea turtles, where other extrinsic markers are difficult to recover. However, sample sizes are often necessarily small and the temporal span covered is highly biased. Recently, indirect methods using stable isotope ratios of carbon and nitrogen, validated by satellite telemetry, have been used to assess foraging strategy at the population scale and a variety of temporal spans. For this current study, we compared the stable isotope ratios of carbon and nitrogen from 19 green turtles (*Chelonia mydas*) satellite tracked from northern Cyprus to different locations within the Mediterranean. For individuals where tissue samples were available over multiple years, foraging site fidelity was investigated through comparison of within individual variation (temporal variation) and between foraging site variation (spatial variation) of isotopic signatures. The isoscape formulated from satellite tracked turtles was then applied to assign foraging area to additional green turtles that have not been subject to satellite tracking. From these data, it proved difficult to assign foraging area to untracked turtles due to similar isotopic compositions within several of the foraging areas. For this reason, the Euclidean distances of carbon and nitrogen isotope ratios were used to investigate parameters of reproductive fitness which are thought to be influenced by differential foraging in other sea turtle rookeries.

MUSEUM COLLECTIONS HELP IN CLARIFYING ECOLOGICAL CHANGES: THE CASE STUDY OF LOGGERHEAD TURTLES AND JELLYFISH IN THE MEDITERRANEAN*

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Considerable debate has existed during the past decade about a possible long-term increase in the abundance of jellyplankton in the ocean as a result of global warming and overfishing. The few available historical data sets on jelly plankton abundance indicate no actual increase of the frequency of the mauve stinger (*Pelagia noctiluca*) in the Mediterranean, but data are qualitative and hence have low accuracy. Loggerhead turtles (*Caretta caretta*) are opportunistic predators consuming large amounts of mauve stingers and other jelly plankton in the Mediterranean Sea but also include fishes and cephalopods in their diets. The δ15N values of jelly plankton are much lower than those of the other prey consumed by loggerhead turtles in the Mediterranean Sea and hence a historical increase in the abundance of jelly plankton in the Mediterranean could be traced through a decrease in the δ15N values of the skeletal material of loggerhead turtles preserved at scientific collections. We sampled bone tissue from six loggerhead turtles collected from Lazio and Campania (Tyrrhenian Sea, central-western Italy) in the late 19th - early 20th centuries and ten samples from loggerhead turtles dead stranded in 2002-2003 in the same region. All the specimens belong to the osteological collection of the Civic Museum of Zoology in Rome. We also analyzed nine exsiccata of the seagrass *Posidonia oceanica* collected along the same coasts in the past (1873, 1880, 1887, 1888, 1889, 1947, 1956, 1967) and eleven modern samples, to assess changes in the isotope baseline. All the specimens belong to the Herbarium - Botany Museum at Sapienza University of Rome, except those from 2008. When compared with modern loggerhead turtles, ancient ones were significantly enriched in 15N (t- test; δ15Nancient =10.83 ± 1.6 ‰; δ15Nmodern= 9.26 ± 0.88 ‰; p=0.011) and 13C (t-test; δ13Cancient = -14.9 ±1.4 ‰; δ13Cmodern = -16.7 ±1.3‰; p= 0.007), which is consistent with a recent increase in the consumption of jellyplankton. However, the δ15N values of the seagrass leaves declined linearly from 1873 to 2008 (r2=0.692, p<0.001, n=20), thus suggesting that the decline in the δ15N value of loggerhead turtles did not represent a true dietary shift but a change in baseline. Conversely, no historical change has been observed for the δ13C values of seagrass leaves (p=0.141). When the δ15N values of ancient turtles are corrected to account for the historical change in baseline (corrected δ15Nancient=8.1 ± 1.7 ‰), differences between ancient and modern turtles vanishes (t-test, p=0.085). This indicates that loggerhead sea turtles from central-western Italy forage currently at the same trophic level than a century ago, although differences in δ13C values suggest a more pelagic diet. These results are consistent with historical data sets indicating no major increase in the abundance of mauve stingers in the Mediterranean Sea.

MODELING FORAGING GROUND DYNAMICS AT THE LARGEST LOGGERHEAD NESTING AGGREGATION IN THE ATLANTIC USING SPECIES-SPECIFIC ISOSCAPES*

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Marine turtles move between geographically distinct feeding and reproductive areas and are difficult to monitor year-round. Our understanding of marine turtle migratory patterns has been enhanced by new tools that have become available (e.g. electronic tagging, intrinsic markers such as genetics and stable isotope analysis). Telemetry has provided considerable insight into movement behaviors of marine turtles, but the individuals tracked may not fully represent the behavior of the population. Generally only few individuals are tracked in each given year due to high cost associated with telemetry. While telemetry elucidates habitat use in detail at the individual level and is critical to delineate migratory corridors, it is not appropriate to depict the dynamics of foraging area contributions at the population level. Thus, marine turtle migratory connectivity has been increasingly studied using a combination of techniques and, in particular, using satellite telemetry and stable isotope analysis. We build upon loggerhead-specific isoscapes developed by Ceriani *et al*. (2014), included a larger number of females equipped with satellite tags and developed spatially explicit models to assign likely foraging areas used by 450 loggerheads nesting at the Archie Carr National Wildlife Refuge, one of the two largest

nesting aggregations in the world. Based on previous satellite tagging and flipper tag returns, females from this nesting location use four main foraging areas: (i) the mid-Atlantic Bight, (ii) the South-Atlantic Bight, (iii) the Subtropical Northwest Atlantic, which encompasses the Greater Caribbean and the Florida Keys, and (iv) the continental shelf of southwest Florida. However, the relative importance of each area has not been determined. Here, we use a novel approach to model dynamics of foraging area contribution to the aggregation nesting in Florida on an annual basis and over an eight-year consecutive period. We provide population-level information at a spatial scale finer than previously available that can be used by managers to identify areas of conservation priority and provide a tool to interpret trends in nesting and aid the identification of threats specific to each foraging aggregation. Implementation of probabilistic assignment of origin with isoscapes for unknown individuals has not been conducted in the marine environment. Similar methodologies could be applied to migratory marine species other than loggerheads. SA Ceriani thanks several organizations and the International Sea Turtle Symposium for their generous donations that supported her attendance to the meeting.

MULTI-YEAR SATELLITE TRACKING OF LOGGERHEAD SEA TURTLES NESTING ALONG THE IONIAN CALABRIAN COAST (SOUTHERN ITALY)

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The Ionian coast of Calabria represents the most important nesting ground in Italy, hosting about 60% of nests laid nationwide each year. Since no information was available on the movements made by the turtles belonging to this rookery, five females nesting in the area were tracked by satellite in the period 2010-2014 and monitored for periods ranging from 5 months up to over three years. In this way it was possible to reconstruct: a) the turtles' internesting movements and post nesting migrations, b) their short-range activities during the stay at the foraging grounds and c) the pre-breeding migration back towards Calabria of three females. We also estimated the turtles' home ranges during their sojourn at the foraging grounds. During the internesting period, all turtles did not remain near the nesting beach, as it commonly observed in nesting loggerheads, but carried out long-distance loops in oceanic offshore areas (total movement length ranging from 322 to 730 km). After completing the nesting cycle, all turtles migrated towards their individually-specific neritic foraging grounds located on the Tunisian shelf, along a coastal sector spanning from the Gulf of Hammamet to the Gulf of Gabès. During migration, tracked females followed a rather direct route (straightness index ranging between 67% and 89%) moving along a basically similar path, first orienting south until reaching Malta Island and then turning south-west, with each turtle travelling at a similar ground speed (around of 2 km/h). While at their foraging sites, turtles occupied two different areas during the year, one in the winter season and one in spring-summer, and all females moved from one area to another roughly in the same period (in April towards their summer foraging grounds, in November-December back towards their winter foraging areas). The home range size at the foraging areas varied between turtles, and three females occupied larger home ranges during winter than in summer. The long tracking duration allowed us to monitor the pre-breeding migrations in three turtles, that were made after 2 years in two turtles and after 3 years in the third individual. The pre-breeding migratory route was much less direct than the postnesting one.

OLIVE RIDLEY MIGRATION OVER THE GUYANA CONTINENTAL SHELF: DISTRIBUTION AND DIVING BEHAVIOUR IN RELATION TO MESOSCALE FEATURES

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Under the influence of both tidal and oceanic currents, the Guyana continental shelf is one of the most dynamic coastal ecosystems of the world. Fed by the North Brazil Current (NBC), the Guyana current strongly affects the biological and oceanographic properties of the Equatorial Atlantic over this region. Olive ridley, *Lepidochelys olivacea,* sea turtles nesting in French Guiana are among the marine species that live in this dynamic ecosystem when migrating. To better understand how this species uses mesoscale features during its post-nesting migration, we equipped 20 adult females in 2013 and 2014 with both Fastloc-GPS tags and CTD-SRDL-fluorometers. Using Residence Time method together with currents data and predictions of micronekton biomass (SEAPODYM), we identified several foraging areas located on the continental shelf

and assessed the habitat affinities during migration. All turtles migrated north-westward, using the Guyana current to reach different Areas of Restricted Search (ARS). The turtles performed deeper dives associated with longer surface intervals in these ARS, which is in accordance with a feeding activity. A behavioural plasticity was observed as 60% of the individuals performed benthic dives, and the 40% remaining pelagic dives. Some turtles seem to favour the eddy edges formed by the NBC retroflection, areas of high epipelagic micronekton biomass, which suggests a foraging behaviour on pelagic organisms. The selection of these foraging areas is probably due to the high nutrient content on the Guyana continental shelf, as it is enriched by the Amazon plume under the influence of the NBC. This study provides the first detailed data on the use of mesoscale activity by olive ridley sea turtles in one of the most dynamic ecosystem.

POST-NESTING MIGRATION OF GREEN TURTLES TO THEIR FORAGING GROUNDS: DISPERSAL AND DIVING ADJUSTMENTS IN RESPONSE TO DYNAMIC ENVIRONMENTAL CONDITIONS*

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To adapt to resource patchiness, many marine organisms have developed migration strategies, such as sea turtles undertaking important journeys between their nesting sites and their foraging grounds. To better understand how green turtles nesting in French Guiana and Suriname select their foraging grounds and adapt their migration to dynamic environmental conditions, we analyzed the trajectories and diving behavior of 14 adult females equipped with Argos-Fastloc GPS tags. Foraging areas located off Ceará state of Brazil were identified using First Passage Time analysis, which indicates a remarkable foraging aggregation on seagrass beds. Currents data confirmed the counter-current migration, as all turtles migrated south-eastward, facing the strong North Brazil Current (NBC). All individuals used a tight corridor close to shore to avoid the highest currents velocities and limit the energy expenditure during migration. Turtles' dispersal and diving patterns reveal a behavioral adaptation in response to strong hydrodynamic processes induced by the Amazon River plume and the NBC. This long and counter-current migration suggests for the first time a strategy developed by these capital breeders to save the energy gained at the foraging grounds, during the way back to the inter-nesting site by swimming in the flow direction using the NBC, before reproduction and oviposition, the two most energy-demanding phases in green turtle life cycle.

RIDING ON THE FAST LANES; HOW SEA TURTLES DECIDE WHEN TO LEAVE THE MAIN CURRENT*

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Sea turtles have long been known as persistent and powerful swimmers. How do they behave when riding in strong currents during their migrations in the open oceans? In this study, three, satellite-tagged, post-nesting green turtles travelled from Lanyu Island, east of Taiwan, partly within the Kuroshio to their foraging sites approximately 1000 km away in the Ryukyu Archipelago. Their swimming behaviors were analyzed by comparing their migration velocities estimated from Argos tag data with ocean currents derived from a data simulation model and from the AVISO (Archiving, Validation and Interpretation of Satellite Oceanographic data) advection estimates. Results suggest that the turtles take advantage of the rapid Kuroshio during the initial portion of their migration route. They must then make a great effort to swim eastward, at speeds over 1 m s-1, toward their foraging sites to avoid being carried far off course by the strong current. The cues that might cause the change in swimming direction were evaluated with a Principle Component Analysis. The factors considered are ambient current velocity, wind, eddy activity (vorticity), magnetic field (latitude) and water temperature.

The analysis shows that the ambient current and water temperature are negatively correlated with the eastward swimming velocity. This suggests that the changes in ocean current and a drop of water temperature, likely due to eddies impinging on the Kuroshio, may trigger the eastward swimming. Despite the differences among the migratory routes of three Argos-tagged turtles after leaving the Kuroshio, they all reached foraging sites in the same general area. That suggests there may be more complex cues that guide the turtles to their foraging sites during their post-nesting migrations.

FEEDING LOGGERHEAD SEA TURTLES INCREASED THEIR SOCIAL ANTAGONISTIC INTERACTIONS IN KEFALONIA, GREECE

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Social antagonistic interactions between sea turtles have received limited research attention. The observation of sea turtles in the wild is difficult as it can often interfere with the observed behavior. However, the study of sea turtle behavior and anthropogenic effects on it is important to study as tourism and settlements continue to encroach on the sea turtle habitats around the world. The bay of Argostoli in Kefalonia, Greece, hosts a resident population of loggerhead sea turtles (*Caretta caretta*). The turtles are mostly observed in the bay during summer months, while a small number is also observed during the winter. The purpose of this study was to examine whether anthropogenic influence in this area, in the form of feeding the turtles by fishermen and tourists, directly resulted in an increase of displays of social antagonistic behavior. Our study was conducted in the harbor of Argostoli, from early June to late September 2014, during morning hours (07:30-12:30) when local fishermen dock their boats to clear their nets and sell their catch of the day to locals and tourists. Turtles were observed swimming along the harbor by observers standing on land. This method was used to ensure that the observers had a minimal impact on the turtles' behavior. Foraging events observed were classified into feeding on fish (n=629), bivalves (n=508), sea grass (n=87), and other items (n=48). Turtles were often observed biting or swallowing marine debris (n=86), mostly consisting of cigarette packets and other items including plastics. These observations were included in the study due to their frequency. Interactions with intruding turtles that occurred after foraging were observed and recorded. These included head to tail circling (n=45), chasing (n=98), biting (n=125), and sparring (n=3), in order of intensity. The sex of foraging and of any intruding turtles, based on visual assessment, was also recorded. In total, 1358 foraging events were analyzed and, in 202 of those, one or two turtles exhibited social antagonistic interaction towards the foraging turtle. Foraging turtles were females (n=870), males (n=416), or of unknown sex (n=72). Whether a turtle was attacked after foraging did not depend on its own sex. Intruding turtles were slightly more likely to be male (n=81) rather than female (n=64), but in 44 cases the sex of the intruding turtle was unknown. In addition, 14 intrusions were carried out simultaneously by two turtles. The sex of the intruder, however, did not have a significant effect on the intensity of the interaction. Turtles that ate fish were more likely to be attacked and their interaction was more intense, most likely to result in biting. The provision of fish by tourists or fishermen to the sea turtles foraging in the harbor of Argostoli caused increased social antagonistic interactions between them. This could lead to disruptions in the turtles' social structure. The elevated aggressiveness may indicate an underlying positive association between the presence of fishing boats and the availability of fish by the turtles and cause them to be attracted to fishing or other vessels.

ABUNDANCE OF THE OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) OFF THE COAST OF MEXICO IN THE EASTERN TROPICAL PACIFIC DURING 2012

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In Mexico, solitary nesting areas of olive ridley turtles (*L. olivacea*) extend from Sinaloa to Chiapas. Assessments on arribada beaches (Escobilla, Oaxaca) show a consistent and sustained increase in the breeding population of olive ridley turtles in the Pacific coast of Mexico. Nevertheless, since females nest more than once per season and do not breed every year, nest counts do not necessarily represent the absolute population abundance. Additionally, hatching success is difficult to assess in arribada beaches due to the beetle *Omorgus suberosis*, which predates on turtle eggs. Abundance estimates from surveys at sea are an alternative approach to study spatial and temporal fluctuations in the population. In this study we estimated the abundance of large juveniles and adults of olive ridley turtles off the coast of Mexico (states of Jalisco, Colima, and Michoacán) in the eastern tropical Pacific, using distance sampling techniques. An area of 25,567 km2 was covered during three surveys aboard a research vessel. The detectability of the species was estimated from its typical diving

profiles, the mean vessel speed, and the Beaufort Sea state at each sighting. The survey area was divided into northern (Jalisco) and southern (Colima-Michoacán) strata. The effort totaled 1,863 km and 606 sightings were recorded. The weighted average of the three-season estimates (winter, summer and autumn of 2012) was 27,635 animals (CV=14.9%, 95%-CI: 24,002-31,265). The greater abundances were estimated in the region of Colima-Michoacán during all seasons. The highest peak was recorded during winter in Colima-Michoacán (N=34,453) and the lowest during autumn in Jalisco (N=11,537). Our results agree with those proposed by other authors, who suggest that the olive ridley turtle may occur throughout the year in neritic areas. Our abundance estimates suggest that this area may represent an important feeding habitat for the species. The higher abundances in Colima-Michoacán could suggest that the beaches from this area have a higher rate of nesting, which could be confirmed only trough systematic nesting counts.

FINE-SCALE MOVEMENT, HOME RANGE AND HABITAT SELECTION OF NERITIC JUVENILE GREEN TURTLES (*CHELONIA MYDAS*) IN CONTRASTED LANDSCAPES*

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There has been a tremendous number of tracking studies focusing on large-scale migrations of marine turtles, but smaller scale movements have not received such attention. Yet, species like green turtles spend most of their life history foraging in coastal foraging areas where they also face various anthropogenic threats.To explore the fine-scale movements of green turtles (*Chelonia mydas*) in contrasted landscapes, we deployed a total of 23 Argos-linked Fastloc™-GPS tags on neritic juveniles (LCC: 47-69 cm) in two islands of the Western Indian Ocean: Europa Island (n=11) and Reunion Island (n=12). In Europa (22°22'S, 40°21), a pristine atoll located in the south of the Mozambique Channel, the presence of juvenile green turtles has long been documented in a clear-water mangrove almost unexposed to any direct human impact. Contrastingly, Reunion Island (21°06'S, 55°31'E) is a densely populated territory where juvenile green turtles are found mostly on fringing reefs closed to beaches with high levels of frequentation and human related disturbances during the daytime. Individuals were tracked for a mean duration of 133 days (SD: 75 days). Juvenile green turtles of Europa's mangrove exhibited a homogeneous utilization of their home ranges crossing throughout specific areas of the mangrove with rare and very low-density seagrass beds (1.5-4 km length). In some occasions, individuals left the mangrove to the outer barrier reef of the atoll where they exhibited more area-restricted movement. Importantly, two individuals migrated to the southwest of Madagascar and explore coastal habitats, a region known to host important green turtles foraging population but exposed to high levels of accidental fishing and poaching. On the contrary, juvenile green turtles of Reunion Island made a heterogeneous utilization of the space showing high levels of spatial fidelity to restrained areas (.5-2.5 km length) of their home range. Foraging and resting grounds were well-defined areas, constrained by the distribution of shelters and food, namely red algae and high-density but rare seagrass beds. Furthermore, a strong diel behavior dichotomy was observed as inshore seagrass beds were only visited at night and were probably used both as resting and feeding habitat. Individuals that did not have access to seagrass beds were the only ones exhibiting exploratory movements, with preferential use of hard substrate. Fine-scale satellite tracking of juvenile green turtles in two contrasted landscapes showed several variations in the movement behavior of individuals exposed to different environments. Resource availability and distribution as well as human presence were proved to have direct impacts on sea turtle movement. As a result, these variations can lead to highly contrasted life history (e.g. energy expenditure, growth rates, decision strategy) for sea turtles of the same population or region and thus control their dynamics. This underlies the importance of movement ecology for sea turtle conservation.

DIET OF BLACK SEA TURTLE MALES FROM BREEDING POPULATION OF MICHOACAN, MEXICO

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On the coast of Michoacan arrive three species of sea turtle: the olive ridley (*Lepidochelys olivacea*), the black turtle (*Chelonia agassizii* aka *Chelonia mydas* agassizi or *Chelonia mydas*) and the leatherback turtle (*Dermochelys coriacea*). The black turtle (*Chelonia agassizii* or *Chelonia mydas agassizii*) is listed as a species in danger of extinction within the Mexican Official Standard NOM-059-SMARNAT-2010, and the Convention on International Trade in Endangered

Species of Wild Fauna and Flora (CITES), and is considered as endangered by the International Union for Conservation of Nature and Natural Resources (IUCN). Sea turtles represent an important part of marine ecosystems, playing important roles as biological controls, mainly from cnidarians and seagrasses, the latter being consumed by them promote productivity of seagrasses, turn indicators healty ecosystems are already. We evaluated the diet of breeding males black Turtle part of the breeding population of Michoacan. The stomach contents of 10 adult black turtle males captured in water in front of Colola beach in Michoacan, Mexico, were sampled. Six groups of resource states were identificate in the diet of black turtle breeding males in Michoacan. Red algae, green algae, seagrass, benthic diatoms, cyanobacteria and sponge spicules. Within seaweed, six of the 12 identified groups are reported as elements of diet in other locations of black turtle as: *Codium*, maritime *Ruppia*, *Dictyota*, *Halymenia*, *Scinaia* and *Polysiphonia* and two are reported for the first time in this study as *Rhizhoclonium*, *Pyropia* well as coccoid cyanobacteria, filamentous cyanobacteria of the genera *Lyngbya* and *Rivularia*, and benthic diatoms. Analysis of variance showed no statistically significant differences between the diet of the 10 sampled males. In 100% of the samples of stomach contents the presence of Chlorophyta, Rhodophyta followed by (60%) and seagrass (40%) were found. In 100% of the samples of stomach contents the presence of Chlorophyta, Rhodophyta followed by (60%) and seagrass (40%) were found. In this paper we report for the first time algae of the genus *Rhizhoclonium* and *Pyropia* as resource state, plus coccoid cyanobacteria, filamentous cyanobacteria of the genera *Lyngbya* and *Rivularia*, and benthic diatoms.

SEA TURTLE SNORKLING SURVEY AT PRÍNCIPE ISLAND, WEST AFRICA

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Príncipe Island has an incredible rich biodiversity. This region, together with the other Gulf of Guinea islands, was considered one of the 10 Richest Centers of Marine Endemism. The beaches are mainly used by green sea turtles (*Chelonia mydas*) and a small number of hawksbills (*Eretmochelys imbricata*) and leatherbacks (*Dermochelys coriacea*). Additionally, an unquantifiable number of green and hawksbill juveniles inhabit the coastal waters. Occasionally, the occurrence of leatherback and logherhead (*Caretta caretta*) juveniles are reported. No information exists about the presence of neritic foraging adults. In the present study several snorkeling surveys were conducted close to the island coast, where turtles are most vulnerable to spearfishing and other activities. From the end of 2012 to the middle of 2014 four surveys were performed around the entire coast line (100km); two during the nesting season and two during the foraging season. Two snorkelers were on the water followed by a paddling boat, as normally done while spearfishing. In this study, the total distance traveled by the boat was 362km and 256h were spent on the water looking for turtles. The number of turtles sighted was 320: 126 greens; 192 hawksbills; 1 loggerhead; and 1 not identified. With this new information, by species, season and life stage, we hope to gain an understanding on the distribution and abundance of sea turtles around Príncipe Island. Essential data for the correct management of this new UNESCO Biosphere Reserve were huge development plans are on the way. The field work was done in collaboration with specialized sea turtle spear fishermen, while providing them with support and train to the creation of alternatives to the sea turtle capture (e.g. in-water turtle-watching, boat tours, research assistance) and to the development of awareness and information activities to fishing communities (e.g. meetings, plays, beach clean ups).

SUMMER DISTRIBUTION AND ABUNDANCE OF SEA TURTLES IN THE ADRIATIC SEA: RESULTS FORM THE FIRST AERIAL SURVEY IN THE REGION*

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In 2010 we conducted the first basin-wide aerial survey of large marine vertebrates in the Adriatic Sea, which provided a snapshot of the summer distribution and abundance of sea turtles in the region. The estimation of abundance yielded over 25,000 sea turtles (CV=21%) for the entire Adriatic Sea. The estimated number increased to over 70,000 individuals when corrected for their availability (time at surface vs. dive time). The majority of sea turtle sightings (70%) came from the northern Adriatic, an area recognized as a critical neritic habitat shared by juvenile and adult loggerhead sea turtles. However, the methodology used prevented us from distinguishing the two species co-occurring in the Adriatic, the loggerhead and the green turtle. In addition, the distance from the plane to the sea surface limited the possibility to identify sea turtles smaller than 30-40 cm, hence the size class composition should add an additional upwards correction of the abundance estimate. The information presented provide a fundamental element for initiating an ad hoc assessment of the status of loggerhead turtles in the Adriatic Sea and identification of high-use areas in the Adriatic Sea, which will enable more effective protection and management of loggerhead sea turtles at the basin level. This study was part of a research program intended to fulfill Italian obligations to Regulation (EC) n. 812/200 on monitoring of cetacean bycatch. Croatia joined the initiative to enable fulfillment of the ratification of ACCOBAMS. The other Adriatic countries logistically supported the survey enabling a basin-wide implementation.

SUMMER-RESTRICTED MIGRATION OF GREEN TURTLES (*CHELONIA MYDAS*) TO A TEMPERATE HABITAT OF THE NORTHWEST PACIFIC OCEAN

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The foraging habitats of green turtles (*Chelonia mydas*) expand from tropical to temperate areas. Previous reports are biased toward tropical and sub-tropical areas; hence, available data do not accurately describe their activity during foraging periods in temperate areas. To reveal the seasonal patterns of habitat use in temperate areas, we conducted by-catch survey, mark-recapture study, and satellite tracking at the Sanriku Coast, a temperate habitat for green turtles in northwest Pacific Ocean. From 2005 to 2014, 78 green turtles were captured from July to November, which corresponded to relatively high water temperature (16–24°C). The straight carapace length (SCL) composition of turtles ranged from 36.8 to 85.6 cm with an average of 49.4 ± 11.4 cm (N = 78), indicating that most of the turtles were juveniles. In the mark-recapture study, 14 out of 72 tagged turtles were recaptured 5 to 426 days after their release. Twelve turtles were recaptured south of the release point. According to satellite tracking data, 3 turtles travelled more than 500 km to reach southern habitats. In these areas, water temperature was warmer (13–25°C) than along the Sanriku Coast (4–22°C). These results revealed that the Sanriku Coast is a seasonally-restricted habitat for juvenile green turtles, which migrate to southern habitats in winter. This is the first report of seasonal migration of juvenile green turtles to a temperate habitat in the northern Pacific Ocean. Our results indicated that the turtles in temperate areas migrated longer than those in tropical and sub-tropical areas.

DOES RECREATIONAL DIVING IMPACT HAWKSBILL SEA TURTLE SIGHTING RATES? PRELIMINARY ANALYSIS FOR A MARINE PROTECTED AREA, HONDURAS

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Recreational diving is a form of ecotourism that is traditionally viewed as an ecologically sustainable activity prompting increased awareness for the marine environment. Still, recent studies indicate that recreational diving may cause increased spatio-temporal variability within coral ecosystems and unintended behavioral changes in marine macrofauna. Few studies however, have looked specifically at the effect of recreational diving on sea turtles. The purpose of this study was to determine if differences in dive site use and habitat composition can affect the rate of Hawksbill sea turtle (*Eretmochelys imbricata*) sightings in a marine protected area. From June 3 – August 31, 2014 we collected turtle sightings data from 14 different dive shops within the Roatán marine Park (RMP), a marine protected area around the western tip of the island of Roatán, in the Bay Islands of Honduras. We also collected daily dive logs from 2 dive shops to calculate the rate of turtle sightings per dive for each site. To quantify benthic habitat we conducted habitat transects at 12 different sites within the RMP. For each site, we delineated 6-7 transects at random, and photographed 1m2 quadrants at 5m intervals along a 30m transect. We analyzed habitat data for 10 of the 12 sites using Coral Point Count with Excel Extensions 4.1 (CPCe) and calculated percent abundance and percent coverage for different species. Using ArcMap 10.1, we plotted habitat composition, turtle sighting rate, and number of divers over 4 months for dive sites in the RMP. A total of 644 hawksbill, 406 green (*Chelonia mydas*), 4 loggerhead (*Caretta caretta*), and 17 unknown sightings were gathered from 686 dives at 46 dive sites. Total algal abundance within the RMP was high (> 60%) for 5 sites, and moderate (<60%) for 7 sites, whereas total coral abundance was low (<10%) at 3 sites and moderate (>10%) for 9 sites. High algal abundance, however, which can be indicative of degrading habitat, did not correlate with low coral abundance, and turtle sighting rate did not correlate with either metric indicating that algae and coral abundance alone are not adequate predictors of turtle sighting rate. Sightings survey effort was unevenly distributed over the 3 months with peak intensity occurring in July, the height of tourist season. We found a slight positive correlation between the number of divers per visit and the rate of turtle sighting suggesting that more turtles are spotted on dives with more divers. Due to the limited time frame of the study, however, we were unable to determine if this trend was seasonal or not. Based on these preliminary findings, we recommend that long-term studies incorporating sightings from additional dive shops and habitat analysis for more sites, should be conducted in the RMP to determine if diving pressure impacts hawksbill sighting rates.

