REPORT THE MEETING
"Sharing experience on marine turtle between Overseas European Territories"

9th - 10th October 2013

Universidade dos Açores - Departamento de Oceanografia e Pescas, Faial, Portugal

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This workshop is conducted in the framework of the EU-BEST project COCA-LOCA *'Connectivity of the Loggerhead turtle in the Western Indian Ocean'*

The objective of this workshop was to gather scientists from the Indian and Atlantic Oceans (see Appendix 1), in order to share experiences and identify future actions for research and conservation of marine turtles in Overseas European Territories

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The Agenda is presented in Appendix 2

OUTLINES OF DAYS 1

Day 1 was dedicated to present most significant advances in marine turtle ecology, growth, spatial behavior and connectivity in the Atlantic and Indian Oceans (See Appendix 3). All participants noted the high quality of studies and presentations. This session was also the opportunity to share monitoring technics and data analysis methods undertaken by the different teams to study marine turtles.

OUTLINES OF DAY 2

DAY 2 was dedicated to discussions in order to highlight research and conservation priorities for highly migratory marine turtles in the Atlantic and Indian Ocean. All participants agreed that as a matter of priority, improving the understanding of connectivity between Indian and Atlantic Ocean was a key issue to sort out in the coming years, especially for loggerhead turtles.

A- Summary of discussions:

1) What is the importance of sea turtles in maintaining ecosystem health?

1a) turtles as indicators of ocean health

1b) Trophic ecology studies

What is the importance of sea turtles for maintaining ecosystem health/human needs, e.g. by helping preventing jellyfish blooms? Sea turtles as an environmental service?

Jellyfish may impact recruitment of fished resources and human safety (*e.g.* beaching)

- I – targeted specific studies on jellyfish intake by turtles
- II – large scale studies combining turtle habitat use and distribution (telemetry, fisheries) and jellyfish biomass (Hard data and Modeling data needed)
- These could produce useful, fundable indicators but maybe hard to get to in a reasonable timeframe and we should focus on other issues. Such approach will need to add leatherbacks as a biological model too…
- 2b) general trophic studies with isotopes (se bellow)

2) Understanding the relation between marine turtle and their oceanic habitats

One major gap, especially for the endangered and most impacted by industrial fisheries loggerhead turtle, is to better understand the relationship that do exist with their oceanic habitats. In order to investigate this relationship, it is needed:

- To join and compare the results of two diverse modeling approaches (*e.g.* BioTelemetry and Seapodym type models) for habitat modelling and identify species-specific habitat spots;
- To collect or gather fisheries or other presence/absence data to validate (or other similar approaches) the models
- To have access to fisheries data from RFMOs, especially from ongoing observers program, targeting different habitats (oceanic versus neritic). This will need a stronger cooperation with RFMO in order to start collecting relevant information and samples from accidentally caught marine turtle.

3) To study the connectivity between marine turtles populations (South Atlantic, North Atlantic and western Indian Ocean) and develop Ocean basin fisheries guidelines

- How does the oceanography around Cape Good Hope affects the connectivity between the Indian Ocean (rookeries) and South Atlantic Ocean (composition of marine turtle in oceanic foraging areas? Is it an evolutionary 'dead-end'?
- How do we manage marine turtles in foraging area composed of individuals coming from several identified Management Units?
- Which rookeries do oceanic turtles come from?
- How is the real impact of open sea fisheries according to related rookeries?
- How much the sea turtles are involved in spreading the invasive species (e.g. rapa whelk)?

Solutions:

3a) Genetics approach

'many-to-many' approach is needed in collaboration with observers programs for sample collection; focus on key oceanic areas where interaction occur the most.

3b) Isoscape /biomarkers/population studies

Such an important approach requires getting the isotopic landscapes including the lower trophic level diet components of each basin (South and North Atlantic, Indian Ocean).

3c) Telemetry

By gathering all existing data, deploying satellite tags where may gaps are identified and developing new analysis in relation with habitat

3d) epibionth and parasite studies

To focus on external fauna that could be used as an indicator of connectivity between habitats and biogeographic areas

4) Improving studies on demography

- to develop length frequency analysis (as an indicator of population structure)
- to improve abundance estimates and gathering long term data on abundance indicator

5) To develop operational (Dynamic) Management of Stocks

Can we predict habitat shifts under climate change scenarios?

Is by-catch on sustainable levels?

