



AFRICAN SEA TURTLE NEWSLETTER



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Ampurna village, Bijagos Islands, Guinea Bissau.

ISSN 2373-1575

No. **9** 2018

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Minutes of the Africa Regional Meeting, 38th Annual Symposium on Sea Turtle Biology and Conservation, Kobe, Japan (19 February 2018)

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Thirty-three people participated in the 2018 Africa Regional meeting, representing projects in at least 17 countries. Ana Liria-Loza, from Natura 2000 – Boa Vista Island, Cabo Verde, facilitated the meeting.

The meeting started with an introduction of all attendees, followed by country presentations:

Guinea Bissau: Rita Patrício, University of Exeter - UK, presented the strategies of project 'Consolidation of Sea Turtle Conservation in West Africa – Guinea-Bissau', funded by the MAVA foundation for three years (2018 – 2020), with the main partner being the Institute for Biodiversity and Protected Areas of Guinea-Bissau (IBAP – GB). The strategies include: 1. Patrolling and surveillance, 2. Effective Management of Marine Protected Areas, 3. Engagement of local communities, 4. Effective legal framework, 5. Mitigation of habitat disturbance, 6. Coastal development and tourism planning, 7. Research and monitoring, and 8. Awareness and education. She also announced the Abidjan Aquatic Wildlife Partnership, a funding opportunity for countries in West and South Africa, working on the eradication of sea turtle harvesting and poaching of eggs (for details contact: matt@reefscan.org).

Cabo Verde: Marina Pereira-Silva, Delegation of the Ministry of Agriculture and the Environment - Protected Areas of Boa Vista Island, Cabo Verde, discussed the project 'Consolidation of Sea Turtle Conservation in West Africa' funded by MAVA in Cabo Verde, and emphasized the need to reinforce the new law, which considers the poaching of sea turtles and their eggs to be a public crime and to increase the collaboration among partners of the project and enhance community engagement in conservation. Juan Patiño-Martinez, from Maio Biodiversity Foundation, highlighted their collaboration with local fishers to report illegal captures/activities, the 'Homestay project', through which local families receive funding to prepare their houses to host tourists, and their research on the reproductive success and sex ratios in different sand colour beaches.

Mauritania: Feitoumatt Lematt Ghrib, Croatian Institute for Biodiversity, described how on the Mauritanian coast many juvenile and adult loggerheads and green turtles are found stranded; these are potentially animals coming from the major rookeries in Cabo Verde and Guinea-Bissau, respectively, but lack of funding has halted the implementation of conservation and enforcement strategies. She emphasized the urgent need for strong collaborations among these three countries for the effective management of these populations, and she hopes that the new data provided by satellite tracking from the main rookeries in Cabo Verde and Guinea Bissau will show the importance of Mauritania for sea turtles and how they are interacting with the local fisheries. Manjula Tiwari, National Oceanic and Atmospheric Administration, USA, further added that the tracking studies and the upcoming bycatch work in commercial fisheries should provide useful information for the government of Mauritania, potentially motivating discussions about turtle-friendly fishing gear changes.

Alexandre Girard from **Rastoma** presented an overview of the Central African Sea Turtle Network, which was created in 2012 and is supported by the French Global Environment Facility and IUCN (France-PACO). It covers 6 countries from Cameroon to DR Congo and has been growing since its creation, consisting now of 9 NGO members, 25 individual members and 6 Board members. He described the general objectives of Rastoma, their plan of action (e.g. priority issues are elected each year by members at meetings), dissemination of information through their website and Facebook, and exchange trips.

Cameroon: Isidore Ayssi from KUDU A TUBE, Cameroon, described the existent conflicts among NGOs in terms of defining their activities and areas of work. Rastoma is contributing to mitigate this conflict by providing a platform for collaboration among the NGOs for a unified view and goals, and to encourage the presentation of results.

Gabon: Jean Churley Manfoumbi from Ibonga-ACPE, Gabon, described the Partnership for sea turtle conservation in Gabon, composed of local NGOs, international NGOs and the government, and provided a summary of their work with sea turtles, particularly focused on the largest population of leatherbacks in the world, and the largest population of olive ridleys in the eastern Atlantic. Currently 80% of sea turtle nests in Gabon are within Protected Areas, the major threats to the populations are: bycatch, entanglement in ghost nets, beach erosion and development, poaching of eggs and animals, depredation by invasive species, presence of vehicles on the beach and washed up logs on the beach. Strategies include nest and in-water monitoring, survey of the impact of threats, providing management recommendations to the government, standardisation of methodologies along the coastline, and strengthening local capacity through beach patrols, genetic sampling, tagging, on-board observers in industrial trawlers, tracking studies, training for trawler crews on turtle rehabilitation, enforcement of TEDs in shrimp trawlers, necropsies of stranded animals and identification of the cause of death, implementation of hatcheries in risk areas, beach log removal, placement of beach panels, awareness actions, and employment of locals in monitoring and ecotourism.

The Gabon Blue project was also described; it is a government initiative to promote sustainable fisheries in Gabon, through the creation of marine protected areas (MPAs), guided by the information provided by the sea turtle conservation projects.

Following presentations, several issues were discussed:

1. Standardization of protocols

The need for standard data collection across projects was mentioned to ensure that data are reliable, so that the government can use the data for decision-making. However, it was also noted that sometimes standardization of methodology across projects does not work, due to the particularities of each project (geography, budget, resources, abundance of sea turtles, etc.), and ideally we should aim for standardizing results.

Key points:

- Within similar projects/across regions protocols should be simplified to facilitate standardization
- Data checking is a good practice to understand if protocols are being followed
- Protocols should be adapted locally
- It is important to first identify which data are needed so that data are comparable to other areas

- The SWOT minimum data requirements is a good place to start to design protocols
- It is important to identify biases in data

2. Population trends

In Gabon there are reliable data for over 18-year, and no clear trend is found for leatherbacks. In olive ridleys there is a 13% increase per year. In Guinea-Bissau the green turtle population is increasing, and there are not enough data to estimate abundance trends for olive ridley turtles or other species. The Cabo Verde population of loggerhead turtles has big fluctuations in abundance. In Ascension Island (South Atlantic) the green turtle population is also increasing. In general, abundance trends need yet to be assessed by many projects. At the next Africa meeting there will be a summary on abundance trends of nesting populations in Africa, compiled by the Marine Turtle Specialist Group.