GPS PHONE TAGS REVEAL LOGGERHEAD TURTLE PREFERENCES FOR NEAR COASTAL FORAGING HABITATS THAT ARE HIGHLY IMPACTED BY SMALL SCALE FISHERIES*

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The central Tyrrhenian coasts of southwestern Italy are frequented by foraging loggerhead turtles but these habitats are also highly impacted by human activities. During the period 2007-2013 over 600 turtles were recorded by the Sea Turtle Stranding and Salvage Network, most of which are washed ashore on sandy beaches just north of Naples and south of Salerno, both home to important fishing ports. Necropsies revealed that these turtles were of generally good health with stomachs and intestines full of benthic crabs and mollusks indicating that turtles died of sudden deaths while foraging, such as in accidental capture by the locally active bottom trawl fishery. Yet not much is known of the actual at-sea distribution and habitat utilization of loggerhead turtles, although first satellite tracking data confirmed prolonged presence of individual turtles in the area. Unfortunately, tracking animals through the ARGOS system has been shown to be especially problematic in the South Tyrrhenian Sea, due to a broadband noise that covers the ARGOS frequency range. For this reason, some 40% of already scarce location data were discarded through filtering, and the high proportion (72 – 97%) of locations for which ARGOS provides no accuracy, precludes from any detailed spatial analysis of loggerhead turtle habitat use and home ranges. We have thus equipped 4 turtles with a GPS tag containing both ARGOS and GSM

antennas to test the possibility of relaying data through the mobile phone network and to compare the performance of both transmission pathways. As expected, the number (<1 d-1) and quality of ARGOS locations was poor, but there were sufficient connections to the GSM network sending up to 26 high accuracy GPS locations per day. This pilot study demonstrated the utility of GSM to monitor sea turtle movements and produced the first detailed map of area use by loggerhead turtles in the southwest Italian foraging grounds. A combination of the best ARGOS data from two turtles and 3 of the 4 GPS tracks revealed that all turtles used a shallow coastal area of only 3.7 km2 just south to the Volturno river mouth and within 1 nm off the coast. The preference of such restricted areas with known high benthic productivity in combination with the high number of dead stranded turtles leads to the conclusion that there must be substantial bottom trawl activity within the 3 nm coastal zone that is off-limits for fishing by law. This study revealed that data of free-ranging loggerhead turtles can be relayed successfully through the GSM phone network in the Mediterranean and, more importantly, provided indirect evidence of illegal fishing practices in that area that call for immediate mitigation.

PRELIMINARY RESULTS OF RESEARCH ON THE STATUS OF SEA TURTLES IN THE SOUTHERN MEXICAN CARIBBEAN

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The southern Mexican Caribbean, also commonly referred to as the 'Costa Maya', is a geographical area stretching from the Southern portion of Sian Ka'an Biosphere Reserve to the Belizean border and east to the offshore atoll of Banco Chinchorro Biosphere Reserve and including the cruise ship port of Mahahual. Unlike the northern Mexican Caribbean, or 'Mayan Riviera', which has been extensively studied, formal monitoring of marine turtle nesting ceased in Mahahual in 2000 and to our knowledge no formal studies have ever previously been conducted in Banco Chinchorro or Bahia de Espirito Santo in Sian Ka'an. Between January and June 2014, our research team set out to determine the status of marine turtles within the Costa Maya region. Our research areas focused on the Biosphere Reserves of Sian Ka'an and Banco Chinchorro, Xcalak National Marine Park and the coasts and communities which connect them. We aimed to locate potential hotspots for further research and identify priority areas for conservation. Bringing together an array of stakeholders from local communities, fishing cooperatives, university students, dive shops, expatriates and international volunteers, and developing unique research methodologies, our main findings include the identification of important developmental areas for juvenile and sub-adult hawksbill and green marine turtles within the Banco Chinchorro and Sian Ka'an Biosphere Reserves respectively, uncovering an openly ongoing illegal trade of hawksbill shell products within the cruise port town of Mahahual and the identification of a heavy incidence of oceanic stage juvenile hawksbill strandings during the months of April and May. This presentation highlights an example of how collaborative community involvement could develop a multifaceted conservation and research program for marine turtles. The successes and lessons learned from the project are discussed, along with suggestions for replication in other areas and the potential for the development of ongoing conservation initiatives. Thank you to Idea Wild for providing us with numerous grants to purchase PIT tags and a scanner. And, thank you to our paying research assistants, without whom we would not have had the funding or manpower to undertake these preliminary surveys; Sam Marriott, Vanessa Edwards, Loftur Loftsson, Francesca Stammers, Nathalie Lundstrom and Juan Carlos Arnal. Thank you to our other volunteers who joined us on an adhoc basis or provided other services to the project; Gareth Davies, Sanna Haapa, Sandro Canovas and Rudy Castelleno Balam. A very special thanks goes to Roberto Hererra, for without him, his knowledge and passion for sea turtles, this project wouldn't exist.

SATELLITE TRACKING OF SEA TURTLE IN BANGLADESH MARINE WATER*

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In Bangladesh, satellite tracking on sea turtle was first initiated in 2010 by Marinelife Alliance. So far we attached 18 pcs satellite tags including 16 SPOT5 and 2 SPASH Tag of wildllife computer to understand depth and dive time parameters of the available species. This is ongoing activity and we hope to attach more tags during the next couple of years. The data is yet to analyzed to reveal the in-water information other than the migration routes. We need more tracking to cover the south-central zone and the green turtle migration. The tracking turtle name and data is mentioned below. Within the scheduled satellite tagging period no green turtle was observed by the local observer while the eggs have been collected for safe hatching at few places. The nesting season of green turtle is during pre and post winter months. The longest recorded tracking was 357 days that was the first tracking ridley URMEE travelled more than 12 thousand kms. The second

longest was URMEE-3 travelled so far 245 days and covered more than 8 thousand kms. The longest straight line distance covered by URMEE-3 that reached south of Sri Lanka and returned without further travel elsewhere. Most of the foraging habitat according to the tracking observed mid and west part of the Bay of Bengal along east coast of India and south central coast of Bangladesh as migration corridor. The detailed data interpretation will uncover the habitat and location preference by the tracking olive ridley and green turtle. The updated location information may be found in the weblink: http://www.seaturtle.org/tracking /index.shtml?project_id=487.

TESTING THE IMPACT OF HABITAT-DRIVEN SWIMMING MOVEMENTS ON THE DISPERSAL OF JUVENILE WESTERN PACIFIC LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*)*

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The implementation of targeted conservation measures for threatened species requires accurate knowledge of the spatial distribution at all life stages. For the leatherback turtle (*Dermochelys coriacea*), a vulnerable species (IUCN, 2013), satellite-tracking provides adequate data on the migration routes and distribution of adults, but observations of newborns and juveniles are largely missing. In an attempt to solve this problem, several authors have hypothesized that leatherback hatchlings drift almost passively with the oceanic currents so that their distribution at sea can be deduced from numerical simulations of the dispersal of Lagrangian (i.e. passive) particles drifting with simulated ocean currents. While the passive drift hypothesis likely holds for the very first months of life, it becomes less and less valid as individuals grow and become more powerful swimmers. The results of passive drift simulations are thus questionable for individuals older than 1 year or so. In this paper we present a simple "habitat-based" model of the swimming activity of leatherback turtles in which we only assume that the swimming speed (1) is directed towards more favorable habitats (in terms of food concentration and water temperature) and (2) increases with the habitat gradient and the size of the individual. With such a model, hatchlings drift almost passively while the swimming activity of juveniles and adults progressively increases with size (and thus age). This simple model is used here to simulate the dispersal of Western Pacific leatherback turtles from their nearly equatorial nesting beaches in New Guinea. We show that this movement model naturally induces seasonal latitudinal migration as soon as juveniles reach the middle-latitudes, a behavior that has already been observed in satellite-tracked juvenile loggerhead turtles. We also show that habitat-driven movements lead "swimming juveniles" to cross the North-Pacific basin more slowly than passively drifting juveniles. As a consequence, the simulated size/age spectrum of leatherback juveniles approaching the Hawaiian archipelago and then California better matches observations. Further work is under progress to include this juveniles' movement model in a more complete population dynamics model that will be used to simulate the spatial distribution of all life stages.

LOGGERHEAD HATCHLINGS IN THE WESTERN MEDITERRANEAN SEA: WHERE DO THEY GO AND HOW MANY OF THEM SURVIVE?

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The loggerhead turtle, *Caretta caretta*, has the broadest nesting range among extant sea turtle species, spanning temperate to tropical latitudes in both hemispheres. Being ectothermic many aspects of loggerhead life-history traits and behavior are strongly linked to temperature. For example, the specie's range is directly controlled by thermal limitations because adverse temperature conditions may exceed physiological tolerance levels and thus impede species survival. In particular, sea surface temperature conditions encountered by hatchlings along drifting trajectories during the initial dispersal phase influence survival and growth rates of the individual turtle and therefore the persistence of a nesting site or the possible expansion of the nesting range. The loggerhead is the most common sea turtle species in the Mediterranean Sea. Nesting is almost confined to the eastern basin although in recent years a growing number of nesting events have been reported also in the western Mediterranean. In fact there are some specific locations, such as the central Tyrrhenian coasts, that have lately been visited by nesting females each year. In order to understand the dispersal processes of hatchlings in the western Mediterranean and the possible effects of temperature on individual survival we used Lagrangian numerical simulations. 12 800 pairs of particles (hatchlings) were released from the central Tyrrhenian coasts. The release started from July 1st for two successive months. Directional swimming behaviour was not considered in the analysis. The drifting period was 360 days and, along their trajectories, particles were constrained in the upper 3 m of the water column.

Simulations were performed for the years 2006, 2007, 2008 and 2012. To simulate the dynamics of the Mediterranean Sea we used daily data (horizontal velocity fields and SST) provided by the Mediterranean Sea Forecasting System model Analysis fields (MFS); unresolved motions of subgrid scales is described by adding a 2D kinematic field whose parameters are calibrated on actual Mediterranean drifters. Temperature effect on the survival of hatchlings was simulated assuming that any turtle encountering SST lower than 10.0° died and that a turtle experiencing a mean SST 15° for more than 10 days had a 50% chance of dying. For each further day still maintaining the average SST lower than 15° the amount of alive turtles was halved. To investigate the effect of climate change we use the trajectories calculated for the year 2012 and we calculate the mortality using the temperature relative to the projections of GDFL's ESMs experiments for the rest of the century. The results of the simulations considering the current sea surface temperature scenario demonstrate that hatchling dispersing in the western Mediterranean encountered unfavourable conditions that led to very high mortality rates in the first year which help to explain the very limited nesting occurring in the region. Considering different future scenarios provided by model's experiments for sea temperature in the Mediterranean Sea, we observe that survival probability for hatchlings carried northwest by currents may increase significantly which in turn will affect loggerhead turtle nesting in the Western Mediterranean Sea. Acknowledgements: FM gratefully acknowledges the assistance of a travel grant provided through the Travel Grant Committee for the International Sea Turtle Society.

FERRIES AS PLATFORM OF OPPORTUNITY FOR REGULAR MONITORING SEA TURTLE DISTRIBUTION IN THE MEDITERRANEAN SEA

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Sea turtles are highly migratory animals that spend the vast majority of their solitary existence in remote marine areas occupying a variety of ontogenetic habitats widely separated geographically and temporally. Information on their abundance and distribution are therefore essential to develop sound conservation and management strategies but yet such data are generally difficult to collect. A variety of approaches have been used to monitor spatial and temporal patterns in sea turtle occurrence depending upon the research needs and the resources availabilities. Dedicated survey platforms such as research vessels or aircrafts provide excellent results to estimate absolute abundance and distribution over wide areas but generally their cost is prohibitive in terms of carrying out regular surveys. Therefore complementary approaches must be tested and employed. Here we propose the use of ferries as platforms of observation for systematic surveys to allow sustained monitoring of sea turtle distribution and abundance in the Mediterranean Sea. Since 2007 a collaborative program has been operating in the central and western Mediterranean using passenger ferries as platform of observation for systematic cetacean monitoring along fixed transect lines. The network includes 12 scientific institutions, 4 NGOs and 5 shipping companies from 4 different Mediterranean countries. More than 1700 nautical miles (NM) along 9 routes are regularly monitored (41% yearly round, 59% June-Sept, 2-8 surveys/month). In these years cetacean observers have been opportunistically collecting also data on sea turtles, marine traffic, marine litter and marine birds. Up to date they have recorded 232 *Caretta caretta* sightings whose distribution and relative abundance are coherent with available information on species presence in the Western Mediterranean Sea. Higher encounters were found in the southern western Tyrrhenian Sea along the Cagliari-Trapani route (155 NM) and lower in the Ligurian Sea (2 routes, 92 and 115 NM) and along transects crossing the Western Mediterranean marine region (from Civitavecchia, Italy, to Barcelona, Spain, 437 NM). Encouraged

by these promising although preliminary results, a specific protocol for monitoring sea turtles was developed and tested during the summer 2013 which used ferries platform taking into account the differences in the detectability of these animals with respect to cetacean species. A dedicated observer scans, with naked eye, a 100 m wide strip on the ship side with the best visibility (Beaufort less then 2) and records all turtles encountered. Information on the distance from the boat, estimated turtle size, turtle behavior and overmapping with litter are also taken. Individuals sighted outside the monitoring strip are noted but used only for presence data and not to estimate abundance. This protocol represents a sustainable, low cost complementary methods for sea turtle monitoring, that is now being enforced by network partners, and that in 2015 would be applied also in the Eastern Mediterranean Sea (Adriatic and Ionian Sea). There is great potential to extend the network including new partners thus to cover ever more areas within the Mediterranean. It also has to be noted that the ferry monitoring program is labor intensive and requires adequately trained participants to recruit new observers. Acknowledgements: FM gratefully acknowledges the assistance of a travel grant provided through the Travel Grant Committee for the International Sea Turtle Society.

OUT WITH THE OLD, IN WITH THE NEW HYPOTHESES: SWIMMING BEHAVIOR AND ONTOGENETIC HABITAT SHIFTS AMONG WILD-CAUGHT OCEANIC STAGE TURTLES*

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From the time hatchlings depart nesting beaches and enter oceanic waters, virtually nothing is known about their in situ behavior, habitat use, and distribution until they return to coastal areas years later as larger juveniles. Using novel telemetry methods, we satellite tracked wild-caught oceanic stage juvenile sea turtles within the regions of the Gulf of Mexico (GOM) impacted by the 2010 DWH oil spill. Our objectives were to: (1) quantify the fine-scale dispersal, habitat use, and movements of wild-caught oceanic stage sea turtles; (2) characterize the turtles' in-water habitats; and (3) experimentally quantify and model active vs. passive behavior of these small oceanic turtles. From 2011-2014, we outfitted 48 oceanic-stage juvenile sea turtles (12-29 cm straight carapace length) with 9.5-gram solar-powered satellite tags and tracked their movements for up to 140 days. Four species of turtle were tracked, including Kemp's ridley (n=20), green (n=24), hawksbill (n=2) and loggerhead (n=2); all turtles were wild-caught, captured offshore in the eastern and north eastern GOM in association with Sargassum habitat. Tagged turtles were released in the vicinity of their capture sites, with up to 12 individuals released per location. Pairs of passive GPS oceanographic surface drifters were deployed with each release to characterize the local oceanic conditions (currents) and to test whether oceanic turtle movements can be predicted solely by ocean surface circulation. We analyzed the movements of turtles and drifters using a high-resolution ocean circulation model to derive swimming velocity along the tracks. Nineteen turtles (n=11 Kemp's ridleys; n= 8 greens) exhibited plasticity in habitat selection from offshore oceanic to nearshore neritic habitats, possibly documenting an ontogenetic shift in habitat use, with several turtles subsequently returning to oceanic habitats. Green turtles remaining offshore were significantly smaller than those entering nearshore waters. Calculated swimming velocities of turtles and drifters differed significantly in both speed and orientation. There were broad-differences in swimming behavior among the species we tracked: loggerheads were most strongly oriented (mean Rayleigh r = 0.51), followed by greens (mean Rayleigh r = 0.47), Kemp's ridley (mean Rayleigh r = 0.34) and hawksbills (mean Rayleigh r = 0.22). The mean Rayleigh r value for drifters was 0.39 (n=26). Kemp's ridleys adopted headings that promote retention within the GOM and over the Continental Shelf whereas green and loggerhead tended to orient in ways that facilitated dispersal into oceanic waters; one of each species were even tracked into the North Atlantic. Hawksbills circulated primarily within large-scale oceanographic features. These data represent some of the first satellite tracks for wild-caught oceanic stage sea turtles and provide experimental confirmation that oceanic stage turtles are not 100% passive drifters. Turtles found in the northeastern GOM may be at a critical developmental juncture, shifting from one ontogenetic stage to another. Our data and methods provide a foundation for species-specific predictions of habitat use and movement models, and represent a critical starting point for more realistic assessments of oil spill impacts on an otherwise poorly understood life-stage of sea turtles.

UTILIZING A REMOTELY OPERATED VEHICLE (ROV) TO OBSERVE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) BEHAVIOR ON FORAGING GROUNDS OFF THE MID-ATLANTIC UNITED STATES*

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In situ observation is typically rare for large marine vertebrates. From 2007 – 2014, we conducted detailed assessments via ROV of the at-sea behavior of juvenile and adult loggerheads. We deployed the ROV within the United States mid-Atlantic offshore region, known foraging ground for loggerhead turtles. The ROV proved to be a powerful versatile tool and allowed for in-depth investigation of animal behavior throughout the water column. Video analysis identified multiple inter- and intra-species interactions, benthic and pelagic foraging, predator avoidance and temperature-specific behavior. Operations from 2007 through 2010 employed a Teledyne Benthos (North Falmouth, MA) Stingray ROV. In 2011, we started using a Teledyne Benthos MiniRover ROV due to its increased versatility, portability, and power. The MiniROVER was outfitted with both a high-resolution zoom color video camera and a low light black and white video camera and six front-mounted LED light sources. Additional system features included real time, on-screen compass heading and depth sensor outputs, and we outfitted the ROV with a TDR (Onset Computer Coorporation; Bourne, MA) to continuously record water temperature. ROVs were used to track and investigate the behavior of 65 turtles. The ROV surveys were focused in the Mid-Atlantic Bight, 40 – 100 km off the east coast of the U.S.A., (~37 to 40° Lat. -75 to -73° Long.). Under variable conditions, usable video was produced at a rate of 53% of effort, for a total of 43.6 hours of turtle video. Each ROV deployment averaged (mean ± SD) 58.7 ± 42.6 minutes of footage, with a range of 9.0 – 185.0 minutes. Turtles' reactions to being filmed was minimal. Multiple inter and intra-species relationships were identified during analysis. Turtles interacted with each other as well as with other species including barrelfish (*Hyperoglyphe perciformis*), grey triggerfish (*Balistes capriscus*), spotted hake (*Urophycis regia*), and mahi-mahi (*Coryphaena hippurus*). Barrelfish and grey triggerfish exhibited strong associative behavior with turtles, with some remaining near the turtles during entire benthic foraging dives. Spotted hake commensally fed in areas disturbed by benthic foraging turtles and mahi-mahi exhibited loose association and physically rubbed on the turtles. Video analysis also identified a variety of unique behaviors including: shark avoidance, breathing patterns, flipper beat rate, and benthic and pelagic foraging habits. Turtles typically foraged on jellyfish, crabs, hermit crabs and scallops. Additionally, some foraging occurred within waters cooler than 8°C and the cold temperatures did not limit the turtles' ability to maintain active foraging. With the use of a ROV, we obtained a detailed assessment of at-sea behavior.

FEEDING SEA TURTLE STUDY IN THE PERSIAN GULF AND OMAN SEA IN IRAN

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One may differentiate between the Persian Gulf and the Sea of Oman when considering the existing populations of sea turtle species and their distribution within the area. The coastal waters harbour two main species of sea turtles which breed regularly on Iranian beaches: the hawksbill turtle (*Eretmochelys imbricata*) and the green turtle (*Chelonia mydas*). The Persian Gulf accommodates the main nesting habitats of hawksbill turtles, as well as some green turtles. Certain islands are the most important nesting sites for these two species. Some mainland Iranian sites also exist, but at this stage there is no reliable estimate of the number of turtles nesting at these places. Green turtles in different life stages are the main foraging species, especially around the islands. However, some feeding hawksbills in juvenile stages have also been found and confirmed. Moreover, there are some occasional records of Olive ridleys (*Lepidochelys* oliviacea) and Leatherbacks in these waters. The Sea of Oman accommodates important feeding grounds for green turtles, of different life stages, all year long. There are also a few important nesting sites for the green turtle (Mobaraki, 2004). Olive ridley turtles have also been reported in the area (Kami, 1997; Mobaraki, 2003). Green turtles in different life stages are the main foraging species, especially around the islands. However, some feeding hawksbills in juvenile stages have also been found and confirmed. Moreover, there are some occasional records of Olive ridleys and Leatherbacks in these waters.

SEASONAL MIGRATION AND ACTIVE WINTER DIVING OF JUVENILE LOGGERHEAD TURTLES IN THE WESTERN NORTH PACIFIC

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Highly migratory loggerhead turtles are the most temperate species of hard-shelled marine turtles. Being ectothermic, their physiology and metabolic rate are profoundly influenced by ambient temperature. Several studies reported diving behavior of overwintering loggerhead turtles, which showed significant increase in dive duration during the winter associated with decreasing water temperatures. Winter dives of adult females are typically characterized by prolonged resting dives (i.e. >4 h), suggesting that they remained quiescent at sea bottom or mid-water. However, there is paucity of data regarding overwintering strategy of juveniles. Here, we combined bycatch surveys and satellite telemetry to examine year-round distribution and diving behavior of juvenile loggerhead turtles in the western North Pacific. The first quantitative bycatch survey at northern Japan revealed that the Sanriku coastal area (i.e. >500 km from their nearest nesting site) served as an important summer foraging habitat for large juveniles, including males (mean SCL ± SD = 70.8 ± 6.4 cm, N = 152, range = 52.5 – 88.4 cm). We deployed satellite relayed data loggers (SRDLs; Sea mammal Research Unit, St Andrews, UK) on six turtles. The satellite tracked turtles frequently used the Sanriku coastal area and adjacent oceanic waters (35-45°N, 140-145°E) during summer although a few turtles travelled eastwards as far as 170°E. During winter, all turtles spent most of their time travelling in oceanic water (>200 m) in the western North Pacific, potentially in association with Kuroshio Extension Current. Although water temperature significantly decreased during winter, wintering turtles predominantly stayed in water >15°C. There was no strong seasonal pattern in diving behavior. Daily average dive duration was 20.1 ± 11.6 min regardless of season and water temperature, inferring that the turtles remained active during the winter. Furthermore, while wintering turtles generally undertake relatively shallow dives (daily average dive depth = 14.8 ± 10.4 m), they sporadically performed deep dives, including the deepest dive (>340 m) ever recorded in this species. Our results are suggestive of active pelagic foraging throughout the winter, which highly contrasts with the quiescent overwintering strategy (i.e. undertaking prolonged dives lasting hours) previously reported in adult females. It might be possible that continuous foraging at relatively warm water during winter is beneficial for juveniles' growth rates.

FITNESS DIFFERENCES BETWEEN LOGGERHEAD TURTLES (*CARETTA CARETTA*) NESTING AT RETHYMNO, CRETE, GREECE

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Foraging success affects reproductive output in sea turtles, and is therefore an important factor to measure in order to understand population dynamics. During 2010 and 2011 we used satellite telemetry to track the at-sea behavior of 20 postnesting loggerhead turtles (*Caretta caretta*) from Rethymno, Crete, Greece. Of these, 19 transmitters provided location and dive data throughout the turtles' migration towards their foraging grounds and the transition into foraging behavior. There were three foraging strategies; 1) nine turtles migrated southwest towards the northern African coast, with eight concentrated in the Gulf of Gabès region; 2) six turtles migrated north towards the Aegean Sea and 3) four turtles did not take long distance migrations, instead remaining resident within the waters of Crete. Two fitness proxies were associated with differences in postnesting strategies. Turtles foraging in northern waters had significantly larger curved and straight carapace lengths and clutch sizes than turtles foraging near Crete or Africa. Those differences reflect the disparity in benthic prey abundances between the three regions. The Aegean had a higher abundance of macrobenthic fauna than the other two regions and the Gulf of Gabès had an increased level of eutrophication. The low level of prey resources in the Gulf of Gabès may be related to the increased presence of harmful algal blooms. Deterioration of the aquatic resources in the Gulf of Gabès may be a contributing factor in the observed steady decline in clutch size and total nests per season in two critical nesting beaches for Greek loggerheads. This project was funded by The Betz Chair of Environmental Science at Drexel University and by The Leatherback Trust, Monterrey, California. Assistance in the collection of these data was provided by the many generous leaders and volunteers of ARCHELON, the Sea Turtle Protection Society of Greece.