- Habitat modeling for MPA definitions (oceanic) and improving regional network

- MPA appropriate design – review in relation to EU requirements
- Developing a integrative tool (model) to feed/answer management (what if?) questions
- to exploit time series of abundance indicators and length frequencies in this approach

6) Impact of marine pollution

What is the impact of plastic and entangling fishing gears on status (environmental health) of turtle (sub) populations?

Why and how turtles could be used as Indicator of ocean health (sensu MSFD)

- studies of interaction between turtles with plastic

B- Strategy for a common project proposal:

1) Identification of potential partners: Towards common databases on

- *1a) telemetry:* Target is to work towards joint publications without using individual tracks but rather general habitat use patterns; build a table with species/stage entries to identify potential database holders (action: J.Bourjea, A.Bolten)
- *1b) genetics:* build a table with species/stage entries to identify potential database holders (Action: C. Monzon Arguello)
- *1c) isotopes* : build a table with species/ stage entries to identify potential database holders (Action: K.Bjorndal)
- *1c) demographic data:* build a table with species/stage entries to identify potential database holders (Action T.Dellinger): biometrics, sex, abundance, L-F data, nesting beaches, including fisheries data

The global objective as a first step is to start with the current group and then identify a few missing key players

- Get a data-sharing agreement signed under funding conditions but only after initial contact
- Some names to be contacted: Catherine McClellan, Tamar project (Gilberto Salas), LL Brazilian fisheries (Fabio Hazin/Paulo Travassos).

2) Scientific strategy:

- 2a) Species versus ecosystem approach – research efforts can benefit other top predators species (ex.) and maybe would be more fundable;
- 2b) biological model: only oceanic stage of loggerhead *C. caretta*, focusing on connectivity at oceanic stages
- 2c) Indian Ocean and North / South Atlantic Ocean (tables, contacts) but look into including the Pacific Ocean in the future

2d) base efforts on already available data versus collection of new data: where to go and identification of gaps?

3) Expected results: Links to main international policies

- 3a) the objective is not to develop specific management plans or actions but rather provide relevant information to decision makers
- 3b) MSFD and OSPAR commissions – criteria for assessing good environmental status (abundance, distribution, etc.) of marine reptiles are still lacking
- 3c) Seek links with IUCN, RFMOs and other international management organizations (ICCAT, IOTC, OSPAR, etc.) to better envisage how our scientific plan can input their management needs
- 3d) Fill gaps and refine the RMUs proposed by the IUCN MTSG (Wallace et al 2010 PlosOne) (at least for the ocean basins of focus)

4) Funding & strategy: Review of financial instruments

- EU Horizon 2020 – enquire for upcoming calls (Philippe)
- EU overseas/RUPs regional (BEST, POCTI, FEP (Feamp), other) (enquire Jerome)
- US programs – enquire (Alan)
- RFMOs (doesn't seem like), but could be used as an operational facilitator and field partner
- National, Bilateral, NGOs (BI, ISSF, CI, WWFs, Greenpeace), Foundations, Private (each partner tries to get info)

5) Action plan for 2013

- To deliver the tables filled in by specific topic (see above) – *by end of November*
- Feed-back on funding (<u>Action P. Gaspar</u>) – *by end of November*

- Contacts – TAMAR, URFPE (Bra) (Action P. Afonso and A. Bolten)
- A draft datasharing agreement (Action: C. Monzon Arguello) – *by end of November*
- A concept note (3 pages max) for funding agencies/guide for science plan (Action P. Afonso; A. Bolten and J. Bourjea) – *mid December*

APPENDIX 1 – LIST OF PARTICIPANTS

Açores/Portugal

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APPENDIX 2 – FINAL AGENDA

DAY 1 - SHARING EXPERIENCE

09:00 Welcome venue

09:30-11:00 Morning 1: The Indian Ocean

1 Green turtle spatial dynamic in the SWIO – J Bourjea (IFREMER)
2 Modeling the dispersal of hatchlings in the SWIO – P. Gaspar (CLS/ARGOS)
3 Tracking loggerhead turtle in SWIO – J. Bourjea (IFREMER)
4 Discovering behaviour of open sea stages of sea turtles: working flipper on hand with fishermen in La Reunion – S. Ciccione (Kélonia)

11:00-11:20 Coffee break

11:20-12:30 Morning 2: The Indian (cont.) and Atlantic Ocean (Madeira & Canaries)