3. Problems with estimating nesting population abundance

Several issues that make the robust estimation of population abundance difficult were mentioned. When counting nests to infer female numbers, one problem is assuming that all females have similar productivity, i.e. that they lay the same number of clutches, and have similar remigration intervals and survival probability. Analysing female survival contributes to better estimations, but it is very difficult in many projects due to typically low recapture rates, which can be the consequence of mortality and also of tag loss (flipper tags and PIT tags), failure in PIT tag readers (battery, depth of PIT tag), or missing recaptures due to high density or long coastlines.

4. Use of flipper tags and/or PIT tags

Because the application of tags is an invasive process it was argued that projects should first define their questions to decide if the use of tags is necessary, instead of tagging just because it is a current practice globally.

Key points to consider when deciding to tag should be:

- The duration of the monitoring (tagging) program
- Recapture rates of tagged individuals
- Will the data be analysed and results released?
- When working with fishers the use of external tags is more important (flipper tags)
- PIT tags have lower loss rates, but are more expensive
- Photo identification may be an alternative to tags in juvenile aggregations and small nesting populations

5. Changes in nesting numbers of less common species

In Cabo Verde in recent years changes in nesting numbers of less common species, i.e., green and olive ridley turtles, have been observed. Similarly, in Central Africa there has been an increase in green turtle nesting, and in Sao Tome of loggerheads. The observed changes may reflect environmental change, particularly climate change, or normal fluctuation events, or, on the other hand, may be a consequence of trained field teams being able to recognize other species, together with increased data collection. The take home message is that it is important to distinguish among these factors to make assumptions about nesting changes.

6. Implementation of hatcheries

It is essential to understand conservation needs and goals prior to the creation of a hatchery.

Key points:

- A protocol must be in place to collect reproductive (and other) data and these must be analysed
- Incubation temperature and moisture of clutches must be controlled
- The location must be carefully selected
- The success ratio of clutches *in-situ* and relocated nests should be compared
- Different treatments should be tested (e.g. sometimes instead of a hatchery it is best to simply relocate clutches to a different location within the same beach)
- Hatcheries should be used to incubate clutches throughout the season, not only during peak nesting

Other issues debated were the impacts of urbanization and need for regulations on coastal development, and the impacts of invasive species and management strategies (example of Sao Tome where nest enclosures can be the solution to stop predation by pigs, currently affecting an excess of 80% of the clutches).

Finally, it was agreed by all the participants that for the next Africa Regional meeting during the 39th ISTS, three priority issues should be selected in advance by email voting and debated at the meeting.



Ghana Moves to Increase Protection for Sea Turtles

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Ghana's 550 km of coastline provides significant foraging and nesting habitats for five species of marine turtles, including the critically endangered hawksbill turtle, *Eretmochelys imbricata*. Unfortunately, these animals face a significant number of anthropogenic mortality risks, which has led to the continued decline in their population. The Wildlife Division (WD) of Forestry Commission Ghana in collaboration with the Florida Gulf Coast University (FGCU), with support from the United States Fish and Wildlife Services (USFWS), and United States Agency for International Development (USAID) West Africa organized the first national sea turtle conference to bring together all relevant stakeholders for a holistic discussion on the existing and emerging challenges facing sea turtles. The conference also received support from A Rocha Ghana (ARG), ESL Consulting and Voltic Mineral Water Company limited. The initiative sought to build a common strategy to create a nationwide effort for protecting Ghana's sea turtles.

The one-day conference, held on 8 March 2018, at the Yiri Lodge, University of Ghana, Legon, Accra, brought together over forty participants from government organizations, research and academia, non-governmental organizations/civil society groups, fishing communities, hoteliers and industry, Diplomats (US State Department and USAID), and the media. The conference featured a keynote address, regional presentations, and targeted discussions.

A total of seven presentations were done during the morning of the conference comprising two from the government, three from NGOs, one from research and academia, and one from the industry (hoteliers). Discussions were held after each presentation to address major issues raised. The afternoon of the conference was used to hold discussions on broader topics such as (a) the major issues affecting sea turtle conservation in Ghana, (b) what actions are currently working and not working, and (c) what is the best way forward to increase sea turtle conservation in the country.



*Andrews Ahyekumhene moderating the conference
(Photo: Daniel Kweitsu Obloni).*

It was clear from the presentations and discussions that the conference was much needed to establish a coordination of projects by WD, and to harmonize sea turtle activities along the coast. Threats to sea turtles in Ghana identified and discussed at the conference are (a) intensive near-shore fishery by-catch, (b) direct harvest of nesting individuals and eggs, (c) increased nest predation by pig and dogs (d) degradation of nesting habitat along the coast of Ghana and (e) negative consequences of emerging beach-based tourism activities and unregulated conservation activities. Lack of monitoring and enforcement coupled with weak legislature were mentioned as underlying causes of the increasing illegalities to sea turtles.

Another issue that was stressed was the need for projects in Ghana to collect and provide long-term consistent data so Ghana can measure trends in the population of sea turtles and determine if the country is meeting its goal of increasing sea turtle populations through protection. It was highlighted that consistent long-term data is the only way to determine if a population is recovering. It was also mentioned that the global sea turtle community is currently working towards regional reports, which will be updated periodically to, among other things, contribute to initiatives like the IUCN Red Listing and formal conventions. Key challenges that hinder the regional reporting initiative, especially for West Africa, include gaps in data, the inconsistency of data collection by projects, and also the difference in data collection protocols used by the different projects. These make data incomparable among years and projects. The SWOT minimum data standard was therefore introduced and participants were encouraged to test their data collection protocols against the minimum standards recommended by SWOT, which is the most comprehensive data source on sea turtles in the world.