AGE ESTRUTURE OF OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) IN THE MAIN BRAZILIAN NESTING GROUND

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Although the olive ridley sea turtle (*Lepidochelys olivacea*) spends much of its life cycle in the oceanic environment, adults return to the neritic zone to breed and nest. The coast of Sergipe state in Brazil hosts the most important breeding area for olive ridleys in the Atlantic Ocean; 6000 nests are laid each year, comprising 77% of the nests in Brazil. Since 1990, the number of trawling vessels operating near Brazilian nesting beaches has increased and the overlap has caused high mortality of breeding adults. Large numbers of female olive ridleys containing eggs are found stranded dead during the middle of the breeding season. In this study, age was estimated for a total of 67 olive ridley sea turtles stranded dead in northern Brazil through skeletochronological analysis of humeri. As annual skeletal growth increment deposition has been validated for the closely-related species, the Kemp's ridley (*Lepidochelys kempii*), this assumption was also applied to the olive ridleys in the current analyses. All of the humeri in the sample were from turtles of adult size and therefore did not retain the diffuse, first-year skeletal growth mark termed 'annulus'. As a result, it was necessary to apply a correction factor to estimate the number of marks potentially lost within the bone's core using data from Pacific olive ridley turtles from a previous study. This approach incorporated a linear model of the relationship between humerus diameter and straight-line carapace length (SCL) and applied Bayesian inference with priors informed by hatchling humerus diameter measurements. Age estimates for 58.3 to 72.2 cm SCL (mean = 64.7±3.6 cm) ranged from 15 to 26 yr. In the breeding area studied, the smallest recorded nesting female was 60.5 cm CCL and our analyses yielded a mean age of 15 yr for this size, similar to that obtained for olive ridleys in the Pacific, i.e., 13 yr. The olive ridley is included in the IUCN Red List as threatened and in the present study area, mature males and females with high intrinsic reproductive value are disproportionately dying due to temporal and spatial overlap between trawling fishing and breeding. Despite the need for age and growth data to better understand olive ridley population dynamics and potential effects of differential mortality, this study represents the first analysis of age and growth for olive ridley sea turtles in Brazil and only the second worldwide. Acknowledgements: We acknowledge the Fundação Mamíferos Aquáticos (FMA) and TAMAR-ICMBio project for collecting humerus samples. The age was determined with the logistics provided by the Laboratório de Ecologia e Conservação da Megafauna Marinha (ECOMEGA, Instituto de Oceanografia—FURG). Finally, acknowledge the financial support from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

JELLYFISH ABUNDANCE AND KELVIN WAVES DRIVE JUVENILE AND SUB ADULT LEATHERBACK PRESENCE IN PERUVIAN NERITIC WATERS

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We combined five years of data (2010 to 2014) of leatherback occurrence with environmental variability in Peru. Bycatch data was obtained from on board and shore-based observers of small-scale fisheries operating from San Jose (06°45'S) and Salaverry (08°13'S) in northern Peru and in San Andres (13°44'S) and Lagunillas (13°54'S) in central Peru. In addition, a time-series of jellyfish biomass (*Chrysaora plocamia*) was created using fisheries independent data obtained from pelagic research cruises by the Instituto del Mar del Peru from 2010 to 2014 (N=1697 effective trawls). In this five-year period, 82 leatherbacks were captured of which 18 died (mean CCL 115.3±17.7; range: 80-136 cm, N=13), interactions were most common during summer months (N=31, 38%) and the remaining 51 leatherbacks were equally reported for each autumn, winter and spring (N=17 and 21% per each season besides summer). Coincidently, during summer months off Peru coastal waters, large blooms of the conspicuous Scyphomedusae *C. plocamia* occur, but they remain through the end of autumn. We found a strong correlation (Pearson, r=0.935, p>0.95) in an annual basis analysis between leatherback occurrence and jellyfish abundance (mean kg jellyfish/1000m3 of filtered sea water). In addition, the

two peaks of leatherbacks occurrence in 2012 (N=23) and in 2014 (N=28) were related with warm Kelvin waves (positive SST anomalies over 60 years of historical data) up to +1.7, +3.6 and +1.2°C in 2012 and up to +3.7, +2.6 and +1.0 in 2014 at 06°S, 09°S and 14°S respectively, the same latitudes at which leatherbacks were reported. Moreover, three esophageal and stomach analyses were performed, one in 1987 and two in 2014. In two of these, 100% of the diet was *C. plocamia* and the third was 98%. This indicates that this jellyfish species is the leatherback's main diet in Peruvian neritic waters. We conclude that environmental variability driven by warm water intrusions resulting from Kelvin waves, together with food availability (represented by the abundances of *C. plocamia* in the area), seem to strongly influence the coastal distribution (<2.5 nm) of juvenile and sub-adult leatherbacks in Peruvian waters. Finally, it is important to highlight that 13 of the dead leatherbacks were found in San Andres, where a traditional sea turtle fishery exists. For this reason, 84% (N=11) of carcasses from San Andres were found butchered, possibly from bycatch with local driftnets that target rays and guitarfish. Urgent conservation measures are therefore needed for this critically endangered population in the area.

GROWTH DYNAMICS OF LOGGERHEAD SEA TURTLES UNDERGOING AN ONTOGENETIC HABITAT SHIFT

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Size-specific habitat use decisions, or ontogenetic habitat shifts, often mark transitions between life stages where individuals seek to balance the benefits of optimal growth with risk of predation. Such trade-offs are predicted to result in the selection of habitats that minimize the ratio of mortality to growth rate (i.e., μ/g) and may lead to the use of potentially suboptimal growth habitats where predation risk is low until critical sizes are reached. Empirical studies have shown these habitat shifts can infer a growth advantage in the new habitat. We combine skeletochronological and stable nitrogen isotope (δ15N) analyses of sea turtle humerus bones to provide a detailed assessment of the ontogenetic growth dynamics of juvenile Northwest Atlantic loggerheads (*Caretta caretta*). The primary objectives of this study were to determine if an oceanic-to-neritic habitat shift inferred a growth advantage in loggerheads as predicted by ontogenetic theory and if this pattern is maintained in individuals exhibiting alterative life history patterns (i.e., discrete shifters vs. facultative shifters). We sequentially analyzed sea turtle humerus bones for δ15N values to identify when turtles made this ontogenetic shift and to categorize individuals into alternate life history groups. Discrete shifters were turtles that exhibited a sharp, single year increase in δ15N values, while facultative shifters were turtles that exhibited a gradual increase in δ15N values over multiple years. Back-calculated growth rates peaked in the 50-59.9 cm straight carapace length (SCL) size class, and mean size at transition from oceanic-to-neritic habitats was 54.1 cm SCL for all turtles. Examination of ontogenetic growth trajectories with respect to year to and from ontogenetic habitat shift (i.e., ontogenetic position) revealed annual growth rates generally peaked within one year of transition, providing support for an ontogenetic shift-associated growth advantage. However, there was considerable variation in the timing of maximal growth rate among turtles with one third of individuals exhibiting maximal growth rates prior to the habitat shift, possibly deviating from theory predictions. Turtles generally experienced only a single year of high relative growth rate, indicating this growth advantage is short-term. Generalized additive mixed models of the potential influence of covariates on back-calculated growth rates showed significant effects of SCL, δ15N, and ontogenetic position, with ontogenetic position the best predictor of juvenile growth rate. Growth variance was higher for facultative shifters when compared to discrete shifters, but size-at-age relationships, mean size at recruitment, and mean growth rates did not differ between shifter groups, likely limiting the influence of alternative life history patterns on population dynamics. We demonstrate the value of combined skeletochronological and growth increment-specific isotope analyses to the study of sea turtle growth variation and life history, and highlight the role individual effects may play in our understanding of sea turtle growth dynamics.

LASER ABLATION METHODS FOR RECONSTRUCTING SEA TURTLE LIFE HISTORY*

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The life history of highly migratory marine species is often difficult to study due to prolonged residence in unknown or inaccessible habitats, especially during cryptic life stages. Traditional methods of studying sea turtle life history (e.g., satellite telemetry, stable isotope analyses of soft tissue) are costly, resource intensive, and generally provide only short-information over inconsistent time intervals. As sea turtle life expectancy can span decades, there is a need for the development of new methods that can provide long-term information on sea turtle life history. Metabolically inert and sequentially deposited tissues, such as humerus bones, contain such extended records in the form of biogeochemical markers (e.g. stable isotopes, trace elements). Trace element analyses via laser ablation, in particular, are commonly used in fish species to study habitat use and migrations as the elemental signatures contained in otoliths largely reflect that of the surrounding water. Here, we investigate the utility of combined stable isotope and trace element analyses of sea turtle humerus bones in reconstructing the habitat use of juvenile loggerhead (*Caretta caretta*) and Kemp's ridley (*Lepidochelys kempii*) sea turtles. Loggerhead bones (n = 41) were collected from turtles stranded on beaches in the Northwest Atlantic, while Kemp's ridley bones (n = 55) were from turtles stranded on beaches in the Northwest Atlantic (n = 28) and Gulf of Mexico (n = 27). Two bone cross-sections were cut from each humerus bone, with the first analyzed for skeletal features and the second for stable isotope ratios (δ13C, δ15N) and trace elements. A high-resolution micromilling system was employed to sample individual growth layers for stable isotopes, while laser ablation-inductively coupled plasma mass spectrometry (LA-ICP-MS) was used to collect elemental data along transects perpendicular to growth layers. Trace element data is presented as the ratio of each element to calcium (e.g., 138Ba/43Ca) to control for differences in bone density and composition among individuals. Increment-specific biogeochemical data were paired with associated information obtained from skeletochronology (e.g., back-calculated body size, year, age) to examine relationships among covariates. On average, 8 (range: 4-12) and 4 (range: 2-5) annual growth layers were sampled from each loggerhead and Kemp's ridley humerus bone, respectively. Ratios of only eight trace elements (25Mg, 43Ca, 55Mn, 65Cu, 66Zn, 86Sr, 138Ba, 208Pb) were observed above background variation. For loggerheads, there was a strong negative relationship between δ15N and barium (138Ba/43Ca), with large increases in δ15N (>3.0‰) and decreases in barium (0.17 to 0.05 mmol/mol) occurring at body sizes coinciding with a known oceanic-to-neritic ontogenetic habitat shift. Strontium (86Sr/43Ca) showed a similar decline to barium, though the decrease was not as strong (4.1 to 3.1 mmol/mol) and exhibited greater variance along the ablation transect. Ongoing analyses will work towards characterizing the biogeochemical patterns within Kemp's ridley sea turtle bones, and differences between turtles from the Northwest Atlantic and Gulf of Mexico. These results suggest these methods may provide a rapid, cost-effective means of assessing sea turtle life history over multiple, sequential years.

A COMPROMISE BETWEEN CULTURE AND SCIENCE TO STUDY THE FEEDING ECOLOGY OF *CHELONIA MYDAS*: A CASE STUDY IN NEW CALEDONIA

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Opportunities to look at entire stomach contents of marine megafauna are scare as it is a fatal method. Here we use green turtles (*Chelonia mydas*) killed for tribal ceremonies in New Caledonia in order to provide additional insight into the results found by the stable isotopes analysis ran simultaneously. The samples were collected from the Grand Lagon Sud (GLS), a World Heritage Area located in the south of New Caledonia. The δ13C and δ15N in skin samples of *C. mydas* in this study ranged from -19.3‰ to -7.3‰ and 2.8‰ to 15.9‰ respectively. These results report a preference for algal diet and concur with the stomach contents analysis. Four genera contribute the most (73.4%) to the total dry weight matter: the algae *Hypnea* (34.4%), *Caulerpa* (11%), *Ulva* (11%) and the seagrass *Halodule* (17%). These results provide more

evidence that *C. mydas* feeding patterns differ from one foraging ground to another. This is the first study to investigate the feeding ecology of green turtles in New Caledonia and our work provides a "current-condition" baseline for the GLS and the possibility for this species to become a bio-indicator of the habitat's health in that area that is being used for mining. This collaboration with the different tribes is also the first step towards an integrated management of the resource and can be used as an example for the rest of the South Pacific.

SATELLITE TRACKING REVEALS EXTREME VARIATION IN FIDELITY TO TWO LOGGERHEAD FORAGING AREAS IN GREECE

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As adults, sea turtles are known to show fidelity to nesting and overwintering areas, with individuals undertaking repeated migrations between the two. Juvenile and subadult turtles do not undertake reproductive migrations and may remain in a single development habitat over a number of years. Amvrakikos Gulf (38.98°N 20.97°E) and Mesolonghi Lagoon (38.32°N 21.37°E) are two known loggerhead turtle foraging locations in Greece, designated as protected areas, where small-scale fishing (set nets, trawls etc.) is permitted. Amvrakikos extends approximately 35km east-west and 20km north-south but is connected to the wider Ionian Sea through a channel less than 500m wide. Mesolonghi is a triangular-shaped lagoon with the lower, widest part having an 8km interface with the Gulf of Patras. This entire stretch is seasonally-fenced to trap fish within the lagoon and often also incidentally traps turtles. To identify potential temporal and spatial of overlap between fishery and turtle utilisation of the areas we investigated long-term movements and habitat associations of sea turtles through satellite telemetry. Between June and August 2013, in the context of the PRO ACT NATURA2000 PROJECT, we attached Kiwisat satellite transmitters to the carapaces of 14 turtles, seven at each site, using two-part epoxy. Study turtles incorporated both sexes and covered subadult and adult-sized individuals (60.3 to 80.2 straight carapace length). Eleven of the 14 transmitters provided data for two summers and nine remain active, providing locations for turtles over two summers and two winters (ca. 500 d). Preliminary assessment of tracking data reveals that: six of the seven Amvrakikos turtles remained within the Gulf, within a 5-15 km range of their capture location. Only one individual departed from the Gulf. It migrated north into the Adriatic Sea, eventually settling in the Drini Bay – a known loggerhead foraging area in Albania. Mesolonghi turtles displayed more varied behaviours. One individual remained within 10km of the capture location, one individual utilised an area up to 30km along the north coast of the Gulf of Patras (extending from Mesolonghi Lagoon), three turtles moved south across the Gulf of Patras to reside in coastal areas of the Peloponnese 20-50km from the capture site and one individual undertook repeated migrations south to Proti Island, off the western coast of Peloponnese, and back to Mesolonghi. The final turtle migrated up to 1800km west, into Algerian waters of the western Mediterranean. It is clear that the majority of turtles show long-term fidelity to Amvrakikos Gulf, which has also been demonstrated through flipper tagging and thus practical management options may be proposed. However, the situation in Mesolonghi Lagoon is more complicated and warrants further study on the impacts on turtle behaviour by the seasonal fish trap barrier. We thank: Smaro Touliatou and Paul Tsaros and Ben Hawksbee and the project volunteers for undertaking the fieldwork. The Management Agencies of Amvrakikos Wetlands and Mesolonghi Lagoon for facilitating the project. Ioanna Fytou of ATEPE for liaising between project partners, ARCHELON for supply of field equipment etc. and the Ministry of the Environment for permits to work with protected species.

CHANGES IN THE FORAGING STRATEGY OF KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*) IN THE NORTHERN GULF OF MEXICO POST DEEPWATER HORIZON*

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On April 20th 2010 the largest oil spill on record for the Northern Gulf of Mexico began with an explosion of the Deepwater Horizon drill rig at the MC-252 well site, which ultimately released 3.19 M barrels of oil and 0.9-1.2 X 1010 mol of natural gas. The most endangered species of sea turtle, the Kemp's ridley (*Lepidochelys kempii*) has a long established record of using the habitat in the vicinity of the spill as primary foraging grounds. Negative impacts, both

short- and long-term, on their foraging area have the potential to induce changes in the health and fitness of a large portion of the Kemp's ridley population in the Gulf of Mexico. Oil is known to have entered the foraging areas. Therefore, the stable isotope signature of the oil should be reflected in the food web and in the tissues of organisms such as sea turtles. We used stable isotope analyses in conjunction with satellite tagging to 1) assess changes in foraging strategies of nesting Kemp's ridley turtles sampled in 2010 (the year of the Deepwater Horizon incident) and two subsequent post-spill years; and 2) estimate the proportion of untagged females that were inside the area affected by the oil spill via discriminant analysis. Scute samples were collected at a long-term study site on the Lower Texas Coast (Padre Island National Seashore) and on the Upper Texas Coast (Galveston Island to Surfside Beach). Kemp's ridley turtles included in this study were sampled only once. We found significantly lower δ13C values in scute samples obtained from 2011 (-18.50) and 2012 (-18.09) turtles compared to 2010 (-17.21) samples. The depleted carbon values are consistent with the incorporation of MC-252 oil (d13C = -27 +- 0.2), methane, or both into the Kemp's ridley food chain. Conversely, the δ15N isotope values did not differ significantly among years, indicating that there was no appreciable change in trophic feeding level. The distinctive isotope values of the tagged females that foraged in the oiled area together with discriminant analysis allowed identification of untagged turtles that foraged in the oiled area.

UNRAVELLING THE AT-SEA BEHAVIOR OF LEATHERBACK TURTLES AROUND SOUTHERN AFRICA BY INTEGRATING HORIZONTAL AND VERTICAL MOVEMENT PATTERNS*

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Establishing the movement patterns of free-ranging animals is central to understanding their behavior and ecology, and often has valuable conservation applications. Through the use of satellite telemetry, researchers have begun to uncover the complex movements of many animals, such as marine turtles. These studies have shown that marine turtles adjust both their horizontal and vertical (diving) movement patterns in response to environmental variation; however, most studies have exclusively used horizontal movement to determine when an animal has switched from transiting to foraging behavior. In this study, we investigated (1) whether shifts in the horizontal movement patterns of leatherback turtles (*Dermochelys coriacea*) occur simultaneously with changes in diving behavior, (2) if analyses of horizontal and vertical movement metrics provide a more insightful interpretation of foraging behavior than analyses of horizontal movement metrics alone, and (3) which oceanographic features best indicate high-quality foraging habitats for leatherback turtles. Between 2011 and 2013, we deployed 20 satellite transmitters onto nesting leatherback turtles in the iSimangaliso Wetland Park, South Africa. The hydrodynamic, towed transmitters had the capacity to record both location and dive data. We analyzed the resulting horizontal movement patterns to identify periods of patch fidelity, indicated by a reduction in movement speed or the presence of many daily locations within a relatively-small spatial extent over extended periods of time. For example, patch fidelity was deemed higher if the turtles slowed its forward movements, or travelled in a winding of circular path within a localized area over several days. Next, we investigated whether simultaneous changes were also observed in other diving metrics during the identified periods of high patch-fidelity. Analyzing both horizontal and vertical movement metrics simultaneously enabled us to detect bouts of presumed foraging behavior and characterize oceanographic conditions at these locations. Distinct shifts in diving behavior were identified corresponding with areas of high patch-fidelity. Shifts were particularly clear in the number of dives per 4-h period, variation in dive duration per 4-h period, and maximum dive depth per 4-h period. On some occasions, however, shifts in diving behavior were observed independently of concurrent shifts in horizontal movement metrics. These results strongly suggest that simplistic interpretation of foraging behavior that are based only on horizontal movement patterns can be substantially improved by including analyses of vertical movement patterns. A comparison of the presumed foraging patterns of leatherback turtles to oceanographic features indicated that leatherback turtles focus their foraging efforts on a range of oceanographic features that can be spatially and temporally dynamic, such as oceanic frontal regions, but they can also be relatively fixed in location, such as persistent coastal up-welling regions. Consequently, conservation efforts to must also incorporate a range of spatially-explicit methods as well as analyses of spatially dynamic features to ensure adequate protection of leatherback turtles in their marine habitats.

RECENT ADVANCES IN BIO-LOGGING TECHNOLOY AND OCEAN MODELS TO STUDY THE ONTOGENY OF CRYPTIC IN-WATER BEHAVIOURS*

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By combining bio-logging data with ocean models key insights into some of the cryptic in-water behaviours of sea turtles can be gained. For example, by comparing global patterns in the migration strategies of satellite tracked adult turtles with ocean model simulations of the cryptic dispersion routes of hatchlings, we propose that hatchling drift experiences reflect the diversity in migration strategies and foraging habitat selections of adults (Scott *et al*. 2014a). If hatchlings drift to regions that contain suitable neritic habitats (for adult cheloniid species), by imprinting on these locations they can later return directly as adults to ensure they find food. From nesting locations where juveniles are unlikely to encounter suitable adult feeding areas, upon returning to their natal areas, adults adopt less typical post-breeding migration strategies and instead forage locally, shuttle along the coast or feed in the open ocean. More recently, advances in the miniaturisation of bio-logging technology has led to the development of acoustic tags small enough to track hatchlings. In Cape Verde, we used these acoustic tags to track neonate hatchling loggerhead turtles (*Caretta caretta*) from the beach and witnessed first-hand their rapid dispersal with ocean currents. Laboratory observations of Cape Verdean hatchlings also highlighted population specific swimming behaviours thought to be adapted to the local oceanic conditions (Scott *et al* 2014b). Here, I will summarise the main findings from this recent work and briefly introduce some current research using "daily diaries"; bio-logging devices that enable new levels of detail into the in-water behaviours of turtles to be determined. Acknowledgements. Research presented was conducted through a NERC funded PhD and a Postdoctoral grant funded by "The Future Ocean Cluster of Excellence". The Future Ocean, funded within the framework of the Excellence Initiative by the DFG on behalf of the German federal and state governments, also provided a travel grant to attendance this conference.

DIET OF LOGGERHEAD SEA TURTLES IN MARYLAND, USA

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The Chesapeake Bay and Atlantic Ocean waters of Maryland, USA include seasonal developmental and migratory areas for the loggerhead sea turtle (*Caretta caretta*). The species is the most abundant sea turtle in the state. Loggerheads, primarily immature individuals, are most often encountered in Maryland between May and October, and strandings typically number under 25 per year. Maryland loggerhead diet is hypothesized to be similar to that of the species in neighboring Virginia, but this study represents the first detailed diet characterization. During 2012, gastrointestinal (GI) tract samples were collected from dead stranded loggerheads by the Maryland Department of Natural Resources and transferred to the Virginia Aquarium for examination. The gut contents were sieved, sorted, and identified to the lowest possible taxonomic level. Thirteen GI samples were examined from loggerheads averaging 72. 4 cm straight carapace length (SCL, 58.4-97.5 cm, SD= 11.8 cm). Six of the samples originated from Chesapeake Bay-facing stranding locations, with the rest collected along Maryland's Atlantic coast. Seventy-seven percent of samples contained decapod crustaceans, with 54%, 31%, 16%, and 8% of the loggerheads having consumed blue crabs (*Callinectes sapidus*), Atlantic rock crab (*Cancer irroratus*), hermit crabs (*Pagurus* spp.), and spider crabs (*Libinia* spp.), respectively. Horseshoe crabs (*Limulus polyphemus*) and bony fishes were each documented in 38% of samples, and 23% and 15% contained large whelks and moon snails, respectively. The most frequently consumed fish was Atlantic menhaden, *Brevoortia tryannus*, which occurred in 23% of samples. Anthropogenic items, including a fishing hook, Styrofoam, rubber, and plastic, were found in two samples (15%). Although the sample size was relatively small, 2012 Maryland loggerhead diet was comparable to that of conspecifics sampled in Virginia during 2010-2012 (Seney *et al*., unpublished, n=124), particularly with respect to occurrence of blue crabs, horseshoe crabs, large whelks, and fishes. Overall, decapod crustacean frequency of occurrence was similar between the two data sets, but rock crabs were observed more frequently in Maryland diet, and spider crabs

were observed more frequently in Virginia. This may reflect a difference in prey availability between the two states. Relatively high frequency of occurrence for horseshoe crab in Maryland samples could be an indicator of increased population size for that previously depleted prey species. As in Virginia, bony fishes are assumed to be consumed from fishing nets or as discarded bycatch. Although this was a small study, it provided valuable, new information on the diet of loggerheads in Maryland. Dietary information should continue to be utilized to complement stranding examinations and population assessments and to inform conservation decisions for this long-lived, protected species.

AN UPDATE ON THE DIET OF LOGGERHEAD AND KEMP'S RIDLEY SEA TURTLES IN VIRGINIA, USA

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Virginia's Chesapeake Bay and Atlantic Ocean waters are seasonal developmental and migratory areas for loggerhead and Kemp's ridley sea turtles. Loggerheads' primary prey in Virginia shifted from horseshoe crab to blue crab to bony fishes and hermit crabs during 1983 to 2002, whereas ridleys have historically shown preferences for decapod crustaceans. During 2010-2013, gastrointestinal (GI) tract samples were collected from dead stranded loggerheads and Kemp's ridleys by the Virginia Aquarium and partners. Contents were subsequently sieved, sorted, and identified, with estimated prey counts and dry weights recorded for whole samples. One-hundred and twenty-four loggerhead (70 whole, 54 partial, 2010-2012) and 81 Kemp's ridley (42 whole, 39 partial, 2010-2013) GI samples were examined. About two-thirds of the samples originated from Chesapeake Bay-facing stranding locations, with the rest from Virginia's Atlantic coast. Sampled loggerheads averaged 75.0 cm straight carapace length (SCL, 48.3-106.6 cm, SD= 14.0 cm), and ridleys averaged 38.3 cm (19.0-64.9 cm, SD=9.9 cm). Eighty-five percent of both species' samples contained decapod crustaceans, with 62% of loggerheads and 77% of ridleys having consumed blue crabs. Fifty-one percent of loggerheads samples contained horseshoe crabs, as did 25% of ridleys. Bony fishes occurred in 27% and 23% of loggerhead and ridley samples, respectively. Anthropogenic items were found in ten loggerhead and eight ridley samples. Among whole loggerhead samples, large whelks constituted the highest percent number (%N) of prey items (39%), followed by decapod crustaceans (27%), horseshoe crab (13%), moon snails (7%), and bony fishes (4%). Prey numbers in these categories were significantly affected by SCL (MANCOVA: $p=0.001$) and location ($p<0.001$) but not by season ($p=0.088$). The highest preliminary percent dry weight values (%W, n=48 turtles) were for decapod crustaceans (21%) and horseshoe crab (17%). Among whole ridley samples, blue crabs and congeners constituted the highest %N (19%), %W (29%), and %IRI (index of relative importance, 50%). The next five highest %IRI values were for mud snails (20%), spider crabs (14%), bony fishes (5%), hermit crabs (4%), and horseshoe crabs (3%). No significant difference in major prey types' frequencies of occurrence was found between the 2010-2012 loggerhead and 2010-2013 Kemp's ridley samples (Kruskal-Wallis: $p=0.074$). Virginia's loggerheads appear to have shifted to more natural prey items during 2010-2012, but bony fishes were still a substantial diet component, and sampled turtles were somewhat larger and included more Atlantic coast samples compared to past research. Primary components of 2010-2013 Kemp's ridley diet were similar to historical Virginia diet, with two notable exceptions: insects were recorded for the first time, whereas horseshoe crab was consumed more frequently. Increased consumption of horseshoe crab by both species may be indicative of increased the prey species' populations. Continued fish consumption is of concern, given its probable connection to feeding in nets or on discarded bycatch or bait. Virginia's sea turtle diet trends will be examined further, as dry weights are collected and archived samples are examined. Dietary information should continue to be utilized to complement stranding examinations and population assessments and to inform conservation decisions for these long-lived, protected species.

MIGRATION PATTERN OF MALE TURTLES: ARE THEY ADAPTED FOR FEEDING BY PEOPLE OR THEY ARE NOT MIGRATING?

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Female turtles migrate to warmer regions at the end of nesting seasons. There is a general opinion that males are also migrate in the same way as females too. In this study, we aimed to elucidate the migration pattern of male loggerhead sea

turtles that were rehabilitated at the Rescue Centre (DEKAMER). Five satellite tracking devices were fitted to loggerhead turtles at the end of the years of 2011 and 2012. Only four turtles were successfully sent signals, one of them lost transmitting signal after a few days of release may be due to damage of the device's antenna. The injured turtles were captured and brought to DEKAMER from Dalyan Channel, Kaş and Fethiye. After their treatment they all released from the same point (Dalyan Beach). These turtles were reported to have biting problems when they were brought to the centre. After releasing, they were all migrated to the same point where they were found, suggesting that they are adapted for feeding by people. Later in the season they showed again the same behaviour of biting people as a way of asking food. This initial study shows that male turtles do spend their times where they can find easy source of food at the western location of Turkish Mediterranean Sea. The water temperatures are also found to be suitable for turtles to stay all year around. The rehabilitation of biting turtles has to be done to regain their natural feeding behaviour with live preys in sea-pens rather than keeping them in convalescent pools during their rehabilitation. In order to understand the migration pattern differences between males from different seasons, more studies are necessary.

OVERLAP BETWEEN THE SEA SCALLOP FISHERY AND LOGGERHEAD TURTLE HABITATS IN THE NORTHWEST ATLANTIC OCEAN

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Interactions with endangered sea turtles are an issue within many northwest Atlantic fisheries and efforts to protect these species have mainly focused on fishing gear modifications. There is limited research investigating the spatial, both horizontal and vertical, and temporal overlap between loggerhead turtles and the various fisheries of the northwest Atlantic, specifically the scallop fishery. To better understand the threatened northwest Atlantic loggerhead population and the impacts of the scallop fishery, we deployed over 100 satellite relayed data loggers with Fastloc GPS on juvenile and adult loggerheads in continental shelf waters of the United States Mid-Atlantic region. We programmed the transmitters for GPS outputs during the first four months of deployment to identify in detail summer foraging site locations. Settings for the satellite tags' duty cycle and temporal resolution were refined to enable robust investigation of loggerhead foraging habits. Since 2009, we have tracked, with satellite transmitters, over 100 adult and late stage juvenile loggerheads, with only 2 transmitters failing immediately. The functional transmitters have lasted on average 328 days with a range of 38 – 808 days. The primary objective of this project included data collection and analyses of sea turtle distributions along the United States eastern seaboard to identify spatial and temporal "hot spots" on the fishing grounds and turtle behaviors that impact by-catch rates. The information collected aids in evaluating loggerhead abundance estimates and scallop harvesting strategy options to minimize harm to sea turtles. In general, we have found that loggerheads within the western Atlantic typically are found foraging during the summer months along the United States coastline at latitudinal ranges from 36° - 41°N. This timing and location directly overlaps with the scallop fishery. Seasonally, the tracked turtles transitioned south during the fall and remained in their most southern habitats during the winter months. During the spring, these turtles migrated back north, returning to their summer foraging grounds. These northwest Atlantic loggerheads have a strong association with the Mid-Atlantic Bight, a region characterized for its fertile fishing grounds. Currently, we have obtained a better understanding of loggerhead summer foraging habits, and with the dive data relayed via the transmitters we plan to develop a more complete assessment of both the horizontal and vertical habitat range.