5 COCALOCA project – S. Ciccione/P. Gaspar/J. Bourjea
6 Marine turtle research program and conservation in Madeira – T Dellinger (Un Madeira)
7 Marine turtle research program and conservation in Canaria - AL Loza/L F L Jurado (Un Las Palmas)

12:30-14:00 Lunch break

14:00-15:30 Afternoon 1: The Atlantic Ocean (Azores)

8 Life history variation, quantifying connectivity and importance of regional collaboration – A Bolten (Archie Carr, Un Florida)
9 Oceanic stage duration, growth rates and survival – K Bjorndal (Archie Carr, Un Florida)
10 Satellite telemetry research program in Açores – M Santos (DRAM/UAz)
11 Mitigation of marine turtle by-catch – M Santos (DRAM/UAz)/R Ferreira(UAlg)

15:30-16:00 coffee break

Afternoon 2: Group discussion

Identification of common conservation problems and data gaps

DAY 2 - FINDING COMMON TOPICS AND PRIORITIES

Morning: Group discussion

Identification of research needs, possible future research and opportunities for collaboration

Afternoon: Group discussion

Review of financial instruments (e.g. EU Horizon 2020, BEST, national, bilateral)
Identification of potential proposals and consortiums

POST NESTING MIGRATION OF GREEN TURTLE (CHELONIA MYDAS) IN THE WESTERN INDIAN OCEAN

AUTHORS:

AUTHORS: Jérôme Bourjea*, Stéphane Ciccione, Simon Behamou, Mayeul Dalleau

(*Presented by)

ABSTRACT:

Marine turtles do not recognize political boundaries, nor do they have regard for Exclusive Economic Zones (EEZ s), cooperative agreements, international conventions, or memoranda of understanding between countries. So is it in the Southwest Indian Ocean (SWIO), a region that hosts some of the most important green turtle nesting sites in the world, most of which are isolated on remote islands (e.g. Europa and Glorieuses, Aldabra and Cosmoledo, Moheli and Mayotte). This region of the world is known to have year round nesting of green turtles but all sites display a marked nesting season. However, very little is known about migratory pathways that sea turtles ply between their nesting and feeding grounds in this region where this species faces numerous threats such as fisheries interaction at both open sea and coastal waters.

From 2009 to 2011, we deployed 81 satellite transmitters on nesting green turtle females during (d) and opposite (o) to the nesting peak in 5 important rookeries of the South West Indian Ocean (SWIO): Europa (Nd=10; No=10), Glorieuses (Nd= 10; No=10), Tromelin (Nd= 10; No=10), Mayotte (Nd=10; No=10) and Mohéli (Nd=7; No=3) and collected previous 24 old tracks in the area for a total of 105 tracks. First results showed that 39.7% of the tracked turtles used Madagascar costal foraging ground while more than 50% used the east African ones (Mozambique (32,0%), Kenya (3.8%), Tanzania (15,4%) and Somalia (2,5%)). It is worthwhile noting that the North Mozambique and South Tanzania remain the most important foraging ground for the tracked turtle (45% of the tracked turtles), but that they are mainly used by turtles tagged during the nesting season. On the other hand, we highlight here that green turtles also use a large range of foraging ground in the area (55% of the tagged turtles), some of them being hot spots (e.g. south of Maputo – Mozambique, Tulear lagoon – Madagascar).

Spatial distribution estimation allowed identifying important year round coastal and oceanic migrating corridors: 2 oceanic corridors, (1) in the north of the Mozambique Channel (11°S -

14°S) and (2) the south of the Mozambique Chanel (17°S - 23°S), more particularly from the north of Europa to the north of Mozambique (38°E - 41°E); and 2 coastal corridors (1) The east African coast, between 16°S (Mozambique) and 7°S (Tanzania), and (2) all the west coast of Madagascar. The extreme north of Madagascar is also an important coastal migratory corridor The 105 tracked green turtles also crossed as many as nine different EEZs in the region before reaching their foraging grounds, which themselves are shared by six countries. Such spatial migrating pattern of adult green turtle, the temporal corridors and the regional feeding hot spots identified are of high importance to implement targeted mitigating measures for artisanal and industrial fisheries and encourage conservation on key foraging grounds.