The outcome of the conference was a list of recommendations to the Executive Director of the Wildlife Division to help improve sea turtle conservation along the coast of Ghana. The recommendations are:

1. All individuals working on sea turtle activities in Ghana must, as required by the Wildlife Conservation Regulations 1971, LI 685, obtain a permit through the Wildlife Division (Forestry Commission). New projects should contact the local or regional Wildlife Division Office to immediately start the process of securing a permit before commencing their activities. Not only is this process required, but it also ensures that project activities are supported by the Wildlife Division to help meet the mission of managing Ghana's sea turtles. This will also help the Wildlife Division to monitor activities by all the projects in the country.
2. The need for a Sea Turtle Technical Team was strongly emphasized at the conference. The duties of the technical team will include the following:
 - a. review all permit proposals and make recommendations to the Wildlife Division
 - b. review activity reports from projects to ensure all projects follow the best management practices as defined by the international sea turtle society
 - c. seek funding for sea turtle conservation work in Ghana by writing proposals
 - d. assist sea turtle projects in Ghana to source funds for their conservation work
3. Participants recommended the setting up of a sea turtle conservation fund. The technical team would have, as part of their duty, to write grant proposals to seek financial support for projects on the country.
4. There was a request to set up a sea turtle data repository at the Wildlife Division. All projects are to contribute summary data to the repository within specific periods so the

Wildlife Division can maintain a national database for sea turtle activity. This will enable the Division to effectively monitor species trends and distribution.

5. There was the request for all projects to collect some basic data that will feed into the national database. An excel sheet with some guidelines is to be circulated later to all participants.
6. Wildlife Division is entreated to map all sea turtle project sites for effective monitoring.
7. Participants at the meeting requested the Wildlife Division to be more visible as the government authority on wildlife issues in the country. This is because some institutions and individuals currently mistake some NGOs as the authority on wildlife conservation issues in Ghana. A common confusion is between the Wildlife Division and the Ghana Wildlife Society.
8. To improve communication among all groups, and help build collaborations, a communication platform was recommended which includes all sea turtle projects along the coast of Ghana. Both <google group> and <what's app> applications were recommended to allow participants and members to communicate amongst themselves. A <google group> has been established and is open for anyone to join at: <https://groups.google.com/forum/#!forum/ghanaseaturtles>. The <what's app> group is also established for active sea turtle projects to be able to discuss field issues requiring immediate attention.
9. Participants expressed the need for a second Ghana National Sea Turtle Meeting to help deliberate on follow-up issues in the sea turtle community.



*Group photo of participants at the conference
(Photo: Daniel Kweitsu Obloni).*



Artisanal Fisheries Still Represent a Significant Threat to Marine Turtles in Mozambique

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The Mozambican coastline harbours important feeding and nesting grounds for marine turtles, mostly greens (*Chelonia mydas*), hawksbills (*Eretmochelys imbricata*), loggerheads (*Caretta caretta*) and leatherbacks (*Dermochelys coriacea*) and to a lesser degree olive ridleys (*Lepidochelys olivacea*) (Hughes 1971; Louro 2014; Pereira and Louro 2017; Fernandes *et al.* 2017).

Despite the existence of strong legislation protecting marine turtles as well as local advocacy and awareness efforts, poaching of marine turtles in Mozambique is still occurring at alarming rates (Williams *et al.* 2016; Williams 2017; Pereira and Louro 2017; Fernandes *et al.* 2017). Turtle meat and eggs are harvested for consumption or traditional medicine. In addition, carapaces are used to make souvenirs or sold in flea markets.

Memba and Nacala-Velha districts are considered some of the most important fishing areas in the northern part of the country (Viagem 2015; Pereira *et al.* 2018). According to the last national artisanal fishing census, Memba district has approximately 6,481 artisanal fishers, with about 80% operating from vessels, whereas hand-line and gillnet are the most common fishing gears (IDPPE, 2009). Maputo Bay sustains the second most productive fisheries in the country (Hoguane 2007; Paula and Bandeira 2014) with approximately 7,774 artisanal fishers, of which 75% operate from vessels (IDPPE, 2013). A total of 237 fishers are registered within the fishing centres at Inhaca Island with the most common fishing gears being gillnets, hand lines, beach seines, boat seining and stake nets (aka “gamboa”; IDPPE 2013).

Here, we report several marine turtle poaching incidents at three locations: Memba and Nacala-Velha, Nampula Province (northern Mozambique) and Inhaca Island, within the Ponta do Ouro Partial Marine Reserve (POPMR), Maputo Province (Fig. 1).

A field visit to Nampula Province took place from 16 to 19 October 2017 and included interviews with three small-scale traders from Wamualo market, a waiter from Hotel Napela (Nacala-Velha), as well as five fishermen from Nachiropa and Nantaca beaches (Memba).

In Memba, marine turtle poaching is mainly conducted by artisanal fishers, including spear fishers, as well as other people who look for nesting female and eggs at night between Mukombo and Nantaca beaches (Agostinho Cardoso, Memba Community Fishing Council, *pers. comm.*). According to local fishers, turtles are mainly taken for their own consumption or to be supplied to restaurants or lodges. Green turtle meat is sold openly at the price of 100.00 to 150.00 Meticaís per kilogram (USD 1.67–2.5). Certain restaurants will reportedly even take pre-orders for turtle dishes.

