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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.

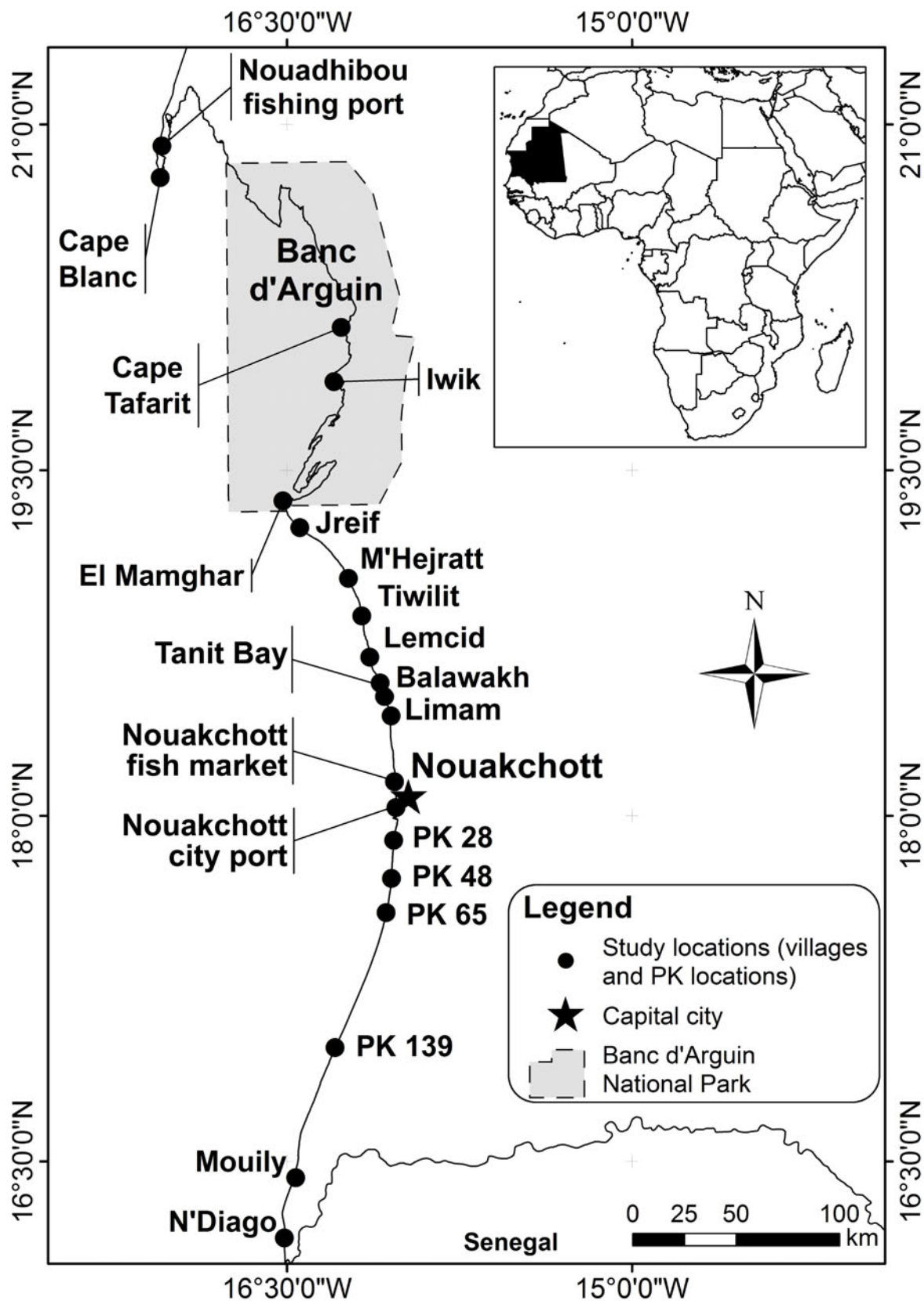


Figure 1. Map of the Mauritanian coastline showing the study locations marked as black spots with their designated names.

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.

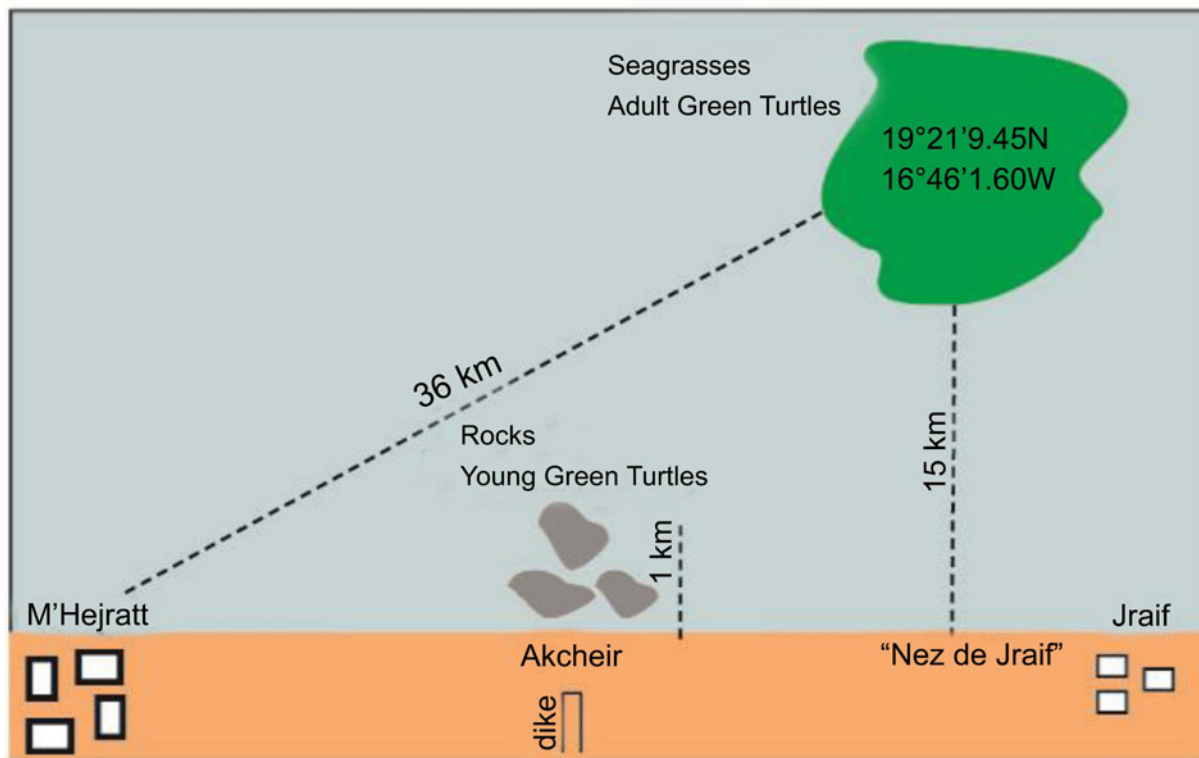


Figure 2. Sea turtle catch areas indicated by the fisherman from M'Hejratt.

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.

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