MODELING DISPERSAL AND SURVIVAL OF SEA TURTLE HATCHLINGS IN THE SOUTHWEST INDIAN OCEAN

AUTHORS : Philippe Gaspar*, Mayeul Dalleau, Jérôme Bourjea and Stéphane Ciccione

(*presented by)

ABSTRACT:

After emerging from their nests, sea turtle hatchlings crawl to the water and vigorously swim towards the open ocean where they become 'lost' to observations for several years. Despite recent progress in the miniaturization of electronic tracking devices, tracking of sea turtle hatchlings can hardly be achieved for periods over a month or so. Observations of where they disperse and how they survive are thus extremely sparse. However it is now widely recognized that, after an initial swimming frenzy, hatchlings' swimming activity is minimal so that their trajectories are close to purely passive drift trajectories. Such trajectories are easily simulated using lagrangian drift software fed with high-resolution surface current estimates provided by operational ocean models. Such passive drift simulations have been performed by a number of authors to identify the likely dispersal areas of several sea turtle populations in most oceanic basins. This approach however raises (at least) two questions :

1) Hatchlings, and then juveniles, certainly become more powerful swimmers as they grow older. How long does the passive drift hypothesis hold?
2) Some drift trajectories lead hatchlings towards areas where they shall not survive if only because water temperature is too low or because food is lacking. Can one determine the trajectories, and the corresponding dispersal areas, for which hatchlings have significant chances of survival ? These areas must indeed be excluded from the estimated dispersal area as no alive hatchling shall actually be found there.

In this work we simulate the passive drift trajectories of hatchlings originating from 6 nesting beaches in the South-West Indian Ocean (on Europa, Glorieuses, Mayotte, MohéLi, Tromelin and La Réunion Island). Trajectories are simulated only for the first year of life, a period during which one can reasonably assume that the passive drift hypothesis is valid. Oceanographic conditions are then analyzed along all simulated trajectories in an attempt to characterize their "favorability" or , in other words, the survival rate associated to each trajectory. Interestingly, the dispersal areas populated by the most favorable 10 % of all simulated trajectories match well with the observed dispersal areas of adults females tracked during the MODIOT project (from 5 out of the 6 studied nesting areas, no adult having been tracked from La Réunion). This is an additional observation reinforcing the Learned Migration Goal (LMG) hypothesis following which oceanic stage juveniles (somehow) record the positions of randomly discovered foraging areas to return to such sites after reproductive migrations.

DISCOVERING BEHAVIOR OF OPEN SEA STAGES OF SEA TURTLES:

WORKING FLIPPER ON HAND WITH FISHERMEN IN RÉUNION

AUTHORS: Stéphane Ciccione*, Jérôme Bourjea

(*Presented by)

ABSTRACT:

By working together, scientists and open sea fishers can work towards reducing sea turtle by-catch and mitigating its impacts. For example, fishers can remove hooks from turtle esophaguses before they release them, or keep the turtle alive on board until assumption of responsibility for them by a health center. Additionally, data collected when turtle by-catch occurs (e.g. boat position, time and date, turtle weight and length, and genetic sample) or after the release (e.g. movement and diving behavior of turtles fitted with satellite tags) can help increase understanding of the biology of sea turtles and their interaction with open sea fisheries. To this end, in 2004 a cooperative program was established by Kelonia, IFREMER and Reunionese volunteer fishers to monitor by-catch of sea turtles in the Réunion longline fishery and to reduce bycatch mortality. By-catch turtles are kept onboard by fishers, and given to the Kelonia health centre to recover after hook removal. Modern surgical techniques and anaesthesia sees more than 60% of turtles recovering. The partnership with the fishermen is a long-term job, but the partnership is going well and has continued to involve the same four boats since 2004.

MOVEMENT AND DIVING BEHAVIOR OF LATE JUVENILE LOGGERHEAD SEA TURTLES (CARETTA CARETTA) IN THE WESTERN INDIAN OCEAN

AUTHORS: Mayeul Dalleau, Simon Benhamou, Stéphane Ciccione, Jérôme Bourjea*

(*Presented by)

ABSTRACT:

We conducted a satellite tracking study on juvenile loggerhead sea turtles in the Indian Ocean, where they have been poorly studied up to date. Eighteen individuals were released from Reunion Island (21.2°S, 55.3°E) to investigate movement and diving patterns of late juvenile stage in the region. Eleven turtles roughly swam towards Oman (20.5°N, 58.8°E), where one of the world largest rookery of loggerheads is located. Three individuals contrastingly went southwards off the coast South-Africa and Madagascar, countries that also host loggerhead nesting grounds. Fourteen transmitters allowed the processing of animal diving profile and we observed a dichotomy between diurnal and nocturnal diving behavior with a greater number of shorter dives occurring during the day. Diving behavior also differed according to movement behavior as individuals spent more time at subsurface (<10m) during transit phases. Our study provides a better understanding of the oceanic movements and diving behavior of juvenile loggerheads, and key information for conservation of this species, which is of major concern in the Indian Ocean and worldwide.