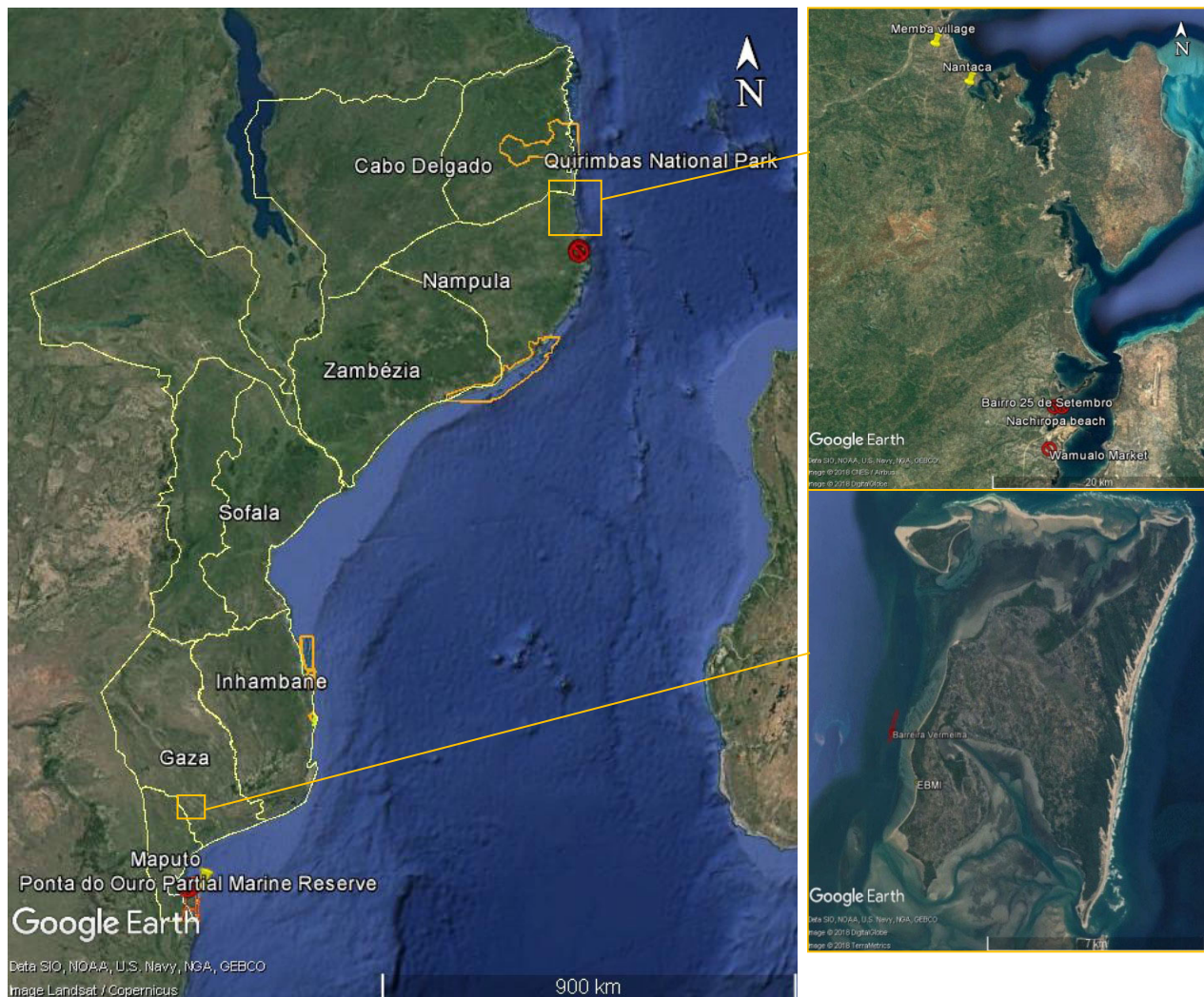


Figure 1. A) Location of marine protected areas in Mozambique (orange) and provinces. Details of the main sites where turtle carapaces were found in Memba and Nacala-Velha (B) and Inhaca Island (C).

Evidence of marine turtle poaching was found at Nacala-Velha, where three green turtle carapaces were in the possession of locals at the Wamualo Market (CCL = 39 cm and CCW = 19 cm), within a household at Bairro 25 de Setembro (CCL = 41 cm and CCW = 23 cm) and at Nachiropa beach (CCL = 44 cm and CCW = 27 cm; Fig. 2). According to local people, these are the most critical locations for turtle poaching and meat trading. Carapaces are not sold, as they hold no market value; they are usually disposed off within mangrove forests. This practice was also reported in the Quirimbas National Park (Pereira and Louro 2017). The Fishing Community Council of Memba recognizes that fishers operating in the region are aware of the legal status of marine turtles. However, turtle poaching has been taking place continuously because there is significant demand for marine turtle meat from local restaurants. Additionally, there is a need for education and awareness about marine turtle biology and conservation. A fisher from Nachiropa, claimed: “I don't know why the consumption of marine turtles meat is forbidden. They lay so many eggs!”

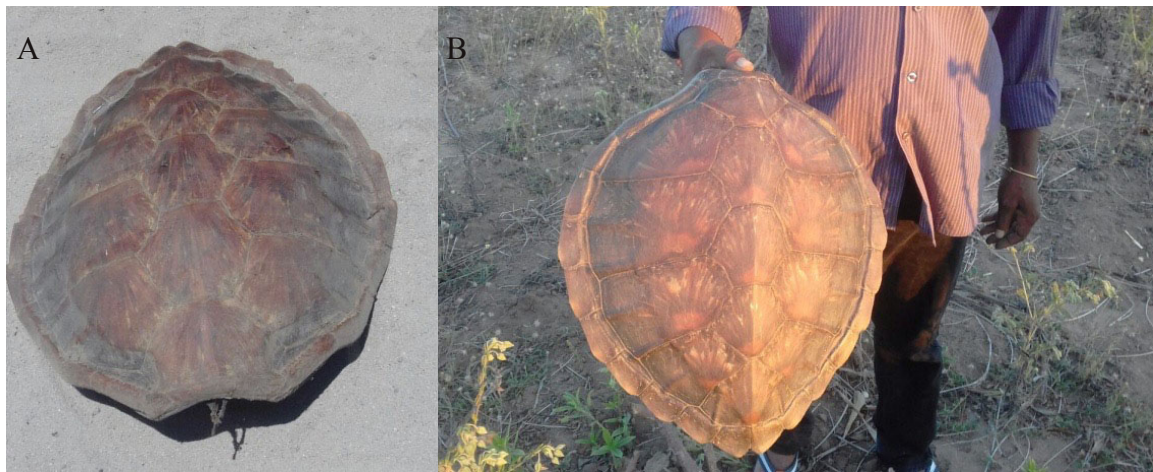


Figure 2. Green turtles poached in Nampula province. A) Carapace photographed at a household at Bairro 25 de Setembro - Nacala-Velha; B) Carapace found in the mangroves at Nachiropa beach Memba (Photo credit: Carlos Litulo).

On 15 November 2017, during a training exercise, rangers from the POPMR found one juvenile green turtle entangled in a bottom gillnet near the Barreira Vermelha Sanctuary. The turtle was released alive successfully (Fig. 3).