HABITAT USE OF A LOGGERHEAD TURTLE POPULATION UNDER HIGH THREAT FROM FISHERIES*

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Threats to marine vertebrates are difficult to mitigate until their spatial distribution is understood. We report on a decade of satellite tracking of loggerhead turtles from North Cyprus with results that effectively represent this rookery. Foraging sites of our 25 turtles were distributed across the Cypriot, Levant and North African coasts and all were in neritic waters,

particularly clustered in a) Cyprus and Syria, b) Egypt and c) off Libya and Tunisia. The West Egypt/East Libyan coast is a migratory bottleneck for turtles exiting North Cyprus and probably for those turtles from rookeries in the wider region. Interestingly, turtles tracked during the first weeks of nesting migrated to other known rookeries of Turkey, Syria and Israel where they likely nested prior to migrating to foraging sites. Our study further highlights the importance of the Tunisian/West Libyan shelf and coast as an area where fisheries bycatch probably threatens individuals from all of the Mediterranean rookeries. Anthropogenic mortalities are suspected to have occurred in Lake Bardawil, Syria (deduced from ARGOS data) and off North Cyprus (death confirmed) during tracking durations of less than a year, all within near shore areas where small-scale fisheries operate. While contributing to the understanding of the wider ecology of Mediterranean loggerhead turtles, our results will be useful in mitigating the considerable threat to this population from fisheries bycatch.

INDIVIDUAL VARIABILITY IN RESOURCE USE WITHIN A JUVENILE GREEN TURTLE POPULATION

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Stable isotope analysis in studies of trophic relations has revealed differences in population resource use and individual specialization, such that individuals use a limited portion of the available resources. It is important to identify individual variation in resource use of green turtles for improved understanding and conservation of the species, as individual specialization can potentially reduce intraspecific competition. The purpose of this study was to examine the individual variability of juvenile green turtles from a feeding area in the Mexican Caribbean. Nitrogen and carbon stable isotopes were analyzed in blood samples from 14 juvenile green turtles (size range: 42.7 to 82.8 cm CCL), captured from November 2012 to August 2014. Individuals were captured multiple times, such that three to seven blood samples were obtained from the same individual during the study period. Isotopic ranges in the population were 3.2 to 7.8 ‰ (&delta^{15}N) and -11.6 to -6.1 ‰ (&delta^{13}C). Significant differences among individuals were found in six green turtles ($p< 0.05$), and there was no correlation with size. One individual (first capture: 56.5 cm, CCL; last capture: 65.5 cm, CCL) showed differences only in carbon isotope values among samples (&delta^{15}N range:5.3 to 5.6 ‰;&delta^{13}C range: -11.6 to -8.8 ‰), while another individual that was captured seven times (first capture: 69.8 cm, CCL; last capture: 76 cm, CCL) showed similar isotopic values during the whole study (&delta^{15}N range: 6.7 to 7.8 ‰; &delta^{13}C range: -8.8 to -7.8 ‰). These preliminary results suggest that while the population of juveniles of Akumal is herbivorous, individuals use different resources and maintain the preference for that resource over a long period. This observed individual specialization in the population did not depend on body size. Funding for this project was provided by CICIMAR-IPN (SIP-IPN 20130541, and 20140132). We thank the International Sea Turtle Society, Ministry of Environment and Urban Planning, Republic of Turkey, The Ministry of Forestry and Water Affairs, Muğla Valiliği, T.C. Muğla Büyükşehir Belediyesi, Pamukkale University, Ortaca Belediyesi, Tübitak, International Seafood Sustainability Foundation, World Wildlife Fund, Hilton Dalaman Sarigerme Resort and Spa, Wildlife Computers and the International Sea Turtle Symposium for the grant support.

SPATIAL ANALYSIS OF SATELLITE TRACKING DATA ACQUIRED FROM FEMALE LOGGERHEAD TURTLES NESTING AT MASIRAH ISLAND, SULTANATE OF OMAN*

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From surveys conducted between 1977-1979, Masirah Island in Oman was reported to host one of the largest aggregations of nesting loggerhead turtles in the Indian Ocean, and indeed the world. The surveys estimated a total of 20-40,000 females to nest on approximately 80km of beaches, mostly on the eastern side of the island. In tandem with recent nesting beach

surveys, females have been fitted with satellite transmitters as part of spatial ecology investigations. First published accounts from 2010 report a dichotomy of internesting behaviors between loggerheads that remained close to the nesting area and those that tracked offshore. Post-nesting movements away from the nesting site were predominantly towards the south in the oceanic habitat off the Oman/ Yemen mainland and Socotra Island. This study presents the preliminary processing of data from 40 tags deployed by an interagency partnership in 2006 and continued between 2010 and 2012. The study was initiated to understand localized and regional movements, with the primary aim of evaluating spatial aspects of conservation management. Tags were predominantly placed on early nesters at the north of the island in late April and early May with the tag configuration optimized to estimate nesting frequency, reveal localized internesting movements and produce longer term spatial data covering post-nesting migratory movements. Preliminary analysis of data from the internesting period reveals a predominance for tagged turtles to remain in a narrow corridor of approximately 100km northwards from the north and eastern beaches of the island for up to 14 weeks after tagging. Post-nesting migration routes are predominantly to the south of the island across continental shelf habitat, with most individuals circulating (presumably in oceanographic gyres) out to offshore waters of Oman and Yemen. Internesting habitat utilization has implications for understanding spatial management priorities both close to Masirah and on a wider regional scale, with data inferring an overlap of female loggerhead movements and seasonal coastal gillnet fisheries. Participatory bycatch assessment and further community consultation work is required to investigate the most effective and acceptable mitigation approaches. Concern regarding fisheries interactions with marine mega-fauna in the Northern Indian Ocean is becoming an emerging theme within the region and is a multi-taxa concern including elasmobranchs, dugongs, cetaceans and turtles. Given the spatial extent, and recognizing the complex nature of resolving fisheries impacts on non-targeted wildlife, it is recommended that expertise is pooled to allow cross-taxa appraisal of ecosystem impacts and conflict resolution.

A CASE REPORT OF THE SIXTH *LEPIDOCHELYS KEMPII* FOUND IN THE MEDITERRANEAN SEA

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It is well known that some sea turtles, particularly leatherbacks and loggerheads, enter the Mediterranean Sea from the Atlantic. However, other species such as the Kemp's Ridley turtles, *Lepidochelys kempii*, are much less known to "get lost" so far from their normal distribution range along the Atlantic coast of the United States and the Gulf of Mexico. Previously, the presence of five Kemp's Ridley sea turtles in the Mediterranean Sea was reported and among these, two on Italian coasts during the last 5 years. The first was stranded on 19 August 2009 at Capo Peloro, Messina (Italy), and the second was caught alive by a bottom trawl net off Bellaria, in the Northwestern Adriatic Sea on 24 March 2010. On 23 may 2014 another 40 cm large specimen of this critically endangered turtle species stranded on the beach of Mondragone, SW Italy in central Tyrrhenian Sea, and was recovered by the Sea Turtle Rescue Center of the Stazione Zoologica Anton Dohrn of Naples. The turtle was generally debilitated and showed signs of post-capture stress typical for turtles that get caught in fishing nets. During the first 20 days of its permanence in the Rescue Center it defecated large quantities of solid remains of crab shells. The analysis of fecal contents revealed that it had fed almost exclusively on crabs, which form the diet of this species in the adult stage, while no anthropogenic item was found in the fecal pellets. After two months of maintenance in the Rescue Center the turtle was transferred to the biggest tank available of the Stazione Zoologica Aquarium to observe its swimming behavior and its interaction with a *Chelonia mydas*, and the other fishes also present in the tank. The turtle recovered strength quickly and it was decided to release it from the offshore island of Ventotene in the middle of pelagic area, so that it may find its way back to the Atlantic. The turtle was equipped with a small GPS/ARGOS tag to follow its movements and released on 9 October 2014. Against our expectations the turtle did not head towards the Atlantic Ocean but went straight back to the coast of Mondragone where it was originally found. The tag is currently still transmitting and we will present its movements and habitat use in more detail. This is the second case of a *Lepidochelys kempii* followed by satellite telemetry in the Mediterranean and these data will help to understand how these foreign turtles make use of their new habitats.

POPULATION CONNECTIVITY AT BOUNDARY REGIONS: CHARACTERIZATION OF THE GREEN SEA TURTLE AGGREGATION IN LA GUAJIRA REGION OF COLOMBIA

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The persistence of populations over time may depend on the survival of particular life stages, which is often determined by suitability of habitats. The Long-lasting juvenile stage of the green sea turtle *Chelonia mydas* limits the intrinsic growth rate of its populations. The conservation of habitats that allow long-term survival and connectivity of juveniles may contribute more individuals to reproductive stages and therefore to species recovery. However, the location of these habitats is partly unkown because portions of the species distribution range remain understudied. La Guajira region of Colombia in the southern Caribbean, harbors habitats with extensive seagrass beds and mangrove forests on which juveniles in foraging activities have been observed. Also, this region is located at a boundary between two genetic connectivity groups, the eastern and western Atlantic groups. Thus, La Guajira is a candidate suitable juvenile habitat in need to be described. Here I present the preliminary characterization of the aggregation of green sea turtles in Bahia Hondita, La Guajira, with the help of a local indigenous group of conservation stewards, the "Sawainruu", in order to reveal its suitability as a juvenile habitat. Green sea turtles were net-captured given the high turbidity of the waters, measured, flipper-tagged and sampled for genetic procedures. Evidence of residency at least for three years and a high rate of growth were observed in the aggregation. All turtles captured were juveniles under 76cm Straight Carapace Length. High genetic diversity and a mixture of genotypes from the two genetic connectivity regions in the Atlantic were found. Finally, a 30% incidence of the Fibropapilloma disease is reported on the mid-size juveniles in a variety of symptomatic levels. Acknowledgements: CVC gratefully acknowledges travel support from the Department of Biology University of Miami, the International Seafood Sustainability Foundation, WWF (World Wide Fund for Nature), Hilton Dalaman Sarigerme Resort & Spa, Wildlife Computers, and other donors, provided through the ISTS.

NEW ASPECTS OF THE GREEN TURTLE DIETARY SHIFT IN ITS LIMIT DISTRIBUTION OF THE SOUTHWESTERN ATLANTIC OCEAN*

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Uruguayan coastal waters host foraging and developmental grounds for immature green turtles recruiting just after the oceanic phase of their life cycle. In other areas, this change in habitat is accompanied by a dietary shift in which neustonic and pelagic invertebrates are replaced by macrophytes as main prey. However, the timing of the dietary change may vary regionally. In temperate areas, resource availability varies seasonally and may result into a larger plasticity in the adaptation of green turtle feeding patterns to local conditions. Previous information shows that green turtles occurring off Uruguay present a diet based in macroalgae, but details about the dietary shift are unknown. The present study aims to understand the ontogenetic dietary shift of green turtle and to assess their nutritional dependence on macroalgae. Skin biopsies of intentionally captured green turtles and samples of potential prey were collected during 2012 and 2013 in northeast Uruguay. For epidermis samples, turtles were divided in two data sets: turtles captured during summer were split in four size classed [Curved Carapace Length < 35 cm (n=17); >= 35 < 45 cm (n=22); >= 45 < 55 cm (n=6); > 55 cm (n=5)]; and turtles ranging 35-45 cm were split in four seasonal groups [Summer (n=11), Fall (n=11), Winter (n=11), Spring (n=11)]. Through Bayesian stable isotopes mixing model we estimated the relative contributions of macroalgae and other prey to the diet of turtles. Potential prey species were included in the model based on (1) occurrence in digestive tracts analyses, (2) abundance in Uruguayan waters, and/or (3) stable isotope ratios compatible with those in turtle epidermic tissue. The model included four macroalgae and one cnidarian species from Uruguay and four macroalgae species from Brazil. The stable isotope ratios in the epidermis of green turtle (N= 137) ranged from -18.2 to -13.6 ‰ for δ13C and from 6.7 to 15.6 ‰ for δ15N, suggesting that turtles fed at more than one trophic level and in different geographic

regions. The diet of turtles smaller than 55 cm CCL was based primarily on seaweeds from Brazil, thus revealing recent arrival to Uruguay. Conversely, the diet of the turtles larger than 55 cm included macroalgae from both Brazil and Uruguay, with a predominant presence of Uruguayan seaweed, as well as a relevant contribution of gelatinous zooplankton. For the smaller turtles, a relevant contribution to the diet of seaweeds from Uruguay was detected only in spring, probably because at that time only overwintering animals were present in the area. These results indicate that small turtles recruit mainly in Brazil and disperse later to Uruguay, where most individuals spend only a few months. However, some individuals stay in Uruguay for longer periods, including overwintering.

REVIEW OF TAG RECOVERIES FROM 38 YEARS OF INWATER CAPTURES AT THE ST. LUCIE NUCLEAR POWER PLANT, SOUTH HUTCHINSON ISLAND, FLORIDA, USA

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The St. Lucie Nuclear Power Plant located on South Hutchinson Island, Florida, USA, has had an ongoing inwater mark-recapture project since becoming operational in 1976. Water being used for the plant's once-through condenser cooling system enters through three submerged intake structures located 365m offshore. Turtles entering the ocean intake structures are entrained with the cooling water and rapidly transported through intake pipe into an enclosed canal system where the only access to the ocean is through manual removal. Turtles that are entrained have been systematically captured, measured, weighed, tagged and released since. During this time, 116 turtles; 59 loggerheads (*Caretta caretta*), 54 green (*Chelonia mydas*), 3 leatherbacks (*Dermochelys coriacea*) have been caught in the canal bearing tags from other projects around the Atlantic Basin. Original tagging locations, time between captures, estimated distance traveled and growth rates of these tag recoveries will be reviewed. Two cases will be highlighted involving sub adult loggerhead turtles tagged off of the eastern coast of Spain in the Mediterranean Sea that were entrained at the St. Lucie Nuclear Power Plant intake canal 470 days and 650 days after the original marking. These turtles are believed to be the first documented turtles to have been tagged in the Mediterranean Sea that have reached the eastern shores of the United States alive.

OFFSHORE DISPERSAL OF FLATBACK (*NATATOR DEPRESSUS*) HATCHLINGS: INSIGHTS INTO THE WORLD'S ONLY NON-OCEANIC TURTLE*

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Flatback turtles (*Natator depressus*) display unique features among marine turtles; they are endemic to Australia, and are the only marine turtle species lacking an oceanic life-stage. Although the nesting biology of this species has been studied in depth for over 50 years, the in-water biology and ecology of the species remain largely unknown. Recent studies on the behaviour of flatback hatchlings have provided valuable insights about the swimming performance and dispersal strategies of flatbacks during their initial life-stage. The body size of hatchlings is considerably greater than for other marine turtles, resulting in larger energy reserves stored in the yolk sac. Hence, they develop a longer swimming frenzy (2-3 days) but with less stroke power than other turtle species, probably favouring a short-distance neritic (non-oceanic) distribution. As shown by oceanographic modelling, the hatchlings remain in coastal, predator-rich waters and their distribution is driven mainly by the swimming activity and local water circulation. By expanding the latter study to a broader geographical extent, the objective of this research is to improve the understanding of the mechanisms that drive the offshore dispersal of flatback hatchlings in eastern Australia, by using the oceanographic 2D SLIM model to predict the fine scale water circulation and hatchling dispersal. We modelled the dispersal of hatchlings from every recorded nesting beach within the Great Barrier Reef World Heritage Area. In addition, we modelled the dispersal from known non-nesting beaches (locations that do not support any flatback nesting) as control group, in order to assess potential differences in the dispersal of hatchlings between non-nesting locations and the real nesting locations. Size of nesting population (and thus number of hatchlings) and swimming behavior of the hatchlings were included as ecological parameters in the model. Dispersal scenarios were generated hourly for 30 days and core dispersal zones were identified using relative density estimators. The use of oceanographic modelling for predicting the dispersal of marine turtles can provide valuable knowledge for understanding the early spatial distribution patterns of flatbacks, leading to a potential explanation of why this species lacks a pelagic life stage and remains within the continental shelf of Australia. Acknowledgments: funding and support for this project was provided by: International Sea Turtle Society, Ministry of Environment and Urban Planning, Ministry of Forestry and Water Affairs, Muğla Valiliği, Pamukkale Üniversitesi, Ortaca Belediyesi, TÜBİTAK, International Seafood Sustainability Foundation, WWF, Hilton, Wildlife Computers, Université Catholique de Louvain, GRS-James Cook University, SEES-James Cook University.

POPULATION DEMOGRAPHICS FROM PHOTO-IDENTIFIED GREEN AND LOGGERHEAD TURTLES FROM MOZAMBIQUE

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Field studies of sea turtle population structure and movements tend to be labour-intensive, with associated expense. Enlisting recreational divers as participants in these studies can help with both these challenges. We collected and solicited photo data of reef-associated sea turtles from a popular recreational diving area in southern Mozambique. Photos of left and right facial scute profiles, and dorsal images of the carapace, were collected for Green (*Chelonia mydas*) and Loggerhead (*Caretta caretta*) turtles from 2010 to 2014. Where possible, each turtle was individually identified allowing residency models to be generated using modified maximum likelihood techniques. The dataset comprised of over 104 photo records of Green turtles, which resulted in the identification of 22 animals. From 110 photo records of Loggerhead turtles, 39 individuals were identified. Photo quality and thus usability for assigning identification varied between species, with citizen scientists submitting more suitable pictures of Green turtles in comparison with Loggerheads. Green turtles resided in the study area for long periods of time, whereas loggerhead turtles were transient. These results have significant conservation implications at the study site as in-water poaching is common and widespread in Mozambique. A brief practical evaluation of the quality and quantity of images submitted by citizen scientists will also be discussed. Acknowledgements: We acknowledge the Fundação Mamíferos Aquáticos (FMA) and TAMAR-ICMBio project for collecting humerus samples. The age was determined with the logistics provided by the Laboratório de Ecologia e Conservação da Megafauna Marinha (ECOMEGA, Instituto de Oceanografia—FURG). Finally, acknowledge the financial support from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

SIGHTINGS RECORDS OF HAWKSBILLS IN A MARINE PROTECTED AREA OF HONDURAS

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The Protective Turtle Ecology Center for Training, Outreach, and Research, Inc. (ProTECTOR) works to increase the conservation of, and research on sea turtles in the country of Honduras. Efforts were made this summer to record the sightings of sea turtles in Roatán, specifically in the area of West End and the Roatán Marine Park (RMP). We worked in tandem with 13 dive shops in West End from June 9 – August 8, 2014 to collect dive sightings data. We prepared turtle sighting record sheets that prompted observers to record their name, the dive site and depth of each turtle sighting, along with the specific species spotted, and whether the turtle was a juvenile or adult. We also gave divers training on how to differentiate between species and between adult and juvenile turtles. The data collection sheet provided representative artwork detailing differences in shell shape and color, as well as head scute patterns among the three species (hawksbills, loggerheads, and greens) likely to be sighted in the area. We collected sighting records from 5 dive shops on Mondays and Thursdays, 4 dives shops on Tuesdays and Fridays, and 2 dive shops once weekly, due to low diving frequency. Approximately 720 turtle sightings were recorded in the two months of data collection ranging from a maximum of 80 turtles observed at one site to minimum of 1 turtle observed at one site. The majority of turtle sightings were recorded at Overheat Reef, Bikini Bottom, and Half Moon Bay Wall with 80, 59, and 41 turtle sightings recorded, respectively, over the two-month span in which we collected dive sightings from the shops. When compared to sighting records of the previous year, ArcGIS mapping showed a significant increase in the number of dive sites with turtle sightings and a subsequent increase in sightings at the same dive sites. The amount of dive sites where turtles were spotted increased from 20 dive sites in the previous year to 51 dive sites in 2014. Taken together, the data suggests an increase in turtles present in the offshore areas of West End between 2013 and 2014.

NESTING BIOLOGY

AN OVERVIEW OF RECENT LOGGERHEAD TURTLE (*CARETTA CARETTA*) NESTING ACTIVITIES ALONG THE CATALONIA COASTLINE (NORTHEASTERN SPANISH COAST), DATA COLLECTION AND IMPLICATIONS FOR THEIR SPECIES-SPECIFIC CONSERVATION IN THE WESTERN MEDITERRANEAN BASIN

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Five new loggerhead turtle nesting activities were discovered in 2011 and 2014 on beaches in Catalonia, on the northeastern spanish Mediterranean coast. These new records confirm that the Catalonian coastline has suitable beaches for natural loggerhead nesting, and could contribute significantly to sea turtle nesting in the western Mediterranean basin (despite at the present probably sex-ratio is highly skewed toward males). These events could be more frequents in a warmer climate change scenario, and these facts mean that rethinks of the loggerhead turtle conservation model and beach monitoring and management policies in the Catalonian region are required. In 2011, a nest was discovered as hatchlings emerged on 1st October in Malgrat de Mar (Maresme). Despite regular monitoring through an official rescue network, no further activity was found until 2014. During 2014, nesting female individuals were observed on the beach in three different locations: 1) 30th July in Blanes, 2) 17th August in Calella de Mar and 3) 25th August in Tarragona. Turles only managed to nest at the last site. It was considered that there was a high risk of vandalism and flooding due to Autumn storms, for that reason this nest was translocated to the Delta de l' Ebre Natural Park. Another nest managed to incubate naturally and was discovered by chance during hatchling emergence on the 27th October of 2014 in Platja Llarga (Tarragona). Considering the dates of the records, the seasonal renesting interval for the species and the locations of the observations, its possible that the nesting activities found in 2014 belong either to only one female or two different nesting females. The emergence success of the naturally incubated nests was 75.4% (134 eggs, 43 cm depth) in 2011 and 41,4% (58 eggs, 38 cm depth) in 2014. The eggs belong to the translocated nests in 2014 (89 eggs, 68 cm depth) failed to hatch early on in the development possibly due to the characteristics and the extreme humidity of the substrate of the new location. In this poster we also analyse data of nest locations, characteristics of the incubation substrate, presence of microorganisms in the nests and stage of embryo mortality. All nesting activities ever found in Catalonia have been in July-August, the hottest period of the year. In 2014 the highest number of nesting activities ever recorded were found along the spanish Mediterranean coast: 6 nesting activities in Catalonia (4 events: 2 nests), Andalusia (see poster Sánchez *et al*.) and Alicante (see poster Tomás *et al*.). It is unclear what may be driving this behaviour, but it is possible that these recent observations are a reflection of an enhanced public and scientific awareness on sea turtle nesting. They could also be the consequence of non-phylopatric turtles and may reflect a potential colonisation from populations elsewhere. Further research should be conducted in order to explore probable changes in sea surface temperatures in feeding grounds and breeding areas which could help explain the nesting behaviour of the loggerhead sea turtle in the western Mediterranean.

HATCHING AND EMERGENCE SUCCESS IN THE GREEN TURTLES *CHELONIA MYDAS* AT RAS AL-HADD RESERVE, OMAN

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Undisturbed natural nest of green turtles, *Chelonia Mydas* at Ras Al-Hadd Reserve, one of the world's largest nesting grounds, demonstrate a remarkable success in hatching and emergence rates despite the extreme arid condition and the sparse beach vegetation. The spearman's rank correlation coefficient (rho) reveals that nest success (number of emerged hatchlings) is highly correlated with clutch size (r = 0.76) and with percentage of hatching (r = 0.26). There were no correlations between nest depth, location of the nest and clutch size. The percentages of hatching and hatchling emergence were highly correlated (r = 0.91). The incubation period varied between 55-65, depending on the sand temperature at different nest depths. Nesting season takes place all year round with a high population density (peak) in June and October and low population density (non-peak) in November-May. Prolonged nesting season and continuous high nest success year-round are very significant factors for the survival of this species. Sand temperature at depth (60cm) is 24-32°C, which is ideal for incubation and normal development. Isolation of most beaches from excessive human activities and the lack of large-scale egg harvest and adult killing make the beaches one of the most successful and most protected nesting grounds in the world. In Oman, the green turtles lack any inter-specific competition during nesting but intra-specific competition occurs during high density season. Conservation strategies must be strengthened and expanded to preserve the turtle nesting grounds in Ras Al-Hadd Reserve

ESTIMATING HATCHLING SEX RATIOS OF HAWKSBILL TURTLES FROM FIVE YEARS OF NEST TEMPERATURES AT MONA ISLAND, PUERTO RICO

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Sea turtles are susceptible to climate change because they are seasonal breeding ectotherms with Temperature-dependent Sex Determination (TSD). Some of the impacts of climate change will occur during the terrestrial reproductive phase (egg incubation, embryo development, hatching success, phenotype and sex ratio). Understanding sex ratios is essential for developing population models for predicting the effects of global warming for future research and management. Fisherian evolutionary theory suggests the primary sex ratios should be 1:1 but sea turtles producing a range of ratios. Several studies report that some nesting beaches produce female biased sex ratios of hatchlings. Estimating hatchling sex ratios is challenging because hatching sea turtles do not have external characteristics that can be used to distinguish gender. The standard direct method requires the dissection of hatchlings and histological analysis of the gonads. Indirect strategies use nest temperature, sand temperatures and incubation durations to estimate sex ratios. Mona Island harbors the largest hawksbill breeding population under U.S. jurisdiction, and the second largest in the Caribbean Sea. We estimated sex ratio based on a data collected from 58 nests monitored over five years (2009-2013), using temperature dataloggers that were placed within the nests as they were being laid and were retrieved after hatchling emerge from the nests. We evaluated three beaches: Sardinera, Carite and Mujeres, and four habitat types: *Coccoloba uvifera*, *Cocus nucifera*, *Suriana maritima*, and Open beach. We compared nest temperature data in the field to previous laboratory research on TSD for this rookery, to generate sex ratios. Sex ratio of hatchling hawksbills in the studied nests at Mona Island was 2.3:1 (F:M). There was yearly variation in predicted hatchling sex ratios (between 46-88% female). Our results predicted 43% female sex ratio production at Sardinera Beach, while Carite and Mujeres beaches had 84% and 86% female sex ratios. Sex ratios differed across habitat types: 56% of females were predicted under *C. uvifera* and 69% under *S. maritima*, while the higher female-biased sex ratios were found at *C. nucifera* (83%), and at open beach (75%). Our study suggests that Mona Island's female biased sex ratios of hatchlings during the study period is consistent with previous work on Caribbean hawksbills and others species of sea turtles, but five years records showed yearly variation in hatchling sex ratios. Therefore, multiyear studies of sex ratio are indispensable to understanding sex ratio dynamics of sea turtle populations and assessing their ability to adapt to current and future rates of climate change.

NEW LOGGERHEAD TURTLE NEST AND INJURED OR DEAD TURTLES RECORDED IN KUŞADASI, AYDIN-TURKEY

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Loggerhead sea turtles are isolated from Atlantic population and colonized in the Mediterranean and their nesting population seems to be around 2000 females only. Nearly half of these populations are nesting on south Mediterranean beaches of Turkey. Their nests have been recorded on the most north-western beach of Ekincik and Dalyan. During the last three years a single nest, on Kuşadası public beach, in each season were recorded nearly 200 km north of these present nesting beaches. The first nest was recorded at the beginning of June (2012) with 81 eggs, second one was at the end of June (2013) with 98 eggs and third one was at the beginning of August (2014) with 72 eggs in it. Average incubation period of these 3 nests was 53. Totally 171 hatchlings were observed and genetic samples were taken from dead hatchlings that remain in the nest. These three nests were protected and watched by local authorities and volunteers on the beaches and attracted almost 20.000 visitors during the entire incubation period. From the incubation period, by comparing the results with nearby beach of Dalyan, we can assume that nearly equal sex ratios of hatchlings are produced. The results were discussed under the possible shifting behaviour of loggerhead turtles as a possible result of global warming. On the other hands, high number of mortalities during the recent years shows the importance of Kuşadası Bay.In addition tothis, injured turtles that found in trawlers was released after they checked by EKODOSD members. If they have serious injuries, they sent to DEKAMER centre for rehabilitation. One of them was a green turtleand found near Kuşadası coast in October 2013. It had fishing-line on right front flipper and finger bones can be seen from outside. In this case this flipper had amputated by vets under sterile conditions. After treatment period, turtle gained wealth and released to sea on September 2014.