CONNECTIVITY OF LOGGERHEAD TURTLE (CARETTA CARETTA) IN WESTERN INDIAN OCEAN: IMPLEMENTATION OF LOCAL AND REGIONAL MANAGEMENT COCA LOCA PROJECT

AUTHORS: Stéphane Ciccione*, Philippe Gaspar, Jérôme Bourjea

(*Presented by)

ABSTRACT:

The loggerhead turtle (*Caretta caretta*) is one of the 7 species of marine turtles. This species occurs in the territorial waters of Reunion and Mayotte. It is listed in Appendix I of the

Washington Convention (CITES) and the IUCN Red List. More than other species, the loggerhead is especially susceptible to bycatch in fisheries, ingestion of plastic debris and boat strikes. A regional convention for the management and conservation of sea turtles and their habitats in the Indian Ocean and South-East Asia (IOSEA) was established in 2003 under the aegis of the Convention for Migratory Species (CMS). Mitigation measures to reduce the impact of these anthropogenic threats on marine turtles have recently been implemented in Reunion. These must be further developed, amplified and extended to Mayotte, and more generally in all the West Indian Region. These measures must be based on a clear understanding of the biology of this migratory species, whose habitats are largely scattered in this Indian Ocean region. The objective of this BEST 2012 action is thus to increase knowledge on this sea turtle species which has, so far, been little studied in the Indian Ocean. In particular, studies of the oceanic migration pathways and of the connectivity between populations of the main known breeding sites of the western Indian Ocean are required to implement effective management measures at the local level through the forthcoming French National Action Plan (NAP), and at the regional level, through a close cooperation with IOSEA which has already defined its Action Plan.

More specifically, our project plan proposes:

- To assess the relative importance of major anthropogenic threats to the loggerhead turtle in the territorial waters of Reunion, strengthening actions to directly reduce the local impact of these threats, and initiate an equivalent process in Mayotte,

- To study the oceanic movements of loggerhead turtles present in the territorial waters of Reunion and Mayotte. This will be achieved by increasing the data already collected through individual Argos tracking, genetic and isotopic results and dispersion modeling of hatchlings from the main nesting sites of the Indian Ocean,

- To establish a cooperation between Reunion, Mayotte and the countries hosting the nesting sites of this species (South Africa, Madagascar, Mozambique and Oman) to implement regional management measures,

- To exchange good practices, experiences and scientific knowledge with the ORs Atlantic already working on the juvenile stages of this species: Azores, Madeira, Canary Islands. The first objective is clearly an "immediate" conservation goal. The following objectives should, in the medium term, allow optimization of the means dedicated to conservation of this species based on a thorough knowledge of the habitats occupied during the different stages of development of this highly migratory species.

MARINE TURTLE RESEARCH PROGRAM AND CONSERVATION IN MADEIRA

AUTHORS : Thomas Dellinger*

(*presented by)

ABSTRACT:

A brief overview of our research on juvenile pelagic loggerhead sea turtles at Madeira is given. Starting with biometry and population composition of the turtles in regard to sex and age, I will proceed describing their ecology, namely their migratory pathways and diving behavior using satellite telemetry and data-logging. More recent projects deal with chemosensory behavior towards potential food sources and the interpretation of stranding patterns using experimental taphonomy. In regard to conservation I will report on fisheries interaction and to our long-term in-water monitoring of turtles, which we started in 2007.

MARINE TURTLE RESEARCH PROGRAM AND CONSERVATION IN CANARY ISLANDS

AUTHORS : Ana Liria-Loza* & Catalina Monzón-Argüello*

(*presented by)

ABSTRACT:

Loggerhead (Caretta caretta) is the most common species in the Canary Island, though green (Chelonia mydas), hawksbill (Eretmochelys imbricata) and leatherback (Dermochelys coriacea) turtles are also present.