Figure 3. Juvenile green turtle found entangled in a bottom gillnet near the Barreira Vermelha Sanctuary, Ponta do Ouro Partial Marine Reserve and later successfully released (Photo: courtesy of the Ponta do Ouro Partial Marine Reserve).

Additionally, 13 carapaces and some bones were found near an artisanal fishing camp close to the Marine Biological Station (Fig. 4). The carapaces were identified and totalled 11 green turtles (average CCL = 35.5 cm \pm 8.4 and CCW = 27.5 cm \pm 6.1) and two loggerheads (average CCL = 77.5 cm \pm 4.9 and CCW = 69 cm \pm 4.2). The main culprit was identified and fined 72,000.00 Meticaís (~1,200 USD) according to the Conservation Law (Law 5/2017 of 11 May; Paulo Gonçalves POPMR Park Warden, *pers. comm.*). The case is currently being prosecuted within the Maputo City Court. Local fishers revealed that the meat is locally consumed and no further evidence of meat trade was found.



Figure 4. Marine turtle carapaces found near an artisanal fishing camp at Inhaca Island, Ponta do Ouro Partial Marine Reserve (Photos: courtesy of the Ponta do Ouro Partial Marine Reserve).

These data suggest that marine turtle poaching by artisanal fisheries is still a significant, widespread, and frequent threat to marine turtles in Mozambique. The case of the turtles poached at Inhaca Island causes even more concern – the first ever marine turtle monitoring and conservation program in Mozambique was established at Inhaca in 1988. The POPMR as well as the Biological Station have been very active with regards to awareness and education about marine turtles and marine conservation in general.

While there is definitely a pressing need for more education and awareness, the widespread phenomenon of turtle poaching in Mozambique seems to be increasingly associated with poor enforcement by authorities. Therefore, awareness campaigns and targeted training for local authorities are urgently needed in order to tackle this ever-present threat to marine turtle conservation in Mozambique.

Acknowledgements: Paulo Gonçalves and Vicente Matsimbe from the Ponta do Ouro Partial Marine Reserve are thanked for supplying information and photographs. We also would like to acknowledge Domingos Cardoso, President of the CCP of Memba, and José Cossa for support during the fieldwork.

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Marine Debris and Sea Turtle Awareness in Somalia

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Marine debris impacts a substantial number of migratory marine wildlife including many species of birds, sea turtles, sharks and marine mammals. Marine debris related mortalities most commonly occur as a result of ingestion or entanglement. In many developing countries, including Somalia, efforts need to be made in upstream locations from where marine debris enters the marine and coastal environment.

In recognition of the importance of providing outreach and marine conservation communications to local communities in Somalia, an awareness event was held on 8 April 2018 focusing on the impact of marine debris on marine ecosystems and the importance of sea turtle conservation. In Somalia, sea turtle products are traded widely and fetch high prices: one egg sells for USD 1; oil per litre sells for USD 20; a carapace of a juvenile hawksbill sells for USD 25; sea turtle meat per kilogram sells for USD 3; a dried sea turtle penis sells for USD 50; and a small juvenile carapace for decoration of offices and houses sells for USD 10.

The objective of the event was to raise awareness in the local community as well as among coastal fishers, local fishery associations, community-based organizations and university researchers working in the field of marine conservation in Somalia. This was an initial step for Somali citizens to become aware of marine debris and the importance of cleaning and protecting beaches of Mogadishu as well as the entire coastal habitats of Somalia. It was the first time that such an event was held in Somalia and it was supported by the Society for Conservation Biology.

In order to mobilize many people for the event, key stakeholders from and around Mogadishu city and residential beach areas came together on 23 March 2018 to discuss the organisation and implementation of the event. Stakeholders included the Ministry of Fisheries and Marine Resources of Federal Republic of Somalia, Darul Hikma University, Somali Integrated Fishing Organization (SIFO) NGO, and HIBO (umbrella organisation of fishing cooperatives).

It was agreed that a public notice would be installed at the site behind Dan Kulmis fisher association at Liido Beach, Mogadishu, for outreach and communications purposes. All stakeholders agreed that the key messages should focus on sea turtle protection and plastic pollution. The messages were printed on both sides so that they could be viewed from either the beach or the fish market.



Banners at front of public beach (Photo: Mohamud Hassan Ali).

Activities on 8 April 2018 included:

- Engaging youth and fishers at the beach and introducing linkages between a healthy environment and healthy people
- Collection and burning of illegal fishing gear
- Youth outreach on plastic pollution at the beach
- Raising awareness on the importance of sea turtle conservation and protection

The event was a great success and it was agreed that 8 April each year should be designated as a Marine and Coastal Conservation Day in Somalia. An annual Marine and Coastal Conservation Day will be used to raise awareness with both public and private sectors for the formulation of Beach Management Units (BMUs) in all coastal towns of Somalia.



Burning of illegal fishing gear (Photo: Mohamud Hassan Ali).

The longer term goals are to extend educational and awareness raising programmes through national stakeholders for the preparation of a draft National Policy on Plastic Imports using a fully participatory approach to ensure harmonization with other national policies. The second goal is to ratify legally binding international instruments in the country. The formulation of the Honolulu Commitment and the Honolulu Strategy provide a framework for a comprehensive and global effort to reduce the ecological, human health, and economic impacts of marine debris. There are many other regional and international instruments addressing the issue of marine debris, which can support Somalia to achieve this goal.



Bycatch of Sea Turtles in Artisanal Fisheries along the Mauritanian Coastline

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In Mauritania, sea turtles are accidentally caught in artisanal fisheries, which have experienced rapid development over the past two decades (Meissa 2013). Generally speaking, the exploitation of marine resources is an activity of relatively recent origin in Mauritanian waters. In the past, only the native Imraguen population in the North and the Wolof population of N'diogo present in southern Mauritania lived near the sea utilizing marine resources on a daily basis (Ould Mohamed 2010). However, currently the Mauritanian coastline is experiencing big population growth and marine resources are being exploited both by local and international fisheries to supply the needs of not only the Mauritanian population, but also that of the world. It has been recognized that fishing efforts are increasing in coastal areas as the global human population continues to grow (Stewart *et al.* 2010).