REPRODUCTIVE VALUE OF BLACK TURTLE NESTING FEMALES IN COLOLA, MICHOACÁN, MÉXICO

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The black turtle nests in Michoacan, Mexico is one of the towns most characteristic eastern Pacific, morphometric and reproductive values are very specific and differ significantly with most *Chelonia* populations in the world. in this paper an evaluation of the relationship of body size black turtle reproductive traits are an important part of their life history was made. Body size affects the survival of large organisms which results in more offspring. The clutch size can be changed due to restrictions imposed by mechanical factors related to certain habits or lifestyles, which can be determined by the balance between the allocation of limited jurisdiction and avoidance of predators and reproduction resources. The aim of this study was to evaluate the maternal influence (female size) on reproductive parameters of black turtle (*Chelonia agassizii*) in Colola Beach, Mexico. 100 nesting females were sampled and the average body size and the average size of their clutches, weight nest, egg weight and egg diameter was obtained by analysis of variance (ANOVA) were performed and differentiation test of means was applied Tukey. The results show significant differences between clutch size by size class (F-ratio = 7.685 P = 0.000). The average size of LCC (Long Curved Carapace) of nesting females was 83.5 cm. No correlation between egg diameter and length straight carpaccio (LRC) (r = 0.2509) was found, and no correlation between the LRC and egg weight of female black turtle (r = 0.2245) was found.

USING STABLE ISOTOPES TO IDENTIFY RELATIVE CONTRIBUTIONS OF NESTING GREEN TURTLE FORAGING AREAS IN FLORIDA*

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The green turtle is a long-lived, highly migratory species that exhibits nest and foraging site fidelity in the adult life stage. Reproductively active females exhibit weak connectivity, returning to the same nesting beach from disparate foraging habitats. Stable isotope analysis is a technique used to describe coarse geographic foraging distributions at drastically lower costs compared to alternative techniques (e.g. satellite telemetry), if fine-scale position details are unnecessary. This technique has been used in a number of marine turtle studies to delineate distinct foraging aggregations from the same nesting beach. Growing evidence suggests that the portion of the Atlantic green turtle population that nests at the Archie Carr National Wildlife Refuge (ACNWR) rookery is one of the fastest growing globally. Although green turtle nesting habitat on the ACNWR and throughout Florida is protected, more information is needed to identify foraging habitat and threats to these sites. In this study, we use stable isotope analyses of δ13C and δ15N to evaluate the efficacy of this technique in delineating distinct foraging aggregations of green turtles nesting on the ACNWR. We also assess variation in foraging area contribution both within and between "high" (in terms of nest numbers) and "low" seasons. Fifty untracked nesting female green turtles were sampled during both the "high" 2013 and "low" 2014 nesting seasons (n=100 total females). Samples were also collected from nine satellite-tracked individuals. Telemetry data from these satellite-tracked individuals indicate foraging areas in waters surrounding southeastern peninsular Florida and the Florida Keys, contrasting with the broad geographic distributions of loggerheads in Ceriani *et al*. (2012). Individual untracked females were sampled from June through September of each year to sample across the breadth of the nesting season. Two skin biopsies were obtained from sampled individuals using a sterile 4 mm biopsy punch and were analyzed for δ13C and δ15N isotopic signatures. K-means clustering in R is used as a non-hierarchical approach to segregate individuals into groupings by isotopic signatures. A putative foraging aggregation is defined as individuals within a given cluster. Our results using a small sample size of long-term recaptured nesting females indicate at least two isotopically distinct clusters. Understanding the number and relative contributions of foraging areas will help direct future conservation efforts and prioritization of critical in-water habitat.

FOOD AVAILABILITY AFFECTS THE REPRODUCTIVE SUCCESS OF THE OLIVE RIDLEY?

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Recently, it has indicated that the females of some species of sea turtle exhibit strong sensitivity to oceanographic conditions such as ENSO events. This is reflected in the probability of remigration, decreasing in warm El Niño years and increasing in cold La Niña years, corresponding to a lower / higher productivity in the feeding areas. If this factor affects the reproductive frequency of females, could also explain the interannual variability in reproductive success? Could have a more relevant effect than local environmental factors? Through GML's, we analyze the influence of climatic factors of larger scale (El Niño and La Niña, sea surface temperature and chlorophyll a concentration as proxy of food) and local scale (rainfall, hurricanes and room temperature) in the interannual variability of reproductive success, considering four variables as indicators: number of nests, number of hatchlings and percentages of hatching and emerging. The study site is nesting beach of olive ridley in Baja California Sur, Mexico with 20 years of continuous monitoring. This site presents different local environmental conditions to normal for the specie, with low humidity and little rain, local environmental factors therefore may have a greater effect on egg development and survival of the hatchlings. Our results showed that, to the four indicator variables, the interaction of the anomalies of sea surface temperature with chlorophyll concentration, largely explains the interannual fluctuations along the time serie (deviance> 0.60 in all cases), showing that the body condition of females is important not only in the number of females that arrive to the beach (and therefore the number of nests laid), but also in the protein contribution to the eggs, which results in a higher probability of survival to hatchlings. A female who has reached the proper body condition, may reproduced and then migrate to nesting areas, however, in years where productivity is lower, body condition is expected to be lower than reached in a year with high productivity, affecting/benefiting the survival of hatchlings. On the other hand, local environmental factors showed negative effects on the rates of hatching and emerging only in years with extreme weather events, when torrential rains and hurricanes impacted the region. This study shows that even in a nesting beach with conditions considered extreme, environmental

factors do not fully explain the interannual variability of reproductive success, and instead, the oceanographic conditions of the pre-nesting period may largely explain this variability, by limiting the availability of food, and therefore the body condition of females.

ACCIDENTAL RECORDS OF *CARETTA CARETTA* NESTS IN THE TWO MAIN ITALIAN ISLAND (SARDINIA AND SICILY) IN THE LAST YEARS: CAN WE STILL TALK ABOUT OCCASIONAL NESTING AREAS?

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In the Mediterranean Sea, the main nesting areas for the loggerhead sea turtle (*Caretta caretta*) are placed in the eastern basin while the western basin is mainly used as foraging and nursery area. Coastal waters around Italy are commonly frequented by loggerhead sea turtles but reproduction and nesting are thought to be rare and occasional events. As in the past, also in the last year (2014) six nests of *Caretta caretta* were found accidentally in Sardinia (n=3) and in Sicily (n=3), two regions in the Southern Italy where nesting events are still not considered as ordinary. In Sardinia some occasional nesting sites of loggerhead sea turtles have been monitored since 2006 by the "Regional Network for Conservation of Sea Turtles and Mammals", issued by several partners as Research institutes (CNR-SZN), MPAs and NPs, Vigilance bodies and coordinated by the Regional Body Administration. It is remarkable that in all cases, nesting events have been casually discovered in frequented beaches by tourists that subsequently have alerted the authorities. In fact, despite the presence of the Regional Network, in Sardinia a real monitoring program for sea turtles nesting events is still not in force. In 2014, three nests were detected in different areas of the island; in only one case the deposition act was monitored hereafter a female turtle has been sighted on the 11th of July, in the sunset, at Cala Sinzias (Cagliari). The recovery of two alive hatchlings on the 25th of September at Is Arenas (Oristano) on the water edge permitted to discover the nest and the same circumstance happened on the 2nd of October *at Marina* di Sorso beach (Sassari) when one hatchling was recovered during the day by fisherman. In Sicily 3 nests were recorded in frequented beaches after their accidental discovery and, as for Sardinia, not during a specific monitoring activity. Two nests were found at Tre Fontane (Trapani) and one was found at Tonnarella (Trapani) by inhabitants that usually frequent those beaches. Only in two cases the nesting act was observed, making possible their protection and monitoring while the other nest was identified by means of alive hatchlings in its proximity. In Sardinia and Sicily the distribution of the nesting sites was recorded exclusively on frequented beaches, the absence of data from other and less frequented coastal locations might be due to the lack of observers. The longer warm season till October has allowed to the people (tourists, fishermen) to extend their presence and to find several hatchlings confused in the proximity of the nest. Taking into account the discovery of loggerhead turtle nests in Sardinia and Sicily, almost every year, we strongly suggest the adoption of a monitoring programme, in order to identify the whole distribution of the nesting sites and protect them until the hatching stage. This resolution would greatly contribute to the conservation of loggerhead sea turtle populations by reducing both anthropic interferences and natural mortality of hatchlings.

GREEN TURTLE REPRODUCTIVE FAILURE AT RAINE ISLAND

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Raine Island is the nesting site for 90% of northern Great Barrier Reef green turtle population, the largest remaining endangered green turtle rookery on the planet. Up to 100,000 green turtles from the northern Great Barrier Reef, PNG, Indonesia and SW Pacific migrate to their natal Raine Island beach to nest each year. This genetic population is in danger of collapse. Nesting and hatching failure is occurring on a grand scale. Few clutches of eggs provide offspring despite

large numbers of nesting females. Inundation of the nesting area during high tides, related to sea-level rise or changes in the island's sand profile is being investigated as the major cause of hatching failure. Anecdotal reports indicate that turtle eggs inundated for even a short period cease development and die. Prior to the mid 1980's surface water had never been seen in the nesting area. Now around 75% of the nesting area is non-viable due to tidal inundation at nest level. Hatching success during the last three years has been recorded at less than 10%. Egg failure occurs in the first stages of development in around 70% of cases recorded. There is also concern that microbial pathogens and/or toxins may be contributing to hatching failure. Up to 500,000 eggs per night are laid in a beach area of 1800 x 50m. With only 10% hatching success this leaves a large decomposing biomass within the nesting beach sand. Investigations are underway to determine whether endemic microbial pathogens or those potentially introduced by nesting turtles may be influencing egg development. Similar concerns exist about toxins being bio-accumulated by adult females from foraging grounds and introduced to Raine Island within eggs. In-situ 'nursery plots' of clutches relocated from the nesting beach and parallel laboratory incubation experiments are being used to investigate inundation, pathogenic and toxic impacts. Nesting failure is another major concern. Nesting success is only around 20%, due mainly to dry and fine foraminiferan-based sand causing body pit and egg chamber collapse combined with high-density nesting resulting in frequent disturbance. This necessitates repeated re-nesting efforts on successive nights, which depletes stored energy reserves and results in resorbtion of follicles. The result is fewer clutches laid in a season. Traditional methods are being combined with new technological approaches to monitor and investigate green turtle reproduction on the very remote Raine Island. These include daytime PTZ video, low-light night still and underground nest depth IR camera systems as well as inundation level and temperature sensors and remote weather station. These systems are solar powered and WiFi linked throughout the island with data and images transmitted via satellite. Adaptive management actions being implemented to improve reproductive success will be presented in a separate symposium session.

LONG TERM MONITORING OF HATCHLING SEX-RATIOS OF OLIVE RIDLEY TURTLES IN THE INDIAN SUB-CONTINENT AND ITS CONSERVATION IMPLICATIONS*

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Marine turtles are highly influenced by environmental temperature, specifically those species that have very limited ranges, low physiological tolerances or shallow nests. One of the shallower nesting, tropically distributed species is the olive ridley turtle (*Lepidochelys olivacea*), which nests along the Indian coast. Indian ridley populations nesting on the east coast of India are also believed to be the evolutionary source for the recolonization of olive ridleys across the world (Shanker et.al. 2004), and are hence of high conservation concern. Considering the importance of these mass nesting rookeries, it is imperative to monitor the species and focus attention on the vulnerable nesting habitats and understand their biology and behaviour in the context of climate change. We initiated a project to monitor temperatures and hatchling sex ratios in Rushikulya in 2008. Nest, sand and air temperatures have been monitored at the Rushikulya beach for seven seasons (2008-2014). Twenty to thirty nests were relocated to a hatchery each season, and Hobo dataloggers were used to monitor temperatures in 4-6 nests, covering the entire season. Clutch size was noted and hatching success and emergence success were calculated. Dead hatchling samples were collected and stored in 10 % formalin. Subsequently, gonads were dissected out and sex was determined using standard histological techniques. Data acquired over the period of seven years was analysed. Here, we present the results of the first long term study of hatchling sex ratios from the Indian subcontinent, and discuss the potential impact of climate change. I would like to thank my supervisor Dr. Kartik Shanker for his constant support and guidance as well as MTCA and MoEF for funding the project. Also, acknowledge WTI (Wildlife Trust of India) and ISTS grant donors for supporting me with travel grant to attend the symposium.

THE WESTERNMOST MEDITERRANEAN RECORD OF A NESTING GREEN TURTLE, *CHELONIA MYDAS*: FETHIYE BEACH, TURKEY, AEGEAN SEA

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The Green turtle (*Chelonia mydas* Linnaeus 1758) is one of two nesting sea turtle species (along with the loggerhead sea turtle *Caretta caretta* Linnaeus 1758) in the Mediterranean Sea. In Turkey, Green turtle nesting areas are concentrated in the southeastern Mediterranean beaches (Antalya region), probably because of warmer temperatures. The Mediterranean subpopulation is classed as critically endangered: the estimated number of mature females is only 339-360, and 350-1750 nests are thought to be laid annually. In 2010, we found one *Chelonia mydas* nest in Fethiye (nest coordinates 36°40´53.55 N, 29°04´29.03 W), which is located on the Aegean Sea. This loggerhead turtle nesting site was designated as a SPA (Specially Protected Area) in 1989. Ninety-eight eggs were counted and 33 Green turtle hatchlings hatched. Altogether, 36 empty shells, 3 dead *Chelonia mydas* hatchlings and 52 unhatched eggs remained in the nest. The nest chamber had a depth of 0.66 m and a diameter of 0.29 m, considerably deeper/wider than a loggerhead turtle nest. This is the westernmost record of a Green turtle nest. This calls for further monitoring of Fethiye's beaches in this respect in the future, especially in light of climate change and the potential warming of more westward Mediterranean sites.

THERMIC REGIME AND SEX RATIO IN OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) NESTS INCUBATED USING ARTIFICIAL METHODS

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Many species of reptiles, including lizards, crocodiles, snakes and turtles present sex determination by incubation temperatures, which makes them vulnerable to anthropogenic climate change. It is estimated that by the effects of global change, the temperature may increase to 3.5ºC by 2100. This increase may not only affect the sex ratio of sea turtles, but also cause significant mortality during embryonic development if temperatures reach lethal limits >35°C. Multiple management strategies have been proposed to help conservation projects adapt to environmental changes. These include reforestation and restoration of coastal dunes and the use of shade in sea turtle hatcheries. We collected incubation temperature profiles over 2 nesting seasons within 73 olive ridley turtle (*Lepidochelys olivacea*) nests (2012: n=45 and 2013: n=28). Data was collected from 3 conservation projects in the region of Bahia de Banderas, Mexico which have adapted their incubation methods to increase nest survival. Incubation methods included the use of a shaded beach hatchery, raised hatchery and polystyrene boxes. Temperatures registered within nests during the study ranged from 15 to 36°C. A total of 69 of 73 nests hatched with mean hatching success of 84.2 (SD 16.4; range: 16.6-84.2). We estimated the thermal reaction norm of embryonic growth rate from the set of the 69 studied nests. This thermal reaction norm was further used to precisely locate the thermosensitive period for sex determination during incubation. The length of the thermosensitive period for sex determination was used as an integrative proxy for the effect of temperature on sex determination during the TSP. Thermal sensitive period length ranged between 16.04 and 23.92 days. Lower and upper thermal limits for transitional range of temperature for Mexican olive ridleys were identified as 28.86 and 31.383 °C respectively with a pivotal temperature of 30.121 °C SE 0.001. Relationship between constant incubation temperature and TSP length was calibrated and used to estimate sex ratio in field-based nests. Both 100% male and 100% female sex ratio were registered during the study however 91.72 % of successfully incubated nests produced female biased sex ratios.

EFFECTS OF METEOROLOGICAL FACTORS ON THE NESTING OF OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*)

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A female turtle's reproductive success is strongly linked with her ability to choose an area with suitable environmental conditions for the effective incubation of her eggs. Olive Ridley turtles are thought to use environmental cues such as wind, tidal cycle, moon phase, precipitation patterns, temperature and photoperiod in addition to physiological signals and socially facilitated behavior to synchronize the time and occurrence of mass nesting event known as arribadas. Our aim was to study whether meteorological factors (wind speed, temperature, humidity and precipitation) as well as moon phase and tidal patterns significantly affect behavior of olive ridley turtles nesting at a solitary strategy rookery. From the 28th August 2005 until 31st May 2007 (597 days) all nesting activity was recorded during nightly beach patrols along Playon Tecolotlan beach. Nesting activity was recorded as successful, poached or false crawl and the sum of these was used to calculate the total number of tracks. We registered 1551 olive ridley turtle nests during of which 227 were predated mainly by humans, in addition to a further 237 false crawls. We identified the main nesting season to occur during a June and March 10 month period from 01/06/2006 until 31/03/2007. Correlation were found between nesting and temperature and humidity.

LOGGERHEAD TURTLE OFFSPRING SIZE DOES NOT VARY WITH MATERNAL ALTERNATIVE FORAGING BEHAVIORS: SUPPORT FOR THEIR EPIGENESIS

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The occurrence and maintenance of alternative life histories have become central issues among previously untrackable species. In the case of loggerhead turtles (*Caretta caretta*) nesting on one Japanese beach, small females tend to forage on planktonic prey in oceanic waters (depth > 200 m), while large females tend to forage on benthic prey in neritic waters (depth < 200 m). These alternative foraging behaviors are presumably maintained by a conditional strategy. By incubating clutches of similar egg size derived from oceanic and neritic foragers in a common environment, we examined whether the morphology of emerged hatchlings varies with maternal alternative foraging behaviors. There were no significant differences in straight carapace length and width and body mass of emerged hatchlings between the two foraging groups, which were classified based on stable isotope ratios, suggesting the development of hatchling tissue from yolk is genetically similar between the two groups. Egg mass significantly increased with female body size only in neritic foragers that laid larger clutches than oceanic foragers, whereas hatchling morphology significantly increased with egg mass in both groups. This suggests larger females produced larger hatchlings within neritic foragers. However, we found no significant correlations between egg number and hatching and emergence success in either oceanic or neritic foragers that could explain the above phenomenon. Effects of incubation environment on embryonic development and hatchling morphology were also similar between the two foraging groups, implying their genetic similarity in thermal response, consistent with their epigenesis. This work was supported by the ISTS Travel Grant and the JSPS KAKENHI Grant Number 25870141.

LOGGERHEAD NESTING AT NORTHERN LATITUDES IN THE MEDITERRANEAN SEA

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Loggerhead turtles in the Mediterranean nest at the northern limit of their nesting habitat range which may be particularly viable to changes in climatic conditions. Normally nesting is restricted to the eastern basin, with only some occasional nests occurring in the western part. These rare and single nests in Spain, France, and Italy have nonetheless received attention and appropriate monitoring and protection, so that valuable data records are kept on these astray nesting females. In an effort to keep track of occasional nests and trends in the Campania Region of SW Italy (from 41.22°N, 13.76° E to 40.04°N, 15.64° E) an awareness campaign and beach monitoring program was initiated in 2008, aiming at informing beach users on the presence of loggerhead turtles and which behaviours to adopt in case a nesting female should be encountered. The beach monitoring program was carried out by the Environmental Education Centers belonging to the INFEA network of the Campania Region and was supervised by the Sea Turtle Rescue Center of the Stazione Zoologica Anton Dohrn of Naples. The beach surveys and dissemination continued for three years and recorded all turtle activities on land during that time. Yet, although systematic monitoring of the beaches ceased after 2010, turtle nests continued to be discovered and reported. Whenever a female was observed laying eggs, immediate protection measures of the nest site were taken and the nest temperature was monitored until hatchling was completed. In some cases the presence of a nest was discovered only through the observation of hatchling emergences, and nest parameters were noted upon conclusion of the hatching phase. Nests were found in 2008 (n = 1), 2012 (n = 1), 2013 (n = 4) and 2014 (n = 2). Most of them (n = 5) were concentrated in the southern area of the Region dispersed over a coastal stretch of 40 km. Mean clutch size was 101 (48 – 132) and mean hatching success was 76% (16.7% - 99%). All nests have been sampled for genetics and analyses of demographic affiliations are underway. Clearly, loggerhead nests were discovered more frequently during the last three years, but it is obviously too early to interpret any trends in this. However, we are confident that because of the raised awareness of the citizens nests are more likely to be recognized and reported to the competent authorities. Observation and monitoring of these occasional nesting areas at the limits of the nesting range will continue since a general increase in hatching success due to climate changes has already been predicted for the Mediterranean Sea. Moreover, these outsider beaches have the characteristics and potential to contribute to the future hatchling production of the Mediterranean loggerhead subpopulation.

TURN THE LIGHTS OFF: A CASE OF HATCHLING MISORIENTATION AT RUSHIKULYA ROOKERY, INDIA

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Sea turtle hatchlings emerge nocturnally after which they head straight for the water and swim into the open sea. Under natural conditions, the primary cues for sea-finding are light intensity and horizon elevation. Hatchlings move towards the brightest lowest horizon and away from vegetation and dunes. However, artificial illumination from inland and a skew in the slope towards the landward side would misorient hatchlings away from sea resulting in mortality of the hatchlings by dehydration, predation, exhaustion and human traffic. There are three mass nesting sites on the east coast of India, namely Gahirmatha, Devi and Rushikulya River mouths in Odisha. Of these, Rushikulya rookery, discovered in 1994, has the most consistent record of mass nesting in the last decade. Although safe from development, the rookery is close to three fishing villages, a national highway and a chemical factory which causes a fair amount of artificial illumination on the nesting beach. As follow-up to a study conducted in 2008, an orientation experiment using arenas was carried out in April 2013 and 2014, during the mass hatching event to assess sea-finding by hatchlings. Circular arenas of 2 metre radius were constructed with four different conditions- fully closed arena, seaward open arena, landward open arena and a fully open arena. For each arena, 20 freshly emerged hatchlings were used and 3 replicates were done for each condition. The study showed that the illumination from nearby villages and a chemical factory was sufficient to cause misorientation, resulting in many hatchlings going towards the landward side in both years and their subsequent death due to predation and dehydration. The proximity of the nesting beach to a national highway and a chemical factory makes it particularly vulnerable, and raises the long existing issue of effects of human development on sea turtles. While in some parts of the world, artificial illumination causes disruption in nesting, it also leads to misorientation or disorientation of hatchlings which is a far more serious threat. Effective light management is required to avoid or lessen the effects of illumination on

hatchlings. The villages and chemical company should try to reduce the usage of lights during mass hatching to avoid hatchling misorientation. Other prevention techniques such as constructing an obstruction on the landward side or a change in beach profile could help prevent hatchlings from straying towards the landward direction.

TEMPERATURE RELATIONS OF NEST ENVIRONMENT AND THE SEX RATIO OF HATCHLINGS FOR GREEN TURTLE NESTING IN SUGÖZÜ BEACHES, TURKEY

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The Mediterranean coastline of Turkey has the majority of nesting sites for Loggerhead (*Caretta caretta*) and Green turtle (*Chelonia mydas*). Sugözü Beaches which have four sub-sections is one of the most important nesting sites for Green turtle in eastern part of the Mediterranean coastline of Turkey. In this study, intra clutch temperatures (n=8) were measured in 2012 nesting season of Sugözü Beaches to evaluate for the temperature relations among sand, air and sea temperatures. Also the temperature results were evaluate statistically with sex ratio of hatchlings which is determined by intra clutch temperature in the middle third of incubation, called as thermo sensitive period (TSP). Our results showed that even there were no relation among intra clutch temperature with air and sea temperatures ($p>0.05$), there is a significant positive relation between intra clutch temperature and sand temperature ($p<0.05$). Besides, evaluation of sand, air and sea temperatures for whole season, the highest correlation was found between sand and sea temperatures, and the lowest correlation was found between air and sea temperatures. Thus, the sand temperature which is the major heat source for intra-clutch temperature was related with sea temperature instead of air temperature. Intra clutch temperatures were found mostly higher than 28.9°C measured (28.1°C to 32.6°C) as pivotal temperature which gives equal number of both sexes. These results could be explained as the sex ratio of hatchlings was female biased. Indeed, histological examination of gonads was found as 86% ovary.

EXPERIMENTAL ASSESSMENT OF MOISTURE EFFECTS ON SAND TEMPERATURES AND LOGGERHEAD SEX RATIOS

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Environmental factors beyond nest temperature may influence development of sea turtle embryos and sex differentiation. We studied the impact of moisture on temperature and developmental responses. In an experimental study, we examined the impact of varying moisture levels on sand temperature change. Water was added to sand in standard nest boxes until moisture content reached 0%, 5%, 10%, 25%, or 35%. Nest boxes were moved to different temperatures and we used temperature dataloggers to record the time it took each nest box of sand to equilibrate. We found that nest moisture level was correlated with the equilibration rate. Sand with higher moisture levels took more time to equilibrate to different temperatures, which is likely due to the higher specific heat capacity of water. Our results may suggest that nests with higher moisture content will experience fewer temperature fluctuations compared to drier nests, which can have less of an impact on hatchling sex ratios. We also examined the role of moisture beyond a temperature effect by studying the relationships among humidity, temperature, and loggerhead (*Caretta caretta*) sex ratios in another experimental study. Standardized containers of eggs in nest sand were incubated in the laboratory under different moisture regimes to test the role of moisture at a constant incubation temperature slightly above the pivotal temperature. The experimental treatments tested the effects of (i) very high moisture without potential for evaporative cooling, (ii) moisture with potential for evaporative cooling, and (iii) moisture added at average rain temperatures also with potential for evaporative cooling. If moisture played no role, the nests were expected to produce a moderate female bias, particularly in our first treatment group. However we found 87-93% males across all experimental treatments. The results from this study may suggest that moisture impacts hatchling sex ratios beyond cooling effects. Our results together support the interpretation high moisture conditions can influence temperature or developmental responses.

LONG-TERM TRENDS IN INCUBATION DURATION AND HATCHING SUCCESS OF LOGGERHEAD NESTS IN THE ARCHIE CARR NATIONAL WILDLIFE REFUGE*

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Climate change is predicted to affect organisms and ecosystems worldwide, disrupting biological rhythms and altering population dynamics. Organisms that utilize temperature-dependent sex determination are predicted to be particularly affected, as their demographics and mating systems are altered directly by the changing climate. Marine turtles are one such group, but long-term data sets that explore how climate change has affected marine turtles are scarce. In marine turtles, a particularly worrisome trend is the effects of increasing incubation temperatures on sex ratios produced and hatching success. Incubation time has been used in the past as a correlate of the hatchling sex ratio produced by a clutch; here, we aim to apply this method to a long-term data set from the Archie Carr National Wildlife Refuge (ACNWR), Brevard County, Florida. Since 1982, UCFMTRG has marked loggerhead and green turtle nests laid on the beaches of southern Brevard County, Florida by placing stakes in the dune and marking a nest's location. The nest is then tracked to determine the number of days until emergence, the hatching success, and clutch size. In this study, we will extend these data to examine how hatchling sex ratios have changed over time at this globally important nesting beach. Loggerheads (*Caretta caretta*) are the predominant species nesting on the ACNWR, with a long-term average of 11,576 nests over a 21-km stretch of beach (~551 nests/km/year). From 1982-2014, UCF has marked 7613 of these nests to evaluate for hatching and emerging success data; of these, approximately 30% have a recorded lay date and emergence date, allowing for a long-term analysis of incubation times and sex ratio production. From 2001-2012, these analyses indicate a statistically significant decrease of incubation times, from an average of 56.42 days in 2001 to 54.42 days in 2012. When controlling for within season variation, year is negatively correlated with incubation times ($p<0.001$, $F=6.34$, $n=1462$ nests). Following the results of Mrosovsky *et al*. (1999), these data indicate highly female-biased sex ratios. However, these results must also be placed in the context of decreasing reproductive success above pivotal incubation temperatures: as incubation temperatures rise, hatching and emerging success rates decrease, resulting in fewer female hatchlings exiting these high-temperature nests. For this reason, we will evaluate hatchling sex ratios and hatching success in concert, adding to our holistic understanding of the effects of climate change on marine turtle nests, sex ratios, and demographics. In the final presentation, the full 1982-2014 incubation duration, hatching success, and predicted primary sex ratios entering the population will be presented.