Sea turtle Research Group of the University of Las Palmas de Gran Canaria (ULPGC; Canary Islands) has worked in the area for more than 15 years. Here, we present our main results derived from biometry, telemetry, epibiont and genetic studies.

The main causes of stranding in the archipelago and the size class distribution are shown. Genetic analyses have shown that the main rookeries contributing juveniles to the Canary's stock are South Florida, Northeast Florida-North Carolina, Mexico and Cape Verde. In addition, telemetry tracks suggest long-term (more than one year) stay around the islands and reveal some transatlantic migrations. Epibiont studies corroborate pelagic behavior for the vast majority of juveniles but show also that some turtles use neritic habitats in the area. Finally, we highlight gaps in the area and possible venues for future collaboration.

OCEANIC SPATIAL BEHAVIOR OF LOGGERHEAD SEA TURTLES IN THE WIDER AZORES REGION

AUTHORS: Marco Santos*, Alan Bolten, Rogério Ferreira, Helen Martins, Frederic Vandeperre, Pedro Afonso and Karen Bjorndal

(*presented by)

ABSTRACT:

Loggerhead sea turtles undergo significant alterations in their ecology due to their complex life cycle that involve a series of ontogenetic shifts. In contrast to the knowledge acquired on their ecology in terrestrial and neritic habitats, little is known on the juvenile ecology in the oceanic habitat. The wider Azores region is considered an important oceanic developmental habitat for offspring of the southeastern USA loggerhead Population. This population is the biggest in the Atlantic and one of the most important worldwide. Juvenile loggerheads inhabit the oceanic zone during an extended period, where they are vulnerable to fisheries. The most significant anthropogenic threat to the survival of juvenile-oceanic loggerhead turtles during the oceanic stage is the risk of incidental capture in commercial fisheries, mainly as by-catch of pelagic longline fleets. The identification of critical oceanic habitats is a priority for the conservation of this endangered population. The primary objective of present study was to investigate distribution patterns and the identification of important oceanic habitats of North Atlantic loggerheads to gain a deeper insight in the ecology of the oceanic-juvenile stage through the utilization of biotelemetry. The present study demonstrates a strong evidence for an extended permanency of oceanic-juvenile loggerheads in the wider Azores region, where the turtles show an apparent preference for steeper slopes areas and eddies. These topographic and oceanographic features of WAR are an advantageous for somatic growth in such oceanic uncertain habitat. These results draw attention to the importance of WAR as a vital oceanic developmental habitat for the North Atlantic loggerheads and for the urgent achievement of mitigation measures on the impact of the longline fishery regarding loggerhead sea turtles by-catch on the area.

MITIGATION OF MARINE TURTLE BYCATCH IN LONGLINE FISHERIES

AUTHORS: Rogério Ferreira*, Marco Santos*, Karen Bjorndal, Helen Martins, Alan Bolten

(*presented by)

ABSTRACT:

In the marine environment, loggerhead sea turtles face several key threats at all life stages, including bycatch in pelagic and coastal fisheries, marine pollution/marine debris, and vessel strikes. While we need to learn more about loggerhead sea turtles, we already have evidence that they are important to the ecosystems upon which they depend, and thus protecting them is an important part of ecosystem based management. Bycatch in diverse fisheries is currently a major concern for the recovery of the Northwest Atlantic nesting population and is undermining conservation efforts. Fishing gears that pose the greatest concern at this time are longlines, trawls, and gillnets. Interactions and mortalities from these gears need to be reduced. In the Azores, since 90's that bycatch of pelagic longline fleets was identified as one of the most significant anthropogenic threat and significant effort have been made to mitigate this problem, culminating in a 5 year longline experiments. Based on the work accomplished by similar longline projects an International Working Group for the Conservation of the Northwest Atlantic Loggerhead Nesting conducted meetings to draw attention to the current status of the species and identified actions that need to be undertaken as described below.

General Actions

Observer Programs - Traditional observer programs or electronic monitoring alternatives are needed for fisheries likely to interact with sea turtles.

Spatial and Temporal Management - Factors influencing the impact of bycatch have been identified and should be considered to manage the fisheries to minimize impacts on sea turtles. During their oceanic life stages, loggerheads tend to aggregate at certain oceanographic features, and fisheries operating in such high sea turtle density zones are likely to have loggerhead turtle bycatch. Thus, spatial and temporal management can be an important tool in fishery management. Sea turtle protection areas, seasonal closures, and emergency closures are all important management tools to reduce sea turtle bycatch.