Mauritanian waters are currently exploited by the Mauritanian semi-industrial, industrial and artisanal fleets, foreign artisanal (dominantly Senegalese), and industrial fleets from the European Union, Eastern European countries (Bru and Hatti 2000) as well as Japanese, Chinese and Korean fishing fleets (Josse and Garcia 1986; Meissa 2013). In 2014, authorized national fleets comprised 5,564 artisanal crafts mainly targeting demersal and small pelagic species. In 2015, as part of an experimental fishing program, 29 additional artisanal crafts were authorized to use gillnets for catching lobsters (Abdel Hamid and Ould Isselmou Braham 2015). As for the Senegalese fleet, in 2014 it consisted of 300 authorized coastal crafts (Abdel Hamid and Ould Isselmou Braham 2015). We can assume that the activities of these fleets are not without consequence on the marine megafauna, which also include sea turtle species present in Mauritanian waters. Increasing fishing efforts have had harmful effects on marine ecosystems worldwide (Jackson *et al.* 2001), and accidental capture by fishing gear is known to be one of the most serious threats to sea turtle populations (Lewison *et al.* 2004). Thus, the fishing activities seen in Mauritania are of obvious concern for sea turtle survival.

Survey of fishermen: This work was based on an interview-based survey conducted with fishermen and the local native population. During the interview survey, we used a photo album, which contained all sea turtle species in their different life stages. This album was presented to all of the participants with the aim of identifying the species they usually encounter. The interview was conducted during September and October 2016. We visited 6 villages (M'Hejratt, Balawakh, Tiwilit, Lemcid, PK28, and N'Diogo), one fishing camp (Limam), the artisanal port of Nouakchott, and the Nouakchott fish market (Fig.1). We interviewed 54 fishermen, of which 47 were Mauritanian (belonging to the Wolof, Pulaar and Maure ethnical groups), five were Malian and two were Senegalese. The age of the interviewed fishermen ranged from 18 to 50.

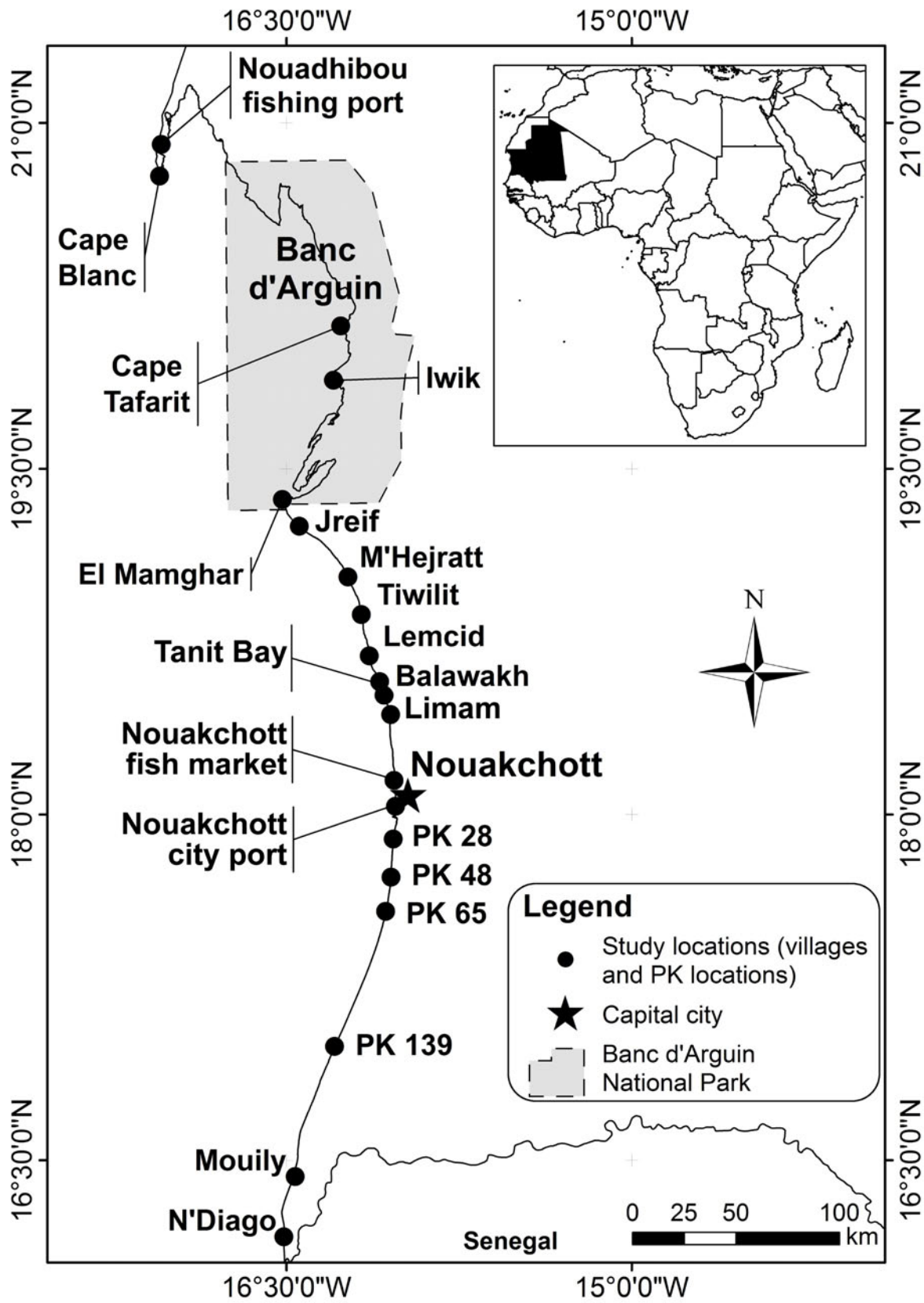


Figure 1. Map of the Mauritanian coastline showing the study locations marked as black spots with their designated names.