REPEATED NEST CHAMBER COLLAPSES FOLLOWED BY ABANDONMENTS IN THE NESTING GREEN TURTLES *CHELONIA MYDAS*: A STRATEGY FOR NESTING SUCCESS

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The body pit and the nest chamber excavation patterns were observed during low density period (November to February) in 17 nesting green turtles. During this period the nesting beaches were extremely dry due to minimal rainfall causing frequent nest chamber collapses. This forced the nesting turtles to abandon their nests seeking a new sites. This process was repeated 2-7 times among the successful and 5-7 times among the unsuccessful turtles before returning to the sea. In seeking new location after each nest collapse they usually travel at random close to the shoreline. The time spent in excavating body pits and nest chambers varied among the 17 observed turtles. A total of 11 nesting turtles succeeded in excavating complete nest chambers with successful oviposition. The other 6 were unsuccessful. After 6 trials, the turtles were completely exhausted and their nest digging activity slowed down significantly. There is no correlation between nesting success and the number of nest digging in the successful group. In the unsuccessful group there is no correlation between number of trials and time spent on the nesting beach before returning to sea. The nesting green turtles adapted an important behavioral strategy to overcome the dry sand condition by repeating nest excavation to ensure nesting success. This is an important behavioral nesting adaptation for survival of the species in extreme dry conditions.

HOW MANY TIMES A LOGGERHEAD FEMALE ATTEMPT DIGGING AN EGG CHAMBER ?

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From June 10th to August 10th, 2013, we conducted nightly survey on the Minabe-Senri beach, Wakayama prefecture, Japan for saturation tagging and found 246 nesting and 270 non-nesting emergence (nesting success = 0.48). As to 318 crawls of the 516, we counted number of body pits on the crawls. For each body pit, depth of surface-dry sand layer was measured in the vicinity. The direction of turtle and result of her nesting attempt at the location was also recorded. A nesting crawl and non-nesting crawl has on average 1.72 pits (N=172) and 1.38 pits (N=146), respectively. Assuming that all females returned to the sea without nesting land to the same beach again until they complete the nesting, it was estimated that a female needs on average 2.1 times emergence and 3.2 digging before complete nesting. In this beach, 37.2% of nesting crawls and 37.7% of non-nesting crawls had multiple body pits. These rates are almost twice as high as those in Inakahama Beach of Yakushima Island, in which sand is the largest loggerhead nesting beach in Japan with a relatively lower nesting success, suggesting that females land to Minabe-Senri Beach need more pits and tend to make another try. Percentage of retrying females did not differ according to number of attempts but differed significantly according to direction of turtles at the failed pits. Less than 10 % of landward females went back to the sea, whereas more than 40 % of seaward females returned the sea without next attempt.

RESULTS OF THE SEA TURTLE MONITORING & AWARENESS CAMPAIGN 2013 – 2014 ON THE MUANDA, COASTLINE, DEMOCRATIC REPUBLIC OF CONGO

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On the 40km of the coastline of MUANDA, the olive ridley turtles have laid a little more than 100 nests during the 2013-14 nesting season, corresponding to a population of 50 to 100 olive ridley females. The monitoring carried out during the last three nesting season shows that the olive ridley nesting trend has been stable over 3 years. Some rare leatherback turtles were also seen nesting. This year three clutches of leatherback turtles have been observed. Nevertheless, the nesting dates suggest that it is the return of a single female leatherback turtle during its nesting season. During the past decade, erosion has increased along the coast of MUANDA. The sandy band became narrower in most places, and nests are increasingly exposed to high tides. The risk of nest failure due to their immersion seems increasing. This is why we developed an intensivenest transplantation strategy. The systematic transplantation of sea turtle nests allowed us to release into the ocean 5,987 newborn olive ridley turtle (*Lepidochelys olivacea*) (of a total of 12,295 transplanted eggs) and 29 newborn leatherback turtles (*Dermochelys coriacea*) (out of 266 transplanted eggs). Success of the nests and eggs transferred was satisfactory for olive ridley turtles (49%). However, it was very low for the nests and eggs of leatherbacks (11%).

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

Yosvani Medina Cruz, Félix G. Moncada Gavilán and Gonzalo Nodarse Andreu

Centro de Investigaciones Pesqueras

The study covers a period of 14 years (1996-2010) and discusses the nesting hawksbill (*Eretmochelys imbricata*) on nine indices 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. The nesting was characterized considering indicators of the nest success as Success Emergence (EE), Eggs Without Apparent Development (HSDA), Eggs with Dead Embryos (HEM) and Deaths Hatched (NEM) on these beaches. Regarding the spatial behavior of these indicators only indicator eggs with dead embryos showed significant differences ($p < 0.01$) between the beaches of study, not going well for emerging success, Hatched Dead and Egg Without Apparent Development ($p > 0.05$). Although for the study period did not find a trend over time for the four indicators of nest success; when is incorporating baseline data on these indicators, there is a significant decrease ($p < 0.05$) for Emergency Success and a significant increase ($p < 0.05$) for Eggs Without Apparent Development, which both spatial and temporal behavior is who determines the nest success. Moreover, the most likely cause of the high percent the eggs undeveloped is the reducing in the population of male hawksbills adult in the area.

AN EXCEPTIONAL SEA TURTLE NEST RECORD IN 2012 AND THE RELATED EMERGENCY CONSERVATION MEASURES SET-UP IN MALTA

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We report an ad-hoc nesting event by a loggerhead sea turtle in Gnejna (Malta) which occurred in June 2012. As reported in literature, the last scientifically recorded turtle nesting event in Malta dated back some 100 years ago, although some claim, also as reported in one recent paper, that turtles were nesting till some 50-60 years ago.It is hypothesised that the nest did not hatch probably due to the high amounts of clay present in this sandy beach which inhibited the normal development of the embryos as well as the high wave events which happened towards the end of the nesting cycle along with a major rainfall event during the last weeks.In this paper we also describe the conservation measures that were set-up during the incubation time of this nest and the related measures we meticulously prepared for the eventuality of hatching that were not implemented since this nest had failed. The morning following nesting, the 79 eggs deposited had to be relocated, as they had been laid on the lowest part of the beach easily reached by waves. On that same day an emergency conservation order was issued to protect this beach from any major activity. The site was surrounded and physically protected with a 24-hour monitoring scheme being set-up through the help of volunteers from Nature Trust Malta and Government officials. Few days after this event we constructed a cage made from Aluminium following the protocol applied in Cyrpus, such that the nest got further protected from any animals potentially present in the area. Material was provided to the general public on frequently asked question and what to do in case of encountering a female laying eggs, in case this or another female came up the beach again to nest. A number of other measures (including the switching to red lamps in the nearby car park), erection of site notices and notices to fishermen in the surrounding areas were also set-up to further enhance conservation. Training was also provided to observers in this scheme on what to do in the eventuality of hatching. Many other measures and policies were drafted for the hatching event, which included a draft notice to mariners to stop all maritime traffic in the area for a number of hours following hatching and such that a nearby Five Star hotel would switch off its outside lights upon the first signs of hatching. A protocol on conduct and action by officials and NGOs for the hatching event had also been written along with a number of speeches for TV and radio to inform the public on what was being done.

UPDATING THE NESTING OF SEA TURTLES IN THE CUBAN ARCHIPELAGO

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Of seven species of sea turtles in the world, three nesting in Cuba: Green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*) and hawsksbill turtle (*Eretmochelys imbricata*). The main nesting areas are principally located in the south cost of the Cuban archipelago. The main results of the monitoring of nesting from 2010 until early 2014 are presented in this paper. A total of 13,836 nesting were recorded for the areas traversed: 12,054 green turtle nests, 1242 loggerhead and hawksbill 540; indicating that green turtle is the specie most frequently nesting in the Cuban beaches with among of nest very superior. The information was obtained from the monitoring and systematics traversed in that period of this paper. This study permitted to know the current situation of nesting of the species in the main areas of reproduction. Areas with higher average nesting by species were: for loggerhead, Cayos de San Felipe (110 nests); for green turtle, Cayo Largo (2258 nests) and hawksbill, Jardines de la Reina. The average emergency biggest hits were recorded for the green turtle (79.85%), followed by loggerhead (72.77%) and thirdly by the hawksbill (61.47%). This current knowledge is very important for conservation and management of sea turtles in Cuba.

INFLUENCE OF ARTIFICIAL ILLUMINATION ON THE ORIENTATION OF HAWKSBILL HATCHLINGS

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The marine turtles in natural abiotics conditions emerge of the nest during the night and follow directly to the ocean, tracking the moonlight reflex over the sea waters. Due to the increase of the anthropologic activities such as tourism and the addition of the artificial lights along the coast, the deviation of the route of neonates of marine turtles is commonly observed. These modifications of the natural environment act in a negative way upon this species extremely threatened. In order to evaluate the influence of artificial lighting above the offspring of *Eretmochelys imbricata* we performed 10 experiments with 15 neonates/test, five experiments in illuminated environments and five in unenlightened environments, in the southern coast of Pernambuco State, North east of Brazil, area with seasonal nesting of *E. imbricata* and about 150 nests per season. Circles were drawn in the sand with 2 meters radius, and in the center a small depression was made depth 2-3 cm. After neonates cross the edge of the circles, the traces were photographed, mapped onto a diagram and estimated the orientation angles of each neonates from the center of the circle to the edge in relation to the sea. To verify changes in the trajectories of neonates we used the Rayleigh test. The significant differences between the movement of neonates of nests enlightened and unenlightened were tested using ANOVA. To assess the similarity and significance of the clusters was used Multi-Dimensional Scaling. The paths of neonates nests located in lighted areas showed changes in the trajectory of 86,67% (N=65) of total. Only nests located in artificially illuminated environments the distribution of trajectories was considered random V=19.4895; p>0,05). The movement patterns of neonates in illuminated environments and not lightened were significantly different ($F < 0.0001$; $p < 0.01$). It's known that the sea turtle neonates are sensitive to spectral lights sources and the modifications in the nesting environmental are a huge threat for these animals, causing death mainly because of dehydration, increase of predation and exhaustion. In Brazil there are laws which control the illumination intensity in protected areas. However, despite to the importance of the area where this study was conducted, the law still not covers these beaches because of the tourism in the region. Therefore this study brings information to may subsidize conservation projects for these nesting areas.

LEVEL OF SEA TURTLE NESTING IN THE ARCHIPELAGOS OF THE CUBAN SHELF

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Quantification of nest of sea turtles continues being a very important aspect for the knowledge of the populations of this species. In the Cuba archipelago this work began carry up in 1982 in the ¨Guanal¨ Beach, south of Isla de la Juventud (Canarreos archipelago), however is not until 2001 that the quantification is extended to others beaches of the Cuban archipelago. Taking this in account, the number of nests per season for the green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*) between Cuban archipelagos (Canarreos, Jardines de la Reina and Sabana-Camaguey) from 2001 were compared. The results indicated statically that the main nesting areas for green turtle and loggerhead turtle were found in Canarreos Archipelago ($p < 0.001$), with a varying number of nests between 1400-2500 nests for green turtle and with more than 140 nests for logeerhead turtle. While the level of nesting for Jardines de la Reina and Sabana-Camagüey Archipelagoes was not statistically significant ($p > 0.05$); although it is evident the nesting of Sabana-Camagüey for both species is isolated. By the other hand a positive trend for the number of nesting of loggerhead ($p < 0.001$) in Canarreos Archipelago was found. However, for the green turtle don't like that ($p > 0.05$).

EVALUATION OF THE METABOLIC HEATING FOR EMBRYOS OF GREEN TURTLE (*CHELONIA MYDAS*) IN SUGOZU BEACHES, TURKEY

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It is a common phenomenon that the sex is determined by temperature in all marine turtle species. Intra clutch temperature is affected by some environmental factors such as sun exposure, grain size of sand, colour of sand, depth of the nest, distance of the nest from sea. In addition to these factors, metabolic heating which is produced by developing embryos is affected the intra clutch temperature. The study was conducted in 2013 nesting season between June and September, on Sugözü Beaches, which is a nesting beach for green turtle (*Chelonia mydas*) in the Mediterranean region. The study area consists of four subsections, respectively extending from west to east; Akkum (1.4 km), Sugözü (1.0 km), Botaş (0.6 km) ve Hollanda (0.4 km). In this study, metabolic heating was evaluated for green turtle (*Chelonia mydas*) nests in Sugözü Beaches. All temperature values were determined by temperature data loggers and also metabolic heat calculated by the difference between intra clutch temperature and the sand temperature surrounding the nest. The loggers were buried to the same depth for intra clutch and sand temperature measurement. Data loggers were used in green turtle nests (n=8) to determine the metabolic heating. The metabolic heating values were not related with numbers of embryos in early and middle stages (P=0.589 and P=0.231, respectively) but were positively correlated with numbers of embryos in late stage (P=0.023). In accordance with our findings the metabolic heat prevails in last third of incubation with 1.4ºC.

HAS THE SIZE AT MATURITY CHANGED OVER TIME AMONG ATLANTIC LOGGERHEADS?

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Understanding the life history of protected species such as sea turtles is critical for population estimates to inform robust management plans. In their 2009 assessment of the western Atlantic loggerhead population, the Turtle Expert Working Group defined the size range for adult loggerheads as beginning at 82 cm straight carapace length (SCL). Neritic juvenile loggerheads caught by in-water researchers in the region range in size from 40 – 100 cm SCL. Population models and spatially explicit demographic data often include gaps in the transition size range from large juvenile to adult. This study compared straight carapace length collected from nesting females in the Archie Carr National Wildlife Refuge on the east coast of Florida, USA, since 1982. Nesting beach observations over time indicate smaller turtles, below 82 cm, are reproductively active in this population. A shift to more nesting females in this smaller size range could indicate an increase in the frequency of younger nesters or decrease in the overall size distribution of the population due to large females removed as bycatch or lower quality foraging options. Additional nesting characteristics including clutch size and hatching success were also analyzed to assess relationships with female size. The results further refine the delineation between the largest stage loggerhead juveniles and adult stage females.

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

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The Godavari river mouth rookery of Olive ridley Sea turtle (*Lepidochelys olivacea*) is situated at 16° 17’ and 18° 30’ N longitude and 81° 30’ and 82° 37’ E latitude in East coast of Bay of Bengal, India. The nesting beaches of Godavari river mouth are divided in to four distinctive types based on their topography and geomorphological characteristics. Nesting beaches’ Geomorphology: Nesting beaches of Olive ridley consist: (i) Beaches of narrow sand spits with fine sediment deposits; (ii) Sand spits and shoals abutting lagoon waters; (iii) Mangrove fringed riverine sand bars and muddy flats; (iv) High elevated terraced beaches are separated from revirine back waters and tidal swamps. As per the geomorphological analysis the Olive ridley nesting beaches mostly constituted by clay loam with 62.00% of silt content and grain particle sizes were varied between 0.075 mm and 0.300 mm. Reproductive Status: Nesting beaches geomorphology in relation to beach profile and grain sizes were analyzed and correlated with reproductive status to estimate the nesting density, hatching success and emergence of hatchlings. Highest nesting density of 34.0 nests/km-1, was recorded on riverine sand spits with fine sediment deposits followed by lagoon fringed shoals/ sandy bars recorded with 4.64 nests/ km-1, sandy shores abutting

the mangrove swamps of 3.14 nests/ km-1 and high elevated beaches contains lowest nesting density of 2.16 nest/ km-1 respectively. Hatching success and emergence of hatchlings of Olive ridley nests were greatly varied from fine sandy beaches (52.50%), to sand shoals and mangrove fringed beaches shown an average hatching success (36.20%) and lowest hatching success (24.45%) was observed in high elevated main land beaches. Acknowledgements: I am very grateful to program chairs of ISTS-35 for accepting my abstract for oral presentation in 35th sea turtle symposium. I am thankful to the 35 sea turtle symposium sponsors and duly acknowledge the Ministry of Environment and Urban Planning, Turkey, The Ministry of Forests and Water affairs-Republic of Turkey, TC MUGIA, ORTACA –BELEDIYESI, Pamukkale University, Denizli, Tubital, ISSF-International sea food foundation and HILTON for their generosity in providing me travel grant award.

SEA TURTLE NESTING NEAR BUCHANAN, LIBERIA

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Very little is known of the density and distribution of sea turtle nesting along the coast of Liberia. To partially address this, monthly between November 2013 and April 2014 we surveyed the beaches around Buchanan Town for one week. We recorded the number of fresh and old sea turtle nesting activities and assigned each to a particular species. Prevalent threat to turtles and their nests were also recorded. A total of 9.8 km of beaches were surveyed each month south of Buchanan Town. North to south, these were Buchanan Beach (2.9 km; N5.85 W10.05 - N5.84 W10.03), Sunset Beach (1.0 km; N5.84 W10.03 - N5.83 W10.02), 'Zone 1' (2.5 km; N5.83 W10.02 - N5.81 W10.01), 'Zone 2' (2.5 km; N5.81 W10.01 - N5.80 W9.95) & 'Zone 3' (0.9 km; N5.79 W9.98 - N5.78 W9.97). A single beach leading north from Buchanan Town (3.6 km; 'Upper Buchanan Beach'; N5.91 W10.07 - N5.89 W10.05) was surveyed twice (January and March 2014) to provide additional context to observations from the beaches south of Buchanan Town. The most frequently nested sections of beach were Buchanan and Sunset Beaches. Leatherback turtles nested on both these beaches with 7 nests on Buchanan Beach, 5 nests on Sunset Beach, and an additional 2 nests on Zone 1, 2 nests on Zone 2 and 2 nests on Zone 3 (Total = 18) Olive ridleys nested on Buchanan beach (10 nests) but not Sunset Beach. One olive ridley nest was recorded on Zone 1, 3 on Zone 2 and 1 on Zone 3. A single olive ridley nest and a single leatherback nest were recorded on Upper Buchanan Beach. No other species of turtle was recorded as nesting in the area during the surveying period. Simple interpolation of these figures to account for nests missed in between surveys for both species results in estimated seasonal totals of approximately 30 nests per species from Buchanan Beach to Zone 3. These interpolated totals equate to low levels of nesting for these species at a regional and global level, even considering potential for pronounced interannual variation in nest numbers. The main existing threats to sea turtles and their nests in the Buchanan area were found to be human consumptive exploitation and, to a lesser degree, the potential impacts of artificial light on turtle orientation. Construction and industrial works in the area could create the potential for additional impacts, such as increased light and chemical pollution and degradation of the nesting habitat. Measures to counter these potential impacts should be incorporated into any development proposal. Acknowledgements: We thank Jonah Capital Ltd for technical, logistical and financial support and extend our gratitude to its staff with special mention to James K Nagbe who facilitated field operations for the six-month duration of the project and was an essential patrol assistant for the February surveys. Further we thank Amec Foster Wheeler and contributions from Dr LeGrand Gonowouo Nono who assisted with the November and December surveys and Katy Hebditch who assisted with overall GIS map production.

SYNCHRONOUS ACTIVITY LOWERS THE ENERGETIC COST OF NEST ESCAPE BY GREEN TURTLE HATCHLINGS*

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The term 'social facilitation' has been used for in nest sea turtle hatchlings during the digging out process as it requires the combined digging effort of many individuals to be successful. Hence if the group size is reduced, the workload per individual will increase and as a consequence the energetic cost per individual should also increase. Given that in a normal group size a substantial part of the energy reserve in the residual yolk is used in the digging out process, decreased group size should reduce this energy reserve further. This hypothesis needs to be tested experimentally by varying group size and measuring the energy expenditure during the digging out process across different group sizes. An open-flow

respirometry system was used to quantify the net energetic cost while digging out of the nest in green turtle (*Chelonia mydas*) hatchlings. The energetic cost of nest escaping 40 cm upward in coarse sand was estimated to be 4.4 – 28.3 kJ per individual depending upon the number of hatchlings digging together. This represents approximately 9.1 – 57.8% of the energy contained within a hatchling's residual yolk at hatching. The energetic cost decreased as the number of individuals digging out together increased and thus supports the 'social facilitation' hypothesis. The reduced energetic cost associated with large cohorts was chiefly caused by the lower metabolic expenditure and the shorter time taken to dig out of the nest by larger numbers of individuals. We conclude that synchronous digging activity of many individuals during nest escape evolved not only to facilitate quicker nest emergence, but also reduce the energetic cost to individuals.

HIDEAWAY FOR HAWKSBILLS: IMPORTANCE OF CURIEUSE ISLAND, SEYCHELLES, FOR SEA TURTLE NESTING

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Many sea turtle rookeries are believed to be small remnants of what were once much larger and more plentiful populations. For these depleted populations, recovery is difficult if threats (e.g. poaching) still linger, and it is difficult to gauge the historic nesting numbers verse what is currently being seen (Meylan and Donnelly 1999). Hawksbills (*Eretmochelys imbricata*) have sustained a long history of extreme exploitation, (see Meylan and Donnelly 1999) as seen in the inner islands of the Seychelles. From the 1960s through the 1990s, the majority of nesting females were taken from many of the beaches (Mortimer 2004). Today, the Seychelles remains one of the five regional populations with more than 1000 annual nesting females (Meylan and Donnelly 1999), making it an extremely important stronghold for hawksbills. Green turtles (*Chelonia mydas*) in the Seychelles have a similar history of exploitation (Mortimer 1984). Although the Aldabra Atoll (part of the outer islands) experiences thousands of nesting females annually (Mortimer *et al*. 2011), green turtle nesting in the inner islands is now very rare (Mortimer 1994). Hawksbills and green turtles both nest on Curieuse. Curieuse is the fifth largest granitic island found within the inner islands of the Seychelles. It is part of a Marine National Park, and sea turtles in the area have been legally protected since 1979, even though poaching was still heavy through the 1980s. Curieuse (when combined with two other marine parks) accounts for nearly 25% of hawksbill nesting in the inner islands (Mortimer 1994). Nesting on Curieuse is monitored by Global Vision International (GVI), a conservation and community development organization, and the Seychelles National Parks Authority (SNPA). The aims are to increase scientific knowledge and interest in the area and add to the data being collected throughout the Seychelles, to have a more comprehensive picture of Seychelles sea turtles. During the hawksbill season the main nesting beaches are checked and all activities are counted. Encountered turtles are measured and checked for tags, and their nest evaluated once hatched. Information has been collected since 2010 with individuals identified through photos, however the 2013-2014 season implemented metal tagging to streamline data collection. Although five years (2010-2015) is not enough to detect trends, monitoring has allowed us to determine annual nesting activities (a low of 312 in 2010-2011 season and a high of 524 in 2012-2013 season), annual population estimations (between 55-100 females nesting per season), hatchling success rates (an average of 95% on the main nesting beach), as well as roughly determine sea turtle movement within and between nesting seasons (tags re-encountered on surrounding islands). Although the numbers are small, we have also had a record year for green turtles in the 2014-2015 season, with 18 nests and nearly 50 activities. Collecting this information and establishing a long-term program will allow us to assess the importance of Curieuse as a nesting habitat and increase the conservation value of the island, therefore ensuring protection of these turtles.

ANNUAL VARIATION OF SEX RATIO OF HATCHLINGS ON DALYAN BEACH, TURKEY

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Sex ratios for hatchlings were estimated by measuring temperatures of nests on Dalyan beach, Turkey during 2012-2014 nesting seasons. Analysis of the nest temperatures during the middle third of the incubation period and the incubation durations were used to analyse the sex ratio estimations of different sections of the beach. The mean value of the incubation periods for 2012 nesting season was 49.5, 2013 nesting season was 54.4 and 2014 nesting season was 52.7. In general, an increase of incubation temperatures was observed during the seasons. The sex ratio of males was found usually higher in early (May) and late (August) periods of the season when it is compared with the middle part of the nesting season usually June and July. The differences between the incubation duration attributed due to the cooler sand temperatures. The nests close to the sea are usually relocated further in land and this may also affect the sex of hatchlings produced in those nests. The relocation guidelines according to the sand and nest temperatures were applied in relocation of nests. In order to estimate the sex ratio of the hatchlings that were produced on Dalyan beach, temperatures of 149 nests were recorded electronically on the beach. The results of this study are showed between 60-80% female dominated hatchling sex ratio. The rate of predation, relocation of nests, and temporal distribution of nests within the season were discussed in the view of sea ratio studies.

DO SEA LEVELS AND SAND CHARACTERISTICS AFFECT LOGGERHEAD SEA TURTLE NESTING ACTIVITY?*

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Israel's Mediterranean coastline is 190 km long, densely populated and serves as a nesting ground for the endangered loggerhead sea turtle. The Israeli Nature Reserves and Parks Authority (NPA) has been conducting a sea turtle conservation program during the last 30 years and estimates that the size of the nesting population of loggerheads is ca. 100 females. This is a small population that is subject to numerous anthropogenic and other pressures, and efforts are being made to understand what may be done to maximize loggerhead nesting success. This study was carried out to examine the influence of beach characteristics (e.g. sediment grain size & moisture) and sea level on the loggerhead turtles' nesting activity. We focused on a 40 km stretch of coastline (the "Sharon" region) characterized by large kurkar (calcareous sandstone) cliffs backing narrow sandy beaches. Our results show that there is a positive correlation between sea level and female loggerheads emergences on the beach, with a distinct preference for mean (versus high or low) sea level. Granulometric analysis of beach sediments indicate that "successful" emergences (nests) generally occurred on fine-sand beaches whereas "unproductive" emergences (no nests) occurred on beaches with a higher percentage of coarse sediment (>500 micrometers). Moreover, although sand moisture (% water) was variable among the beaches monitored, "unproductive" emergences were more strongly (positively) correlated with moist than with dry beaches. Therefore, based on our findings in this study, it appears that the nesting success of loggerhead females relies on finding sandy beaches with dry sand and fine to medium grain size. Since sediment grain size appears to be an important factor for nesting success and is affected by a number of factors, e.g. coastal infrastructures, these findings may be incorporated into current Israeli coastal and marine spatial planning. This is an important example of long-term ecological research regarding a keystone species – the loggerhead turtle and use of this information in considering the multi-faceted management of Israeli shores in the protection of endangered species.

FACTORS AFFECTING LOGGERHEAD HATCHLING SURVIVAL ON THE BEACH: A CASE WHERE THE DISTANCE TO THE SEA IS HARDLY INFLUENTIAL*

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The mortality rate is extremely high for early life history stages of sea turtles. There are few rigorous estimates on the scope of this mortality for their first days of life, but it is evident that the rate is very high. It is of crucial importance to evaluate this phenomenon and identify the main ecological factors that influence it. Synchronous emergence has been identified as a very useful strategy to reduce this mortality because this way predators, their main threat, satisfy their hunger and a lower percentage of hatchlings are therefore attacked. It has also been assumed that in many cases those nests that are laid further from the shore, or those that emerge during the daytime, suffer more casualties due to predation or disorientation. In this beach-based study, the survival of newborn loggerhead turtle (*Caretta caretta*) hatchlings was observed in one of the most important nesting sites in the world, Cabo Verde. On average, almost half of the hatchlings did not reach the sea. Their predator the ghost crab (*Ocypode cursor*) caused 97 % of natural mortalities. The density of crabs present on the beach influenced this predation, but even at low densities 30% of the hatchlings fell prey to the crabs. The number of turtles emerging in synchrony was the most important factor that influenced the mortality rate. For example, in groups of 5 turtles the mean mortality was of 68% whereas in groups of 50 this stat fell to 22%. The predation rate on hatchlings was always lower when the groups were more numerous, due to the lower probability of an individual being attacked by a crab. This data suggests a very evident adaptive pressure that favours synchronous emergence from the nest. Observations in this study also suggest a significant difference in predation depending on the time of day, as it is higher at night than during the daytime. Other threats associated with daytime emergence probably have greater costs for sea turtles, though. Nevertheless, the nest's distance from the sea did not seem to have a great effect on the overall predation, and no correlation was observed between predation and the distance of the hatchling's emergence to the sea. These results could be due to the crab's behaviour of waiting for the hatchlings close to the tide line during the night. In the absence of artificial lighting on the beach, hatchling disorientation was minimum (<2%) for this population, although emergence took place in areas that were very far away from the shore. For endangered sea turtle populations with such a high beach-based predation on hatchlings, it may be important for management plans to implement a control over predations.