Outreach - Outreach to fishing communities is needed to ensure they understand the importance of sea turtles and why bycatch mitigation and safe handling and dehooking is important. Particular attention should be paid to fishermen in developing countries so that they have the resources and information to appropriately address sea turtle bycatch.

Longline Actions

Pelagic longlines are most often fishing on the high seas, so management requires international efforts. Existing longline fisheries should be subject to binding measures to reduce sea turtle bycatch and mortality, and longline fishing effort should not increase without binding measures for sea turtle conservation. These measures should include the following provisions:

- Reduce the number of daylight hours that the gear is in the water.
- Ensure leader lines are sufficiently long to allow a hooked turtle to reach the ocean's surface to breathe.
- Avoid the use of light sticks.
- Use bait type and baiting techniques that minimize turtle captures.
- Use hook sizes and hook types that minimize turtle captures and deep-hooking. Case by case assessment is important as the effects of "J" vs "Circle" hooks and hook size on target catch and turtles of different sizes require basic information.
- Provide training and information on safe handling and dehooking protocols to fishermen and fisheries observers in order to reduce post-hooking mortality.
- Avoid areas of high turtle density.

OCEANIC STAGE DURATION, GROWTH RATES AND SURVIVAL IN NORTH ATLANTIC LOGGERHEADS

AUTHORS : Karen A. Bjorndal*, Alan B. Bolten, Helen R. Martins, and Equipa Tartaruga

(*presented by)

ABSTRACT:

The durations of the ocean stages of all sea turtle species are poorly known, but stage duration is a critical parameter for models of population dynamics and development of management plans. To date, all estimates of ocean-stage duration have been based on growth rates and the time required for a sea turtle to reach a designated size-at-emigration from oceanic habitats. We present growth data for oceanic-stage loggerheads in the waters around the Azores based on three techniques: capture-mark-recapture, skeletochronology, and length-frequency analyses. All three approaches yield very similar growth rates. Estimates of duration of the oceanic stage range from 7 to 12 years depending on the selected size at emigration. The advantages of length-frequency analyses for growth rates are discussed. We use a size-at-age function derived from length-frequency growth analyses to estimate survival probabilities of oceanic-stage loggerheads based on catch curve analyses. Our best estimate of "true" annual survival probability (that is, survival not confounded by emigration) is 0.911 in small size classes. In larger size classes in which mortality and emigration are confounded, the estimate of apparent annual survival probability is 0.643. Future research needs, particularly for studies integrated over broad spatial ranges, are discussed.

LIFE HISTORY VARIATION, QUANTIFYING CONNECTIVITY AND IMPORTANCE OF REGIONAL COLLABORATIONS

AUTHORS :   Alan B. Bolten*, Karen A. Bjorndal, Helen R. Martins and Equipa Tartaruga

(*presented by)

ABSTRACT:

Following a brief introduction to sea turtle research in the Azores, we discuss the development of a life history model for loggerhead turtles in the North Atlantic. Early models based on size frequency of oceanic populations compared with neritic populations, tag returns, and population genetics indicate a linear life history. However, results from satellite telemetry and stable isotope analyses demonstrate that the loggerhead life history is more complex and can be used to test hypotheses of ontogenetic movements.

We present a three-component model of ecosystems (nesting beach/rookery, neritic, and oceanic) inhabited by loggerheads to evaluate approaches to quantify connectivity among populations in these ecosystems. Between the nesting beach/rookery and oceanic systems, we review the developments in population genetics that allow for quantifying connectivity beginning with simple mixed stock analysis to a recent Bayesian hierarchical "many to many (m2m)" approach that provides for both rookery centric and foraging ground centric analyses. Advances in mtDNA sequence length improves the m2m analyses. An example from the South Atlantic is presented that demonstrates the connectivity between the South Atlantic, Indian Ocean, and Western Pacific. To quantify the connectivity between the oceanic and neritic systems, we can also use a modified m2m approach as well as analysis of biomarkers. An example using trace elements is presented. Connectivity between the neritic and nesting beach/rookery ecosystems can also be quantified using the m2m approach.

It is clear that successful conservation and management of sea turtles requires multi-regional collaborations