Fishing represents a source of food for traditional native fishermen, whereas it is a source of income for professional fishermen. Our six-page-long questionnaire proved to be time consuming because it required over an hour per participant. We therefore had to limit ourselves to gathering the most essential information such as:

- 1) General information about fishermen (their origin, age, profession, etc.)
- 2) Information about their fishing season (length and months of the year) and fishing area
- 3) Information about fishing gear used (net length, net material and mesh size)
- 4) The average amount of time their nets are left in the sea
- 5) Number of men in their canoes/pirogues
- 6) Horse power (hp) of their outboard motors
- 7) Whether their fishing activities were diurnal or nocturnal
- 8) The annual number of turtles caught and the turtle species
- 9) The approximate size of turtle individuals
- 10) What the fishermen usually do when they untangle the sea turtle from their net
- 11) Their estimate of whether there are more or less sea turtles today compared to numbers seen in the past
- 12) Whether they knew that sea turtles are protected by Mauritanian law and that it is forbidden to eat sea turtle meat, fat and eggs.

We also asked a question about their knowledge of seagrass area locations and the location of their targeted species, and accidental capture of sea turtles.

All of the interviewed fishermen used 9 - 22 m long canoes with engine power ranging from 15 to 60 hp, with 15 hp being the most common. During fishing activities, each canoe/pirogue had between 3 and 30 people on board. The length of the fishing nets used varied from 50 - 200 m with an unknown mesh size because the fishermen were reluctant to share this information. Even though 70% (n = 38) of the fishermen did not want to disclose the information about the time of the day during which they conducted their fishing activities, 28% (n = 15) reported that they fished during the day, whereas only 1 individual (2%) claimed to fish both during the day and at night. The amount of time the nets were left in the sea varied from 6 hours up to 2 days depending on the targeted species, season and the fishing area. If a turtle was trapped during this period, there was a slim chance that it would survive because the diving time of sea turtles is much shorter than the net recovery time, and survival is further reduced during forced apnea (Lutcavage and Lutz 1997). Fishing is allowed and conducted in all areas between N'Diogo in southern Mauritania and the southern border of Banc d'Arguin National Park (PNBA; Fig.1). In rare cases, fishermen secretly enter the PNBA area to fish despite the risk of pirogue confiscation and financial penalties. Thus, even though the fishermen avoid going into the PNBA area, they have still not been completely banned.

Bycatch: Our interviews with the fishermen revealed that all the fishermen know about the existence of sea turtles. In particular, they knew about the presence of the most frequently encountered species, green turtles, *Chelonia mydas* (Mint Hama *et al.* 2013) and leatherbacks, *Dermochelys coriacea*. Our survey revealed that depending on fishing area and fishing season, between 2 and 50 sea turtles can be annually caught by one pirogue. Among the interviewed fishermen, 20.4% (n = 11) annually caught ≤ 10 individuals, 14.8 % (n = 8) caught ≤ 20 individuals and 7.4% (n = 4) ≤ 50 individuals, while the remaining 57.4% (n = 31) fishermen refused to provide an answer or estimation about their annual sea turtle catch.

It is worth noting that according to the fishermen, a considerable accidental catch exists as the result of using different artisanal fishing gear. During our interviews, they also admitted to a significant numbers of voluntary sea turtle catch. However, because these numbers are derived from the fisherman’s evaluations, we should acknowledge their bias in conveying such information. Thus, these results should be interpreted with a certain measure of caution. Also, it is worth noting that the fishermen showed a lot of hesitation when answering our questions. According to the fishermen, their estimation is that turtles are caught on a daily basis, but they also said that they sometimes catch several turtles at once, and sometimes they do not encounter even a single turtle during the whole year. Even though most of them avoided talking about catching turtles, two of the interviewed fishermen admitted to voluntarily hunting for sea turtles. This is not unusual in an area where people recognize everything that comes from the sea as edible and consider sea turtle meat healthy and useful for many things. Thus, they admitted having eaten sea turtle meat or eggs at less once during their life. The interviewed fishermen seemed to know the locations where sea turtles can be easily found. Moreover, one of the fishermen from M’Hejratt village described a rocky area where sea turtles of various sizes could be encountered (Fig. 2). The other interviewed fishermen mentioned Tiwilit, M’Hejratt, Jreif, Tânit bay, Banc d’Arguin National Park, Mamghar and Iwik (Fig.1) as areas rich both in seagrass and sea turtles.