NEST CHARACTERISTICS AND HATCHLING MORHOLOGY OF GREEN TURTLE ON SAMANDAG BEACH, TURKEY

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Chances of survival of sea turtle hatchlings can predict with knowledge of the hatchling morphology. Given the importance of hatchling morphology for hatchling survival, it would be useful for conservation workers or nest site managers. In this study, we tested relationship between nest features and hatchling morphology. Also, we aimed find suitable indicators for hatchlings morphology. A total of 785 hatchlings from 40 nests were examined and four dimensions, straight carapace length (SCL), straight carapace width (SCW), curved carapace length (CCL) and curved carapace width (CCW), were measured. Nest features such as clutch size (CS), distance of the nest from the sea (DFS), incubation period (IP) and nest depth (ND) were tested for correlations with hatchling morpholgy. Data were analysed with the Pearson's correlation coefficient. This was also used to check for collinearity between potential indicators. Collinear predictors were reduced, using Principal Components Analysis (PCA). All mean hatchling dimensions were correlated with each other. DFS was negatively correlated with CS and IP. None of the nest characteristics correlated with the mean hatchling size dimensions, except IP which mildly correlated with SCL and SCW. Our results showed that none of the nest characteristics were suitable for indicator. When the best fitting linear model of the effect of PCs, derived from collinear nest characteristics, on hatchling size was constructed, the model only explained 19.75 % of the variance in hatchling size. Perhaps there may be other factors that are more suitable as indicators; or that hatchling size is influenced by a complex inter play among several factors, such that it is not possible to identify a few key factors to be used as indicators; or that some dimensions of hatchling size have variations that are less environmentally influenced, thus rendering themselves unsuited to be measured using indicators.

DESCRIPTION OF REPRODUCTIVE LOSSES FOR THE NESTING MANAGEMENT PROGRAM OF THE OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) IN PLAYA CEUTA, SINALOA DURING THE 2013 AND 2014 SEASONS

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On the coast of Sinaloa the presence of five species of sea turtles has been recorded: black turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*); the latter being predominant in the nesting sites. Playa Ceuta, Sinaloa, is a protection site for nesting sea turtles that started in 1976 by the Autonomous University of Sinaloa, which has a management program for the transfer and planting of eggs. The aim of this study was to compare performance during the ontogenetic period between females nesting and releasing of the hatchlings in the 2013 and 2014 nesting seasons. For data analysis model Godinez *et al*. (1991) was used, which is based on (five phases) management actions: 1=nesting, 2=collection, 3=transfer, 4=incubation/hatching and 5=hatchling release. During the 2013 season 515 nests were recorded (43,051 eggs total), whereas for the 2014 they were 633 nests (52370 eggs total). The 2013 season recorded greater reproductive losses with respect to 2014, these being higher during the month of July for the season 2013 (26.6% of reproductive losses) and during December for 2014 (19.76% of reproductive losses). December where fewer reproductive losses in 2013 and September in 2014 respectively. For both seasons, the greatest losses occurred during phase 1 (nesting) and phase 4 (incubation/hatching), it was nearly 20%; while the lowest was during phase 3 (transfer), it was less than 1%.

ARE NESTING LOGGERHEAD TURTLES CHANGING THEIR REPRODUCTIVE SCHEDULES ON DALYAN IZTUZU BEACH, TURKEY? NEST EARLIER, NEST EVERY YEAR

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Conservation and monitoring studies have been carried out for 26 successive years on Dalyan Iztuzu Beach which is one of the main nesting beaches for loggerhead turtle (*Caretta caretta*) in Turkey. First clutch is being laid in mid May and remigration interval is 2 to 3 years for nesting females until recent years. In this study, we used last 7 years nesting and tagging data to investigate alterations in the reproductive schedule and remigration intervals of nesting loggerhead turtle on Dalyan Iztuzu Beach. Nesting and tagging data were used and significant changes were observed on the time of the first nest of the year and the distribution of the number of nests laid per month. First observed nest date shifted from mid May to late April (R2= 0,81). The proportion of nest being laid in May was increased (R2= 0,736) while the number of nests laid in June (R2= 0,363) and July (R2= 0,356) were slightly decreasing. Remigration interval was calculated as 2 years but we observed that 7 females visited nesting beach for 2 successive nesting seasons. This may suggest that nesting loggerheads are changing their reproductive schedule and migration pattern in order to prevent the effects of climate change or other anthropogenic factors are affecting their reproductive behavior.

NESTING OUT OF THE RANGE: THE LOGGERHEAD SEA TURTLE NESTS AGAIN IN SPAIN

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Traditionally, the western Mediterranean Sea has been considered out of the loggerhead turtle (*Caretta caretta*) nesting range. However, sporadic nesting events have been reported from east Spain, south France and west Italy since 2001. From that date, four confirmed nests have been recorded on the Spanish Mediterranean coasts, the last in 2011. But the summer of 2014 has been outstanding concerning this turtle activity, with several sightings of live loggerheads crawling onto beaches at night at different points of the coasts, with at least three confirmed nests on beaches of the Spanish Mediterranean (see Abella *et al*., Sánchez *et al*., this conference). Here we report one of these exceptional nesting events. On 30th June 2014 several passers-by observed a female loggerhead turtle laying eggs on an urban-touristic beach in San Juan, Alicante province (38.37261°N-00.40932° W). However, local environmental authorities did not receive notice of this event until 4th July 2014. On this date we went to San Juan beach and observed that the clutch was laid 12 metres away from the sea shore and near hammocks for tourists. We also discovered two broken eggshells, most probably broken by beach cleaning machinery. Therefore, we decided to remove the clutch, with care, for incubation in a safer place. Total clutch size was 131, with a total of 129 unbroken eggs successfully relocated. Forty of them were placed in an incubator at the Oceanografic park of Valencia city and 89 were relocated onto a protected beach (La Punta Beach 39.31177°N-00.29426°W), where another relocated clutch was successfully incubated in 2006. Incubator temperature was set to 29°C, increasing it to 29.5°C in the fourth week of incubation, and reaching to 31°C at the end of the incubation period. Between the 49th and the 54th days of incubation, 36 out of 40 eggs hatched successfully from the incubator, while 66 out of 89 placed in beach hatched after 59 days (79% hatching success for the whole clutch). Mean straight carapace length of hatchlings was 3.72±0.12 cm (N= 102). Samples of dead embryos were taken and live hatchlings are being reared at the Oceanografic to increase survival chances. Sex ratio was estimated based on necropsies of deceased individuals over the headstarting period. Incubation temperature was recorded during the thermosensitive period at La Punta beach (mean T±SD= 29.14°C range: 28-30.2). Beach temperatures were also recorded during the incubation period and at later months at La Punta beach and on other protected beaches of the region to identify the better places to relocate possible future clutches. It is important to note that East Spain is a highly touristic area with many kilometres of beaches developed with buildings. These new events raise important questions about the history of loggerhead nesting activity in the western Mediterranean. New reports and ongoing genetic analyses will determine whether the loggerhead turtle has nested here in the past, or if these increasing reports are evidence of a new colonization of the species, in the western Mediterranean Sea, in a climate change scenario.

NINE YEAR NESTING ACTIVITY OF GREEN SEA TURTLES IN THREE EASTERN BEACHES OF TURKEY*

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In eastern Mediterranean the most significant nesting beaches which have the majority of green turtle (*Chelonia mydas*) nesting activities, are located in Turkey and Cyprus with a ratio of 99% (Kasparek, 2001). Kazanlı, Akyatan and Samadag beaches in Turkey hold the primary importance for nesting green sea turtles (Smart and Coley, 1990). Thus, recent studies show that Sugözü Beaches located in Ceyhan (Adana) is also another important nesting ground for this species (Canbolat

et al., 2005). This study compares the nesting activity and summarizes the total nest numbers for green turtle during 2006-2014 as 9 years of study among Sugözü, Samadag and Akyatan beaches. Our results show that nesting potential of this area has an increasing trend since the first results in 2006. Typical fluctuations in nest numbers can be seen among the nesting seasons. Comparing the data of nest numbers for green turtle, Samandag holds the prior nesting activity with 4956 nests (52%). Akyatan and Yumurtalık follow with 3296 and 1190 nests respectively. In annual basis, Samandağ has 551 nests per year, Akyatan has 366 nests per year and Sugözü has 132 nests per year. Our results point out that these beaches have a great potential for Mediterranean as green turtle nesting grounds with 1049 nests per year.

ESTIMATION OF ARRIBADA OLIVE RIDLEY NESTING EFFORT AT OSTIONAL BEACH, COSTA RICA

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The olive ridley sea turtle (*Lepidochelys olivacea*) nests in massive aggregations, numbering in the thousands to the hundreds of thousands. Estimating this effort is technically challenging given the large numbers of nesting females involved and the complexity of the arribada behavior. Since 2006, a transect in-time method was developed to generate robust estimates of the Ostional arribada population. However, efforts are underway to develop an alternative method that complements the transect methodology to generate representative estimates of the nesting effort of ridleys at Ostional and to better estimate hatchling production at this important arribada beach. As such, we have developed a methodology based on 1x1m quadrats to sample the beach after the egg harvest and destruction of eggs that occurs during virtually every arribada. The methodology consists of placing the quadrats' wooden frames at random locations across the main nesting area within 10 days after each arribada and egg harvest. These areas were then dug up and the number of new nests quantified. Based on these counts, an estimate of the nesting effort was generated for each arribada; this estimated the number of nests left on the beach incubating after nest destruction and egg harvest. To estimate hatchling production, the same quadrats' frames were used to sample the nesting area again 3 days after the last hatchlings of each arribada emerged; we then exhumed the nests found in each quadrat. This methodology was applied to each arribada during the 2014 nesting season. The results of this methodology will be presented and discussed at the Symposium. We will also generate a series of recommendations for the appropriate management of the Ostional beach ridley population aimed at increasing hatching success at this very important rookery.

BIOCHEMICAL INDICES AND LIFE TRAITS OF LOGGERHEAD TURTLES (*CARETTA CARETTA*) FROM CAPE VERDE ISLANDS*

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The loggerhead turtle (*Caretta caretta*) is an endangered marine reptile for whom assessing population health requires knowledge of demographic parameters such as individual growth rate. In Cape Verde, as within several populations, adult female loggerhead sea turtles show a size-related behavioral and trophic dichotomy. While smaller females are associated with oceanic habitats, larger females tend to feed in neritic habitats, which is reflected in their physiological condition and in their offspring. The ratio of RNA/DNA provides a measure of cellular protein synthesis capacity, which varies depending on changes in environmental conditions such as temperature and food availability. The purpose of this study was to evaluate the combined use of morphometric data and biochemical indices as predictors of the physiological condition of the females of distinct sizes and hatchlings during their nesting season and how temperature may influence the physiological condition on the offspring. Here we employed biochemical indices based on nucleic acid derived indices (standardized RNA/DNA ratio-sRD, RNA concentration and DNA concentration) in skin tissue as a potential predictor of recent growth rate in nesting females and hatchling loggerhead turtles. Our major findings were that the physiological condition of all nesting females (sRD) decreased during the nesting season, but that females associated with neritic habitats had a higher physiological condition than females associated with oceanic habitats. In addition, the amount of time required for a hatchling to right itself was negatively correlated with its physiological condition (sRD) and shaded nests produced

hatchlings with lower sRD. Overall, our results showed that nucleic acid concentrations and ratios of RNA to DNA are an important tool as potential biomarkers of recent growth in marine turtles. Hence, as biochemical indices of instantaneous growth are likely temperature-, size- and age-dependent, the utility and validation of these indices on marine turtle stocks deserves further study.

THE CREATION OF A MAP OF HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) NESTING IN TOBAGO, WEST INDIES

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In the context of declining hawksbill sea turtle, *Eretmochelys imbricata*, populations the wider Caribbean region is of global conservation importance for the critically endangered species. However, it remains the case that not all hawksbill populations are well documented, because nesting often occurs on small dispersed beaches on islands where monitoring is logistically difficult. For example, on the southern Caribbean island of Tobago (11°10' N, -60°44' E), a full survey of all of Tobago's nesting beaches has not yet been published. We produced an updated map of hawksbill turtle nesting for Tobago and an augmented list of all Tobago's sandy beaches (n=78). We used published data and previously unpublished data to indicate which beaches have been surveyed for hawksbill turtle nesting activity. As of 2013, 55 of Tobago's 78 sandy beaches have been surveyed at least once. A total of 1,323 hawksbill nesting events were recorded between 2005 and 2012. Two beaches (3.6%), #35 and #38, hosted more than 100 crawls in a year. Thirty-five (63.6%) beaches are "Data Deficient" having been visited only once or irregularly in a single season and only three beaches (5.5%) have been surveyed in all eight years. One-hundred and twelve (112) instances of poached hawksbill turtles were recorded across all surveyed beaches of Tobago between 2005-2012. Survey data presented for 55 beaches around Tobago is a near twofold increase from the 30 previously documented and includes novel records of nesting on six beaches. Crawl counts are consistent for nine of fifteen beaches for which crawl abundances were known previously while all other beaches scored higher which is likely a result of improved monitoring. The lack of consistent, regular survey effort is however a critical limitation to assessing the abundance of the hawksbill population in Tobago. Furthermore, the significant poaching pressure is likely underestimated given the low level of monitoring at many of Tobago's beaches. Few sites in the Caribbean are known to support >1,000 hawksbill crawls per year; hence the nearly 600 crawls found on beaches #1-43 in 2012 along Tobago's 41 km of Caribbean coastline signify a site of regional conservation relevance which warrants increased conservation efforts.

A PRELIMINARY RESEARCH ON THE GHOST CRAB POPULATION DWELLING ON IZTUZU BEACH (DALYAN, TURKEY)

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Population conditions of ghost crab *Ocypode cursor* (Linnaeus, 1758), which belongs to Ocypodidae family, and scavengers and top predators of sandy beach ecosystems, were considered in the current study. In recent years, due to lack of proper data about some organisms, it is being difficult to monitor the aspects of their current status. Population parameters of ghost crabs living on İztuzu Beach, where is one of the nesting sites of logger-head sea turtles (*Caretta caretta* Linnaeus, 1758) in Turkey, were collected. Between May'13 and November'13, 300 individuals were captured on İztuzu Beach, and morphological data (carapace width, carapace length, weight, gender, rotation of the bigger cheliped) of these ghost crabs were collected. Also, information about burrow diameter, distance of ghost crab burrows from the sea, and burrow numbers per m2 in the 7 chosen quadrates were recorded. During the field studies, capture-measure-release method was applied not to harm organisms and their habitat. Associations of data were "weight/carapace width", "carapace length/burrow diameter", "gender/total number of individuals" and relationship between the rotation of bigger cheliped and gender. Results showed that there is logarithmic relationship between weight and carapace width, and linear relationship between carapace length and burrow diameter. According to the examination of ghost crab individuals, it seems that males constitute the majority of the population (39 females and 261 males). Burrow distribution based on their numbers in the chosen quadrates, represents that ghost crabs are using first 6 m zone from seaside to inland. Majority of collected individuals is in the carapace length class 2-2.9 cm for which one can say that the ghost crab population on İztuzu Beach is a healthy and young population.

SOCIAL, ECONOMIC AND CULTURAL STUDIES

CONSERVATION & CONSUMPTION — CONFLICTED AND CONFUSING BEDFELLOWS IN SEA TURTLE CONSERVATION*

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Much messaging on consumption and conservation circulates in the international sea turtle community (e.g. on social media; at meetings; via sea turtle networks), yet little is known about relationships between messaging and consumption patterns. This paper presents from 24+ online surveys with North American sea turtle conservationists, focused on consumption beliefs and actions, and conservation, across a variety of questions about individuals, communities, and greater scales. We present data and interpretations of these, as part of a larger Masters project on consumption and sea turtle conservation. We contextualize results using distilled messaging from websites and other social media presences of sea turtle conservation groups and individuals, and observations during the 2014 International Symposium of Sea Turtle Biology and Conservation. We situate community messaging within literatures on consumption and conservation (e.g. political ecology of consumption; critical consumption studies; sustainability & behavioural change). We compare themes emergent from respondents' answers, via the use of adapted grounded theory and thematic coding, with community messaging and/or relevant literatures. Many papers advocate against consumption of goods (x; y), or argue for reduced overall consumption. Much consumption discussion in sea turtle literature(s) focuses on direct consumption of turtle products. Consumption is often portrayed as negative, and counter-productive for conservation. We acknowledge, however, that sea turtle conservation uses, condones, depends on, and promotes consumption in various ways. Examples include the proliferation of sea turtle tourism and related spin-offs, popular fundraising campaigns calling for people to 'adopt-a-turtle', and sales of 'turtle fair' (e.g. turtle T-shirts) as important for funding certain facets of conservation. Further, conservationists are consumers themselves, but infrequently undergo consumption analyses. Little is known about conservationists as consumers, or how/why they justify choices. This project represents a unique investigation of consumption and conservation-related beliefs within a group that strongly identifies with conservation. We use respondents' insights to consider consumption with obvious ties to sea turtle fitness and mortality (e.g. eating turtle products; eating unsustainable seafood; buying excessive plastics), but also to explore relationships with greater realms of society such as education, consumer psychology, complex consumer identities, and the relative weighting of the 4Rs (reduce; reuse; recycle; resist/rethink). We discuss responses to questions such as 'can consumption ever be viewed as helpful within sea turtle conservation?', and 'what are the greatest barriers to reducing or limiting North American consumption of plastics?', to contribute to ongoing discussions about sea turtle conservation and consumption. Through this case study, we argue that consumption and conservation, though often portrayed as dichotomous, are more interrelated than we typically admit. They should, therefore, be discussed with a greater emphasis on their relationship, and related complexity and conflicts (internal; external; philosophical; material). The opportunity to present at this Symposium is of particular significance since it allows for data return and discussion with our greater research community.

USING A NOVEL ECONOMIC TOOL TO ASSESS THE IMPACT OF MARINE TURTLE-BASED ECO-TOURISM*

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Marine turtles have historically contributed to economics through harvest for food, tools, and decorative objects. Only recently have they begun to fill other economic roles benefiting humans: most importantly, as a focal point of eco-tourism. Education-based recreational use of turtles has been shown to generate sizeable amounts of gross income, most often exceeding those produced from traditional or historic consumptive uses. While marine turtle-based eco-tourism exists in the United States, no data have been published regarding the economic impact of these non-consumptive educational uses. Brevard and Indian River Counties, located on the east coast of Florida, are known primarily for their dense loggerhead (*Caretta caretta*) nesting, as well as, the Archie Carr National Wildlife Refuge (ACNWR), the highest density loggerhead-nesting beach in the western hemisphere. Since 2001, there has been a rise in the annual number of turtle walks conducted in this region. This expansion contributed to a significant increase in attendance from 2,162 to 3,047 participants (2001-2014). The demand for turtle-related educational tourism is increasing around the ACNWR. The economic impact of turtle walks can be used as a conservative estimate of the monetary contribution of the species in the region. I examined the economic impacts of marine turtle eco-tourism around the ACNWR using social surveys and IMPLAN, an economic

input-output modeling software, to determine the degree to which educational tours (turtle walks) impact this region's economy. This software represents how one market's contribution interacts (directly and indirectly) with connecting markets. IMPLAN has been used for tourism industries around the U.S., but this study is the first to use an all inclusive economic impact tool for sea turtle eco-tourism. During the turtle walk season (June and July) surveys, which asked guests to provide estimates of expenditures during their stay within the region, were distributed at 6 different turtle walk locations. Every adult individual attending the walks conducted at the study locations were given time before each tour begun to complete the one-page survey (n=1250), 93% of which completed it. Guest expenditure estimations reported on the completed surveys and total reported donations to each organization guiding a tour at the study locations were inputted into the IMPLAN software. My results indicate that due to market interactions within this region, turtle walks contributed a minimum of three new jobs and a conservative estimate of $250,000 (USD) during the two-month turtle walk season. Using financial comparisons and economic impact tools, like IMPLAN, can improve our understanding of the many roles sea turtles, other species, and their habitats have in our world. They can also enhance conservation efforts, policy and regulation, and management decisions regarding the focal species and/or the habitat it requires. The creation of a monetary-based common language can facilitate improved communication between scientists, policy makers, land managers, and the surrounding community.

EXPLOITATION OF THE TORTOISESHELL IN OTTOMAN EMPIRE

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In the artistic history of humanity, the tortoiseshell has been very soon considered as a high-valued commercial and precious material. Ottoman Empire lasted from 1299 till 1922. The Palace of Topkapi, the principal residence of all the powerful sultans, was the heart of Ottoman Empire. The harem was added to this palace in the XVIth century. It accommodated up to 1500 women in 400 rooms. All the luxurious internal doors and the shutters of the harem are in marquetry, with inlay of mother-of-pearl, of tortoiseshell and colored tinted precious wood. This art of the inlay in furniture, doors and diverse objects of mother-of-pearl, ivory, bone and tortoiseshell was very fashionable in Turkey between XVIth and XVIIIth centuries, and is called "Sedef". Numerous objects of period Ottoman as mirrors, boxes, writing cases, caskets, etc. had inlays of tortoiseshell. This material was also used for the tips of pipes (chibouks) from the XVIIth century. We can wonder about the concerned species and the origin of these pieces of tortoiseshell used in Ottoman Empire because this one possessed a part of the "Coral Sea" (current Red Sea) where Massawa was a important harbor and a link of the economic exchanges between the Mediterranean Sea and Indian Ocean. The craftsmen could certainly get easily for themselves slabs of tortoiseshell of adult females of *C. caretta* and *C. mydas* killed on the nesting beaches of the Mediterranean Sea, in particular in current Turkey, but the maritime business also allowed them to buy beautiful slabs of *E. imbricata* from the Red Sea.

FROM CONCRETE TO SAND: TRANSFORMATION OF THE MEDITERRANEAN TOURIST INDUSTRY*

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The Mediterranean Sea faces a plethora of anthropogenic stresses that threaten its diverse and abundant population of marine organisms. One of the biggest culprits is rampant development for the mass-tourism industry. Using the lens of the potential for marine turtle community-based ecotourism in Turkey, a transferrable policy framework of participatory coastal management, and community-based conservation and education initiatives will be proposed, to be adopted by the signatories of the Barcelona Convention and Mediterranean Action Plan (MAP). Based on clause 1.1.4 of the 20-year objective of the MAP Phase II (1995): '...to encourage regional and international cooperation that promotes environmentally-friendly tourism compatible with sustainable development', a participatory community-based conservation model to counteract destructive socioeconomic practices that fail to balance biodiversity conservation is proposed. Reflecting upon successful non-consumptive marine turtle ecotourism models, the long-term socioeconomic benefits of sustainable ecotourism over destructive mass-tourism are shown. The building of resorts may provide economic benefits in the short-term, but in the long-term, the destruction of the Mediterranean ecosystem and extinction of biodiversity like marine turtles will have severe socioeconomic consequences, as well as ecological. Improved coastal management of Protected Areas (PAs) and Marine Protected Areas (MPAs) that integrates research on the "core-use zones"

of marine turtles— such as feeding, breeding and nesting habitats — with local participation is proposed instead of centralised development-oriented management. The policy framework of the Convention on Migratory Species (CMS) and research into the migratory patterns of sea turtles are assessed to create proposed extraction-free areas that overlap spatially with "core-use zones". These include crucial feeding habitats like sea grass fields for *Chelonia mydas*, and areas of continental margins known to have large juvenile turtle populations. This will be extended to include ecotourism guidelines that utilise a temporally and spatially adaptive and randomised zonal exclusion strategy that limits pressure on "core-use zones", thereby reducing the stress of excessive human-turtle contact. Community participation in conservation activities and the ecotourism industry, coupled with educational programmes targeted towards directly-involved stakeholders like fishermen, boat captains, hotel managers and tour operators will be proposed. Community members will also be trained in turtle-monitoring techniques, providing an alternative to economic practices with destructive impacts on marine turtles. This grassroots participatory ecotourism model aspires to successfully balance the conservation of marine turtles with socioeconomic development pressures. In creating a tourist industry that seeks to interact symbiotically with nature, as opposed to extracting from and subordinating it, this ecotourism model can help preserve the sociocultural value and diverse ecosystem services provided by marine turtles. While this model focusses on marine turtles in Turkey, the scales can be adapted to include other countries facing similar threats of unsustainable development, and other biodiversity threatened by extinction.

COMMUNITY PERSPECTIVES ON TOURISM IN REKAWA TURTLE SANCTUARY, SOUTHERN SRI LANKA*

Thushan Kapurusinghe, M. M. Saman and Himali Purnima Kahawita

Turtle Conservation Project

Rekawa Turtle Sanctuary is located in a small fishing village in Southern Sri Lanka. At present, tourism activities are conducted by an NGO and by a hotel in Rekawa village. Community perceptions of present and future economic, environmental, and socio-cultural effects of tourism in Rekawa were explored in detail, with key demographic variables being recorded. Twenty-four community members from Rekawa village were selected for individual interviews (15 interviewees) and for the focus groups and interviewed between June and July 2011. Random sampling was used to select interviewees from the turtle nest protectors employed by the Turtle Conservation project (TCP). Two focus group sessions were organised and conducted each consisting of six participants. Random and targeted sampling methods were used to select the participants for the focus groups. Community perceptions were examined for both positive and negative aspects of tourism, both in terms of the current situation and what might happen in future if tourism industry further developed in Rekawa. Interviewees were also asked to suggest how tourism might be diversified and improved in Rekawa. Most interviewees (13/15) provided a detailed account of their perceptions on tourism in Rekawa. It was evident that majority of the interviewees (14/15) were rather more aware of the negative consequences of tourism than the benefits. Not surprisingly those involved and benefitting from tourism activities were more able to describe various benefits deriving from tourism activities. Out of fifteen, thirteen (13/15) respondents recognized and mentioned about the current economic benefits of tourism in Rekawa. These included providing food and accommodation for visiting tourists, guiding for tourists, selling local products such as coir mats, batiks, fruits and vegetables etc. During the interviews, all respondents mentioned sea turtles as the main tourist attraction. Therefore, it can be suggested that sea turtles are considered as the flagship species in Rekawa. They mentioned the mangrove forest, lagoon, birds, beach, coral reef, water ponds, and the temple as other attractions after the sea turtles. According to the locals' perception, local tourists do more harm to the environment than foreign tourists. For example, local tourists litter more. However, the hotel and some foreign house owners in Rekawa dispose of their garbage in the road, on the lagoon shore, on the beach, and in the Rekawa cemetery. Interviewees have described both positive and negative effects of tourism on Socio-cultural aspects in Rekawa. Some tourists have donated bats and balls to play cricket in the village as cricket is a popular sport among the village youth. There is a local performing arts group in Rekawa and locals think that it can directly benefit from tourism in Rekawa by charging tourists to see their traditional dances. The results suggest that the locals' perception about the present tourism activities in Rekawa is 'good' in general terms. Rekawa community members recognise many positive and negative consequences of present tourism activities and also aware of possible future consequences.

SEEKING TO SATISFY 6—CONSIDERING THE CASE OF NASCENT SEA TURTLE TOURISM DEVELOPMENT IN MARTINIQUE, FRANCE. CONCEPTUALIZING SEA TURTLE TOURISM TO SATISFY: TOURISTS; LOCAL PEOPLE; INDUSTRY ACTORS; CONSERVATIONISTS; AND SEA TURTLES—CAN IT BE DONE?*

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This paper combines a tourism country profile of Martinique, France, with a survey of the literature on sea turtle tourism (academic; applied; on-line & otherwise community- derived), to explore the question: "is it possible to design local turtle tourism to satisfy: tourists; local people; industry actors, conservationists; and sea turtles?". It addresses challenges in planning for and sustaining profitable turtle tourism, and ensuring satisfactory revenue sharing between local populations industry actors, and conservation interests. Factors such as: geographic location; dominant tourism types; local service-related and infrastructure considerations; local, national and regional conservation goals; and existing tourism offerings are considered. The paper also incorporates material from neigbouring Guadeloupe's more advanced understanding of local turtle tourism ('development') offerings. It emphasizes potential pairings of offerings and services, as well as potential challenges, considering the primarily European, often elite, and '5S'-focused, (sun, sea, sand, sex, and snorkeling) tourist population, and corresponding catering industries. The paper includes 'key ingredients', lessons learned, and considerations drawn from a survey of tourism and sea turtle-related literatures. It considers relevant case studies for successful sea turtle tourism development in: 1) small islands; 2) the Caribbean; and 3) markets catering primarily to 4S (and 5S) tourism. It represents preparatory research for upcoming work with 'on the ground' actors in Martinique to contemplate formal sea turtle tourism development on island, with a combined emphasis on local livelihoods and sea turtle conservation. While literature-based, it is informed by conservation reports and Web-based materials, and it seeks to further new models for improved understanding of sea turtle tourism, its potential and successes, and challenges it may face. This paper seeks to combine literatures and ideas not known to be previously combined in paper form, and to incorporate sea turtle tourism successes from the international sea turtle conservation community (and related industries), to inform the larger project, and greater scholarship and practice related to sea turtle tourism. The author is particularly interested in presenting at the Symposium as it represents a unique opportunity for interacting with sea turtle conservation and tourism experts with relevant academic and/or applied experience. Further, the Turkish hosting of the 2015 Symposium represents a distinct opportunity for interacting with European experts.