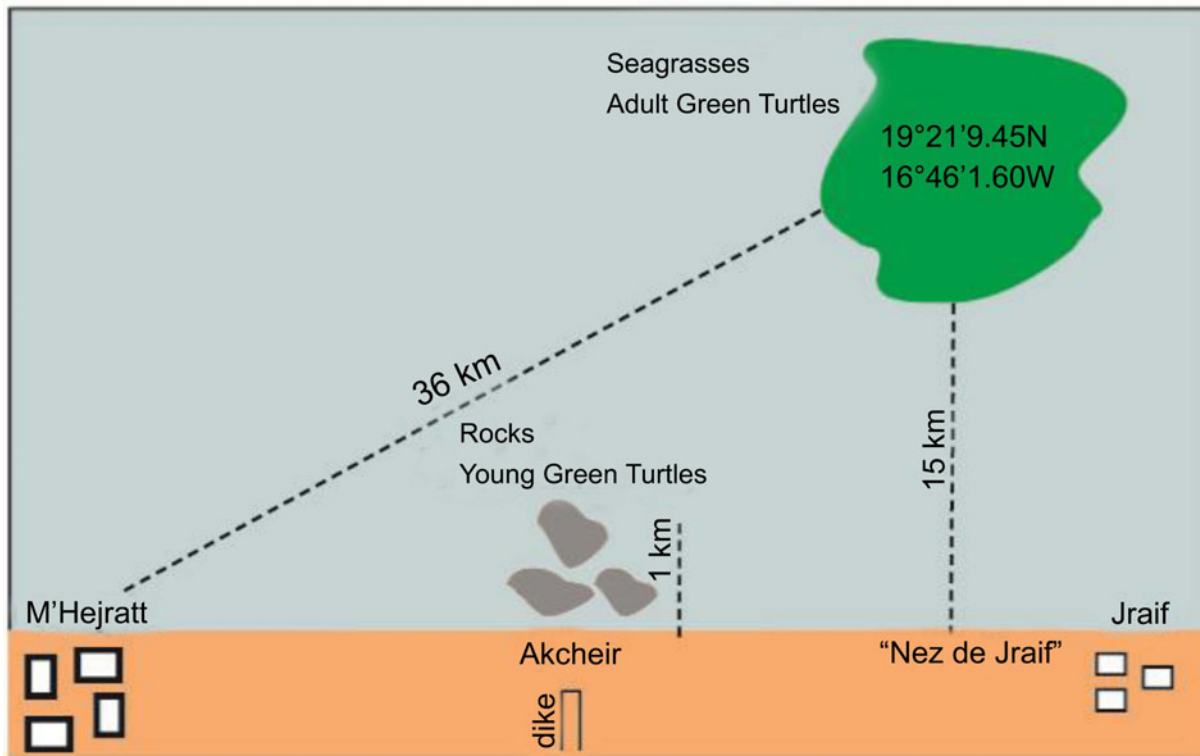


Figure 2. Sea turtle catch areas indicated by the fisherman from M’Hejratt.

What happens to turtles untangled from the fishing net? Depending on the fisherman, when a turtle is trapped in the net it can be: 1) released back into the sea (usually large-sized turtles, which may damage their fishing gear), 2) brought alive to the village and subsequently slaughtered, or 3) slaughtered and consumed in the canoe/pirogue while the carapace, viscera, head and the rest of the turtle’s body are tossed back into the sea. This way the poachers cannot be caught by the Maritime police and cannot be brought back to the village for confiscation of other captured turtles.

This would explain numerous green turtle carapaces, parts of viscera and flippers that we often observed along the beach and in areas near the villages (Fig. 3). However, 61% (n =33) of the interviewed fishermen did not want to answer this question in fear of having problems with the authorities.



Figure 3. Carapaces of green turtles found along the Mauritanian beach (© J.Fretey).

The fishermen claimed that turtles are attracted to the hooks by the fish baits attached to them. Nonselective nets such as squid nets, fixed or encircling gillnets (locally called “filet courbine”) and the legally prohibited monofilament nets are frequently observed discarded along the beach (Fig. 4).



Figure 4. Monofilament nets observed along the Mauritanian coastline (© L. Hama and M. Wagne).

In addition, the fishermen noticed that ropes of octopus pots resulted in leatherback bycatch. This species has been observed “playing and turning” around these ropes until they get entangled. Some stranded leatherbacks were seen to have a rope wrapped around their neck (Fig. 5; right picture).



Figure 5. Loggerhead with an ingested fishing hook (left) and a leatherback with a rope wrapped around its neck (right) (© F. Dovilliez, L. Hama and M. Wagne).

According to our investigation, all of the nets used by Mauritanian artisanal fishermen catch sea turtles at different rates. During our fieldwork, we often found stranded (dead) loggerheads and green turtles on the beach with parts of a fishing net or hook in/on their body (Fig. 5 (left); Fig. 6). These cases testify to the impact of fisheries on sea turtles along the Mauritanian coastline. Thus far, nothing has been done to reduce the negative impact of fisheries on sea turtles in Mauritania. Given that our evaluation of sea turtle bycatch in Mauritania is based on information collected from fishermen, we should work with national authorities to introduce on-board observers on industrial and artisanal fishing boats who would record accidental sea turtle bycatch. Based on previously collected information, it is clear that sea turtle bycatch persists and presents a possibly significant negative impact on sea turtle populations in Mauritania and West Africa (Fretey and Mint Hama 2012; Hama *unpublished data*).

Awareness of Mauritanian laws prohibiting intentional take of sea turtles at sea and on land: Most of the interviewed fishermen (57.4%; n= 31) refused to answer this question, whereas 38.9% (n = 21) said they knew about the legislation protecting sea turtles and are aware of problems that plague sea turtles from watching TV documentaries. The remaining 3.7% (n = 2) fishermen claimed not to have known about the existing legislation protecting sea turtles in Mauritania. Even when fishermen agreed to answer our questions, they were often careful about the information they provided. They claimed to care about marine resources, including sea turtles, and said they would stop or decrease the exploitation of some species if their overall financial situation was better. Some fishermen seemed to speak openly, whereas others seemed to distrust the reason for the interview because they know that sea turtles are protected by law. Sometimes the interviewed fishermen contradicted themselves. They claimed never to have captured sea turtles, and then later admitted to annually catching a

certain number of turtles. Interestingly, from our interviews it seemed that older fishermen (>50 years of age) seemed to be more aware of the threats impacting sea turtles in Mauritanian waters. Although the number of turtles visiting/inhabiting Mauritanian waters and nesting beaches is still unknown, some fishermen (<50 years of age) reported that sea turtles are numerous, but far less numerous than in the past because of overfishing, industrial fishery activities and noise emanating from fishing gear and big boats. In contrast, 4% (n = 2) of the interviewed fishermen thought that the number of turtles was increasing, whereas 13% (n = 7) thought it was decreasing year after year. The remaining 83% (n = 45) of the interviewed fishermen did not have an opinion.



Figure 6. Immature stranded Chelonia mydas individual entangled in a fishing net (© J.Fretey).

Conclusions: Data from our first sea turtle bycatch investigation shows that sea turtles are often caught accidentally by fishermen in almost all of the fishing nets used. The lack of data and strict supervision of the Mauritanian coast and fisheries are the main causes behind these activities. We suggest focusing additional attention on the education of fishermen, the native/local population inhabiting the Mauritanian coastline, and Mauritanian institutions to actively contribute to the protection of sea turtle species. Mauritanian institutions should be continuously informed of the real problems these species encounter in Mauritanian waters and how they impact the population of sea turtles in other areas of West Africa and across the Atlantic. It is also necessary to revise the regulation of fishing areas and fishing gear used by fisheries in order to reduce sea turtle accidental catch.

Acknowledgments: This project was funded by the US Fish & Wildlife Service (Marine turtle Conservation Fund) (Number F15AP00844) and the Federal Government Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit; GIZ).

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**This newsletter is supported by
Ocean Ecology Network, Inc. and John Dutton Productions**



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