ADAPTIVE THREAT MANAGEMENT FRAMEWORK: INTEGRATING PEOPLE AND TURTLES

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Since its inception in 1980, The TAMAR Project has experienced great success in protecting sea turtles in Brazil. Currently, the populations of the five species that occur in Brazil are in recovery due to the increase in the number of nests: *Caretta caretta*; *Eretmochelys imbricata*; *Chelonia mydas*; *Lepidochelys olivacea* and *Dermochelys coriacea*. The Project has helped over 15 million hatchlings reach the ocean and is now likely protecting the reproduction of some of those early successful hatchlings. It has also contributed significantly to worldwide scientific data and knowledge about sea turtles' biology, such as life cycles and migration patterns. This success reflects not only TAMAR's research and protection strategies, but just as much its initiatives to bring fishers' and local communities' participation into its effort to protect sea

turtles. TAMAR's conservation strategies have always relied on a variety of environmental education and social inclusion activities highly adapted to the socio-environmental evolving contexts of its 25 locations distributed across nine states in Brazil. The defining characteristic of TAMAR's community integration interventions is that these interventions respond to the perception of threats, or the possible formation of threats, due to the evolving social interfaces with sea turtles. These interfaces are influenced by highly localized socioeconomic, political, geophysical, and ecological factors, among others. Diversity and flexibility are critical to enable timely and effective local responses to existing or potential threats to sea turtles. TAMAR's EESI strategy has four threat management lines of actions. Two lines of action address the main present and immediate threats to sea turtles in Brazil: sea turtle bycatch and coastal development. The other lines of action are designed to prevent the emergence of new threats. Social inclusion initiatives were developed to address the greatest threat to sea turtles at the early stages of the Project, which were turtle harvesting and egg collection. While turtle and egg harvesting accounts are insignificant in Brazil nowadays, social inclusion remains an important preventive strategy for this and other types of human-related threatening behaviors that may emerge and have become an organic part of TAMAR's sustainability strategies, which include support to t-shirt manufacturing groups and other productive groups, basically formed by members of local fisher communities. The fourth line of action is long-term preventive cross-cutting capacity building and educational programs, targeting mostly children and youth in the communities where TAMAR works, which results in the formation of new generations committed to the preservation and sustainability of the environment. This work brings EESI under the same conceptual framework that underlies its conservation approach by adopting an adaptive threat management framework to organize and qualify its educational and social interventions according to the main categories of threat addressed by TAMAR. The intuitive, creative, contextual, decentralized, and independent way environmental education and social inclusion (EESI) activities have been carried out have generated positive results in the resolution of specific and evolving local problems through the course of the Project.

MARINE CHELONIAN ILLUSTRATION: THE BEGINNING - THE EARLIEST IMAGES

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It can be argued that images created by humans are a guide to their perception of the natural world. The paths of chelonians and humans have been intertwined since prehistory traversing regions of both dietary and mythological importance. And images of turtles tell as much about the artist's world view as they do about the subject itself. Some efforts recreate the subject in exacting detail while others caricature it or imbue it with anthropomorphic characteristics. Past projects in this area have focused on specific topics without regard for timeline. Several species of marine chelonians, as well as other topics (such as anatomy and diet) have been covered in depth and the evolution of such images has also been detailed. But quite often, the earliest efforts in any arena can be very telling and such is the case with these chelonian images. This effort focuses the earliest imageries, primarily those on paper, but also examples from other media. In fact, the earliest surviving zoological illustrations are found on cave walls and clay, stone, or wood fetishes. Later examples can be seen on Babylonian clay seals, as well as Egyptian palettes and tablets. And the scenes pictured in all of the previous instances run the full gamut of natural history, items of and or/related to food and food gathering, as well as scenes of religious significance.

INVITED TALKS- THE 5TH MEDITERRANEAN CONFERENCE ON MARINE TURTLES

LONG TERM MONITORING OF NESTING MARINE TURTLES - WHAT WE HAVE LEARNED AND WHERE WE NEED TO GO NEXT*

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In order to assess the status of marine turtle populations we need accurate estimates of demographic parameters such as longevity, breeding frequency and sex ratios. Such data however can often only be obtained from long-term monitoring studies over several decades, requiring a huge investment of manpower and funding. Here, I present a summary of what we have learned so far about Mediterranean marine turtles at our long-term research project in Cyprus, where, since 1992, we have been studying green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles in partnership with the Society for Protection of Turtles in Northern Cyprus, the Department for Environmental Protection and the University of Exeter. Over the years we have used a diversity of techniques including flipper tagging, PIT tagging, satellite tracking, and molecular studies with many of the females originally tagged in the first few years of the project continue to breed, and providing us with valuable data on life history traits.

MARINE TURTLES AND SURFACE LONG LINE BY-CATCH IN THE MEDITERRANEAN SEA: LESSONS LEARNED AND REMAINING GAPS FOR REGIONAL INTEGRATED MANAGEMENT*

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The bycatch of non-target species, including large air-breathing marine vertebrates as marine turtles, is a major concern for fishery managers and conservationist. Worldwide and in the Mediterranean Sea, surface drifting longline is pointed out as a major threat for the conservation of sea turtles. The distribution of sea turtle at sea does not fit with the boundaries of the coastal states or the EEZ and other international limits and thus bycatch is a global problem that, in the case of the Mediterranean Sea involve all the major fishing countries, regional fishing organizations (RFOs) such as the GFCM and ICCAT, NGOs, and international conservation organizations as the Bern and Bonn Convections, UICN and many others. Marine turtle stocks distributed in the Mediterranean Sea include the native loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) turtles but other species such as the leatherback turtle (*Dermochelys coriacea*) are also frequently observed and incidentally captured by fishing gears in the whole basin. Moreover, important numbers of Loggerhead from Atlantic origin reaching in western Mediterranean are being affected by fisheries and other human-derived activities. To better understand the effects of by-catch in the Mediterranean Sea, and particularly that of surface drifting longlines, we review the global situation and the recent evolution of the longline fisheries and fleets, the longline-type used in the different countries, the temporal and spatial distribution of these fleets in the Mediterranean Sea, main countries and fleets involved, the main areas where marine turtles and fisheries overlap, the different methodologies used to calculate direct and delayed mortality and the possible bias due to gaps in data collection. To open the discussion on options to reduce the fishing mortality in marine turtles produced by surface longline based on the best scientific and traditional fishers-based available information and data we'll review lessons learned and remaining gaps of the current procedures used by the RFOs for sustainable fishery management in the region, including the implementation of measures and tools to reduce the bycatch of marine turtles. How scientists and experts are involved in the process of formulation of advice and what we should do to increase the participation of more experts in marine turtles to broad the knowledge-base necessary to improve the regional management approach for marine turtles in the Mediterranean Sea will be also discussed.

HOW MANY TURTLES IN THE SEA? A STATIONARY AGE DISTRIBUTION MODEL OF THE MEDITERRANEAN SEA TURTLE POPULATIONS*

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The Mediterranean populations of the loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) are considered as regional management units (RMU). They are subject to several anthropogenic threats, with documented mortality induced by incidental capture in fishing gear. However, how such mortalities actually affect the interested populations is uncertain without an estimate of population size. We derived a theoretical demographic structure assuming a stationary age distribution, i.e. stable population and constant proportions of turtles in each life stage, and incorporated uncertainty of the main vital rate parameters to identify a likely order of magnitude of turtle abundance in different life stages. Through this approach, we aim to (i) provide an estimate of all population stage classes, particularly the juvenile classes that are most subject to fisheries interactions, (ii) provide an estimate of reproductive life span, based on estimates of adult annual survival (iii) identify and review the key demographic parameters, and (iv) identify the priority gaps in our information in need of further investigation. When we calculated the potential biological removal (PBR) for the part of the population at risk of fisheries capture, our estimates were comparable to or lower than the estimated bycatch levels in fisheries, suggesting that current bycatch rates exceed the recommended values for endangered species. Although the model assumes a stable population and provides only a rough estimate of abundance, these results suggest that the current bycatch level should be regarded as unsustainable for the Mediterranean turtle populations, and efforts to reduce bycatch mortality and fisheries interactions are needed.

SURFACE CIRCULATION PATTERNS DRIVE THE GENETIC STRUCTURING OF JUVENILE LOGGERHEAD TURTLE POPULATIONS IN THE MEDITERRANEAN SEA*

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Turtles of both Atlantic and Mediterranean origin share common foraging grounds in the Mediterranean Sea. However, the detailed structuring and distribution at sea of specific loggerhead turtle populations in the basin is still unclear. We analyse the origin of 275 stranded or bycaught juvenile loggerhead turtles (30-69 cm CCL) from six distinct foraging grounds within the Mediterranean Sea through a Bayesian mixed-stock analysis with longer fragments of mtDNA. We aimed to describe the distribution of juveniles of Atlantic origin within the Mediterranean Sea, unveil the use of Mediterranean foraging grounds by juveniles from the Mediterranean populations and understand the mechanisms of such distributions. Differences were found in the relative contribution of juvenile turtles of Atlantic and Mediterranean origin to each foraging ground. A decreasing proportion of Atlantic juveniles was detected along the main surface current entering the Mediterranean Sea, with a high prevalence in the Algerian basin and lower numbers elsewhere. In regards to the turtles from Mediterranean populations, juveniles from Libya prevailed in central and western Mediterranean foraging grounds other than the Algerian basin. Conversely, the Adriatic Sea was characterised by a large presence of individuals from western Greece, whilst the southern Levantine Sea was inhabited by a heterogeneous mix of turtles from the eastern Mediterranean rookeries (Turkey, Lebanon and Israel). Overall, the distribution of juveniles could be directly related to the surface circulation patterns observed, revealing that the contribution of different nesting beaches to any particular juvenile foraging ground strongly depends on the pattern of surface currents connecting these beaches with the foraging ground used. These results have deep implications for the assessment of bycatch impacts on the populations using Mediterranean foraging grounds.

COUNTING NESTS AND BYCATCH IS NOT ENOUGH: WHY WE NEED TO INVEST IN SEA TURTLE SURVIVAL AND GROWTH RESEARCH*

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Concern about the status of sea turtles worldwide has created a fantastic network of scientists and conservationists that have worked very hard to prevent extinctions and recover populations. We have many success stories, and undoubtedly there are more healthy populations today than a few decades ago. Careful monitoring at nesting beaches, with standardized methods and good record-keeping, can give us trends in the productivity of a population; with a little more effort, we can count the number of nesting females each year. But nesting females can vary because of changes in the probability of nesting, or remigration interval, as well as changes in the number of new recruits to the nesting population and the survival rate of the adults. In fact, trends in numbers of nests and even nesting females can be quite misleading when they are assumed to be a constant index of population size. For example, the recent ten-year decline in loggerhead (*Caretta caretta*) nests in the southeast U.S. was quite alarming, and triggered management and legal actions to increase protections. However, shifts in the size distributions of juvenile turtles suggested that the decline was due to a gap in the age structure of the population, reducing recruitment of new adults. A large wave of subadult turtles could be seen in the juvenile size data, and demographers correctly predicted a recovery in nest numbers that started in 2008. In general, because adult females are a small proportion of total population size and can have variable nesting behaviors (frequency and/or location of nesting), nesting beach surveys are not sufficient for population status determination. Counting the number of juveniles caught in fisheries each year or stranded dead on beaches may help, but these numbers are also subject to many external factors that cause them to vary each year. Monitoring the size distributions, growth rates, and survival rates of juvenile turtles is essential for population assessment. The National Research Council in the United States reviewed sea turtle monitoring and assessment in that country and concluded that while nesting beach monitoring was essential for conservation, it is insufficient to diagnose changes in the trends of nests or nesting females. This problem is very clear today for the Kemp's ridley sea turtle (*Lepidochelys kempi*), which has shown a sudden change in the trend of the numbers of nests. This species was saved from extinction by a joint conservation effort by Mexico and the U.S. Almost all nests are very carefully monitored, and the species had been recovering well for almost 20 years until 2010, when nest numbers decreased by over 40%. Since then, the nests number has not gotten back on its track of recovery, and has now declined to 2006 levels. The cause of this dramatic change has not been determined, but many suspect the BP Deepwater Horizon oil spill was at least partially to blame. Unfortunately, because there has not been regular monitoring for vital rates (survival and growth), there are too many competing hypotheses to determine the full effect of the oil spill, and the future of the species is now uncertain. Although there are additional costs for good monitoring, we can use some existing data and new technologies to better understand how sea turtle populations change through time.

SEX RATIOS OF LOGGERHEAD TURTLE HATCHLINGS ON TWO NESTING BEACHES IN TUNISIA*

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Sea turtles show temperature-dependent sex determination (TSD). For any conservation strategy, information on sex ratios at different life stages is then necessary especially in the presence of confirmed climate change. For this we estimated hatchling sex ratios in the loggerhead turtle (*Caretta caretta*) by placing electronic temperature recorders in nests at two nesting sites in Tunisia (Kuriat and Chebba) during the 2013 and 2014 nesting seasons. Based on the mean temperatures during the middle third of the incubation period, and on incubation duration, the sex ratio of hatchlings at both sites was highly male-biased. Presently, the majority of hatchling sex ratio studies are focused on major nesting areas, whereby the sex ratios are universally believed to be heavily female-biased. Here we present findings from two minor nesting sites in the Mediterranean, where the hatchling sex ratio was found to be male-biased, suggesting a potential difference between major and minor nesting sites.

AERIAL SURVEYS AS A TOOL TO INVESTIGATE ABUNDANCE AND DISTRIBUTION OF LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) IN THE MEDITERRANEAN SEA*

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The knowledge of biological and ecological parameters for species of conservation relevance is essential to identify and enforce protection schemes. However, species' behaviour and habits, geographical range and migratory patterns often hamper the understanding of such parameters. Considering that the quality of scientific data affects the effectiveness of conservation plans, it is essential to put in place reliable research techniques and consistent data collection protocols. In this contest aerial surveys implementing distance sampling techniques represent one of the most successful methodologies to obtain abundance and density estimates of wild animals, for a variety of species and habitats. In light of these considerations, a series of multi-species aerial surveys, primarily targeting cetaceans, has been conducted in the seas around Italy between 2010 and 2014. Data were collected for several megavertebrates of conservation concern, including the loggerhead turtle (*Caretta caretta*). Here we present abundance and density estimates for the loggerhead turtle for the whole study areas and periods. The surveys were designed using the software Distance 5 and 6, and transects were identified to guarantee equal coverage probability across the study areas. A high wings double engine aircraft (Partenavia-P68), equipped with bubble windows to allow direct observation of the track-line, was used as the research platform. Flight altitude and speed were kept constant at 750 feet and 100 knots, respectively. In 2010 the study area extended from the Ionian Sea and the Gulf of Taranto to the Seas of Corsica and Sardinia, the Ligurian Sea and the Northern, Central and Southern Tyrrhenian Seas, for a total of 347,418 km^2. The Central and Southern Tyrrhenian Seas were also monitored during the summer 2013 covering an area of 93,215 km^2, and winter 2014 over an area of 111, 146 km^2, respectively. The uncorrected abundance estimates were: 45,442 individuals (%CV= 17.11; 95%CI= 32,229 – 64,073; Ionian Sea and Gulf of Taranto, May 2010), and 57,354 (%CV= 13.10; 95%CI= 44,353 – 74,166; remaining portion of the study area, July 2010), 11,334 (%CV= 20.99; 95%CI= 7,478.0 – 17,178; Central Tyrrhenian Sea, August 2013), (93,215 Kmq) and 48,267 (%CV=12.61; 95%CI= 37,492-62,140; Southern Tyrrhenian Sea, January 2014). The loggerhead turtle is one of the species of megavertebrates occurring in the Mediterranean Sea, for which conservation concern has been raised during the last decades. It classifies, in fact, as *Endangered* according to the IUCN criteria. The high rate of by-catch occurring across the whole Mediterranean Region represents one of the main causes of mortality for the species. Several studies have been carried out to date on the species biology and ecology, but to properly assess the potential detrimental effects of by-catch and other threats on the species occurrence, it is crucial to also evaluate and quantify trends in abundance. In this light, our results provide essential background data to be considered in future management and protection schemes, and, in general, to inform conservation. Furthermore, they represent valuable information to abide the many legal requirements under several national and international regulations to which the European countries have committed.

TURTLE ON BOARD: PARTICIPATIVE PROJECT FOR SAVING TURTLES FROM BYCATCH ON THE SOUTHWESTERN MEDITERRANEAN*

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Fishermen spend many hours at sea and are exceptional observers of sea turtles. They not only accidentally catch them in fishing gears but also usually see them floating at sea sick by exposure to infections or contaminants, or injured after caught in ghost nets or hit by propellers and ships. Their cooperation is very important for the advancement of knowledge of turtle abundance, distribution and survival. In addition, fishermen collaboration is essential in recovering turtles affected by all these threats. The project "Turtle on Board" arises to improve the relationship between fishermen and scientists with the common goal of making fishing more sustainable and respectful with sea turtles in the Southwestern Mediterranean fisheries. The project builds on the experience of many initiatives developed in the Mediterranean in the same direction and tries to apply the latest scientific knowledge in decision-making and management of the rugged turtles at sea. The work area extends over 1000 km of coastline and encompasses near 30 ports, around 450 boats and more than 1000 fishermen using a wide variety of fishing gears including longline, trawl, purse seine, trammel or almadraba. Fishing associations sign a cooperation agreement and allow installation in their fish markets of a permanent information point

and a tank for turtles, that fishermen commit themselves to maintain. They also commit to rescuing the greatest number of affected turtles, always following an established protocol, which is activated by calling the 112 emergency phone number. This protocol immediately activates the assistance of a turtle recovery team that will go to the port to pick up the affected turtle and take appropriate decisions on its status and destination. The recent discovery of the decompressive syndrome that may be affecting many turtles is already included in the protocol. This syndrome complicates decision-making by non-specialists and recommends moving to port all by-caught turtles. Resting on board some turtles may recover. If not recovered, the expert from the recovery center should take an appropriate decision in each case. Fishermen will also receive an official authorization to catch, manage and transport affected turtles to the port for their recovery. These perceptive permits to manipulate endangered species will also recognize their decisive contribution to turtle conservation. The vast majority of Fishing Associations of Andalusia and Murcia are already participating in the project with enthusiasm but they insist that their collaboration should be recognized and respected. Their work is very hard on sea and interactions with turtles are just harder for them. It is important to find realistic ways of reducing bycatch, and also support fishermen to reduce that impact. However, it is not reasonable that fishermen bear responsibility for transferring affected turtles to port for recovery, and then not be co-protagonist of recoveries and releases of these sea turtles. It is essential to support fishermen in these tasks and recognize and accredit their effort and dedication. Anglers who collaborate with turtle protection should feel gratitude and social recognition for this important work. It should identify and promote responsible turtle-friendly fishing practices.

MIGRATIONS OF LOGGERHEAD TURTLES NESTING IN KYPARISSIA BAY, GREECE, DERIVED FROM FLIPPER TAG RETURNS*

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The Bay of Kyparissia in western Peloponnese, Greece, contains the second largest nesting aggregation of loggerhead turtles in the Mediterranean. The Bay's coastline includes a 44km long beach from the river Alfios in the north to the river Arcadikos in the south. Although turtles nest along the entire beach, the majority of nesting (about 84%) occurs within the southernmost 9.5km which is considered the core area. Since the early 80s, ARCHELON has undertaken a long-term monitoring and conservation project in Kyparissia Bay. Tagging of nesting turtles started in 1982 and was performed in the core nesting area. Two types of tags were used: metal Monel 681-style tags on front flippers and plastic Jumbo Rototags usually on hind flippers. In total 1,358 loggerheads were tagged during the period 1982-2012. Of the tagged turtles, 69 individuals (5.1%) were recovered from 1 September 1985 until 5 June 2013, at various localities in the Mediterranean; specifically 27 in the Ionian Sea (incl. 3 in the Gulf of Taranto), 20 in northern/central Adriatic, 9 in the Gulf of Gabes, 8 in the Aegean Sea, 3 in the eastern Mediterranean and 2 in southern Adriatic. Excluding the turtles that were recovered relatively close to the nesting area in the Ionian Sea, the greatest concentrations of tag returns were observed in the northern/central Adriatic Sea (47.6%), in the Gulf of Gabes (21.4%) and in the Aegean Sea (19%). Although the first two areas are known foraging grounds of loggerhead turtles in the Mediterranean, the Aegean Sea has not previously been identified as important for turtles nesting in Kyparissia Bay. The longest migrations (about 1,400 km) were directed to the Gulf of Trieste, Slovenia, and to Sinai Peninsula, Egypt. The elapsed time (in days) between last observation at the nesting area and first recovery averages 901 days for turtles recovered in the Ionian Sea (range: 11-5,493 days), 795 days (range: 77-2,015) in the Gulf of Gabes, 760 days (range: 101-2,641 days) in northern/central Adriatic and 525 days (range: 33-1,154) in the Aegean Sea. It is worth to note that one turtle was observed alive in the Ionian Sea after 5,493 days, which was about 15 years from its last observed nesting in Kyparissia Bay. Elapsed times in relation to the distance of the recovery location can provide an idea of the average travelling speeds of migrating turtles; the maximum of these speeds reached about 12km/day for five turtles (3 migrating to northern Adriatic, 1 to Gulf of Gabes and 1 to the Aegean Sea); this speed concurs with similar research elsewhere. The present study highlights three important regions for loggerhead turtles in the Mediterranean with one of them identified for first time as a preferred site for loggerheads nesting in Kyparissia Bay. Many thanks to fishermen, coast guard and fisheries officers, concerned citizens and colleagues in several countries that provided information on recovered turtles. Also, many thanks to the hundreds of ARCHELON volunteers and field assistants for tagging turtles in Kyparissia Bay over the decades.

INTEGRATED CONSERVATION AND PROTECTION OF THE LOGGERHEAD SEA TURTLE IN THE MEDITERRANEAN CONSIDERING NESTING AND FORAGING-WINTERING AREAS: THE CASE OF THE NATIONAL MARINE PARK OF ZAKYNTHOS WITHIN THE MEDPAN NETWORK*

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Efficient conservation of migrating marine species such as the loggerhead sea turtle is by definition highly complicated since numerous threats must be addressed in terms of various anthropogenic activities in a very large geographical area. Global protection is therefore difficult to reach and any successful protection measures in a given area don't ensure an efficient protection of loggerhead sea turtles during their whole life cycle. The National Marine Park of Zakynthos (N.M.P.Z.) was established in December 1999 aiming at the conservation of one the most important nesting areas of the loggerhead sea turtle in the Mediterranean, since Lagana's bay is hosting 15-20% of the documented total of nests in the Mediterranean. Beyond the management of its own protected area, the N.M.P.Z. Management Agency intended to identify the migrating routes of the loggerhead sea turtles in order to understand their specific geographical distribution during foraging and wintering period. It was identified that Zakynthos'sea turtle population is migrating mainly to the Adriatic north eastern coasts. Those areas encompass many Marine Protected Areas (MPAs) that could be involved in addressing many threats such as incidental catch, deliberate killing, boat strike, marine pollution, etc. In this framework, the operation of the MedPAN Network, which main objective is to improve the effectiveness of MPAs management in the Mediterranean, can contribute to a more coordinated and efficient integrated conservation of the loggerhead sea turtle. The gathering and dissemination of scientific information within the scope of integrated management should supply basic guidelines for managers in order to implement and evaluate actions for sea turtle conservation. A principal tool to support such initiatives is MAPAMED, an up to date active and interconnected MPA Database which supports the assessment of management effort in Mediterranean MPAs. Through the correlation of MPA data and the information about loggerhead sea turtle wintering, breeding and foraging areas at least at the level of protected areas, managers are able to take action and provide the institutional players with specific information and immediate actions to be carried out. Such a case is representative of the N.M.P.Z. area which sea turtles seem mainly to use both Croatia and Slovenia coast line as foraging and wintering area, according to information provided by tag recovery and satellite tracking. At least six managing authorities and four Institutions are able to directly share information concerning not only the monitoring of the sea turtle but also tourism and fishing activities. Since the MedPAN network aims to reinforce the interactivity between its members and build their capacity as well as ensure an effective management of MPAs in tight relationship with stakeholders, specific issues concerning threats to sea turtles, such as from tourism and fishing activities, should therefore be more efficiently addressed and protection measures fully implemented. Furthermore, data should integrate immediate and latent threats such as marine pollution, sea turtle illnesses (viruses) and invasive species and afford quick actions to be carried out.

ESTIMATE OF ABUNDANCE AND ABUNDANCE TREND OF LOGGERHEAD SEA TURTLES AT THE FORAGING ARE OF THE WESTERN MEDITERRANEAN SEA: BAD NEWS*

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The loggerhead sea turtle (*Caretta caretta*) is the most abundant sea turtle species in the Western Mediterranean, being the local stocks composed of juveniles coming from East Mediterranean and Atlantic nesting populations. In the Western Mediterranean the species has been impacted sharply by human activities, particularly fisheries, over the last decades. We investigate the impact of such activities, and long-term changes, on local loggerhead turtle stocks through the comparison of results of aerial surveys carried out in 2013 in waters off the Valencia Community and surrounding areas (East Spain) with previous aerial surveys conducted by our team in the past in the same area. We apply standard line-transect methods to estimate sea turtle abundance. We carried out four surveys (one per season) over ca. 5150 nautical miles, from the coastline up to waters over the 1000 m isobaths. In total, we recorded 56 loggerhead turtle sightings (47 on effort). Loggerhead turtles were found in the four seasonal surveys. We review abundance estimations from previous surveys according to turtle distribution and diving behaviour, since turtles expend more time under water (i.e., being less probably detected) when they are over the continental self than over the slope or deeper waters. Based on current abundance estimations, we found that local stocks have declined dramatically in the studied area (<50% of previous estimations). These results are compared with other evidences such as updated stranding records and results of interviews

with fishermen. Fishermen interviewed agreed in the reduction of local loggerhead turtle stocks and in that fisheries are, in large part, responsible of this decline. Other non-exclusive explanations for this decline, such as trends in hatchling production at contributing nesting rookeries or atmospheric and environmental patterns, are also discussed. The study of loggerhead sea turtle conservation status in the Western Mediterranean becomes essential due to the double origin and stratification of the local stocks. Since evidences suggest a big decline, conservation measures in the area are mandated. We strongly recommend the use of aerial surveys to study conservation status of marine turtles in other areas of the Western Mediterranean, due to the effects of past and present anthropogenic threats existing in this basin on local stocks. This study is supported by project Prometeo2011/040 of Generalitat Valenciana and project CGL2011-30413 of the Spanish Ministry of Economy and Competitiveness.

REEVALUATION OF HABITATS OF SEA TURTLES IN TURKEY*

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Sea turtles have a panmictic distribution and they use both the marine and terrestrial habitats for nesting, foraging, nursery, wintering. Turkey has a lot of coastal habitats for both green and loggerhead turtles. Although the nesting habitats are well documented, there are limited studies on the marine habitats of sea turtles in Turkey. This study focuses on indicating particularly foraging habitats of sea turtles in Turkey. The size of stranded turtles is a good indicator to understand the foraging marine habitats of sea turtle. The data about stranded turtles and recently published data were used to evaluate the possible marine habitats of sea turtles in Turkey. In addition to Muğla and İskenderun Bay as previously mentioned, Canakkale region, the Northern part of the Turkey includes important foraging habitats of both adult loggerhead and juvenile green turtles. The distribution of sea turtle in Aegean region extends Marmara Sea.

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