Marine Turtles of the Primeiras and Segundas Islands

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Introduction

Marine turtles represent a primeval component of the biological diversity of marine ecosystems. It is believed that during the Jurassic period marine turtles were abundant in tropical and sub-tropical waters (Frazier, 1999). It is further believed that the long-term survival of these marine species is at great risk (Van Dijk e Shepherd, 2004). For the past 200 years, the marine turtles' ability to maintain their existaance has faced ever-increacing threat (Lutz & Musick, 1997), because of both natural and anthropogenic factors, although the consequences of the latter are more difficult to reverse. A large proportion of the marine tutle population throughout the globe have been on the decline, and some even led to extinction (Lutz & Musick, 1997).

The inclusion of marine turtles in the list of animals threatened with extinction is a result of o history of exploration. These species are bear the particular characteristic of inhabiting diverse marine and coastal habitats that traverese national boundries, thus their protective status under international treaties. These species are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which places them under Appendix I, which prohibits trading the species with any signatory nation. In

2002, The IUCN Red List of Endangered Species included all marine turtle species in the category of globally endangered species.

As mentioned above, these species occupy different habitats in order to complete their life cycles. Females that are more than 20 years old lay approximately 1500 eggs in clean, sandy beaches where there is minimum disturbance. Once the eggs hatch, the baby turtles head towards the water and migrate to non-polluted areas of algae, coral reef and deep-water where they find abundant food (Witham, 1995).

Marine turtles form a component of a complex ecological system, to the extent that their survival depends upon resources of the sea such as fish, invertebrados and conchas, that are also sought by humans (Carr *et al*., 1978). Extensive ocean areas must be protected in order to preserve these species. The value of the sea turtle is immesurable. They are not only of cultural, economic and ecological importance, but crucial idicators of the state of conservation of both the marine environment and the coastal zones (Pilcher, 2001).

These species have long been regarded an economic and cultural resource of the communities residing along the coast. Parts of these species, such as flesh and eggs, are consumed as a source of protein and the shells are made into ornaments and utencils (Costa e Motta, 2006). The chief threat to marine turtles is accidental capture. They commonly appear as the by-catch in beach seines, longlines and gill nets. They are also hunted, either harpooned in the sea or captured as they lay their eggs on the beach. The dissappearance or degradation of nidification beaches, either from erosion or sea-level rise, further diminishes the sea turtles' numbers (Ackerman, 1980).

The Green turtle inhabits coastal waters, in seaweed beds, coral reefs and mangroves. The species is an herbivour, feeding on seaweed and other sea vegetables. The Hawksbill turtle, on the other hand, dwells in coral reefs and feeds on sponges and other invertebrata. Finally, the Olive Ridley turtle, often found on beaches with little or no vegetation, feeds in shallow waters (Mrosovsky, 1983).

It is estimated that between 20,000 and 30,000 marine turtles are inadvertently killed every year in the United States, usually the by-catch of shrimp trawls. In Mozambique's Sofala Bank, an average of between 0.8 and two turtles are killed. Yearly estimates of the Sofala Bank's marine turtle by-catch ranges from 1,932 to 5,436 (Gove et al., 2001).

Mozambique is home to six species of marine turtle, namely the Green turtle (*Chelonia mydas*), the Hawksbill (*Eretmochelys imbricata*), the Olive Ridley (*Lepidochelys olivacea*), the Leatherback (*Dermochelys coriacea*) and the Loggerhead (*Caretta caretta*). These species are distributed throughout the 2700 km oand diversity of habitats of the courty's coast (Figura 1), from the northern coral reefs to the undulating dunes of the south and the marshland in between. of the desde recifes de coral na zona norte, zona pantanosa no centro e por fim dunas parabólicas no sul. The nature of these coastal habitats provides for specific nidification areas for all of the aforementioned species (Figure 2) (Costa *et al*., 2007).

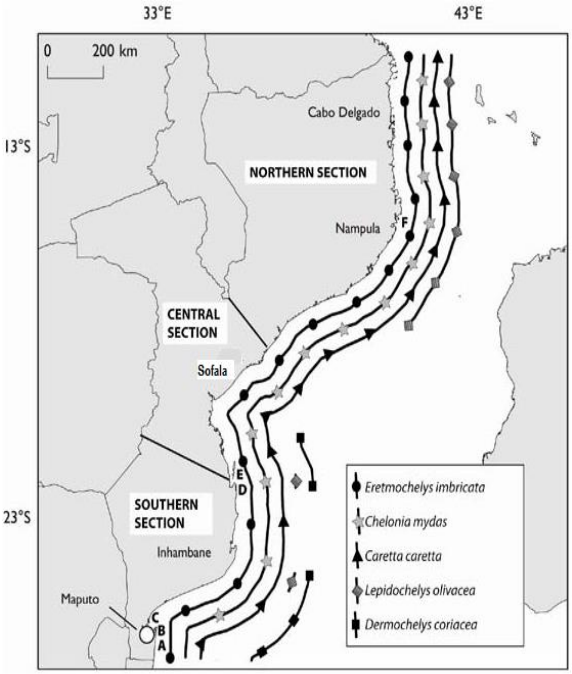
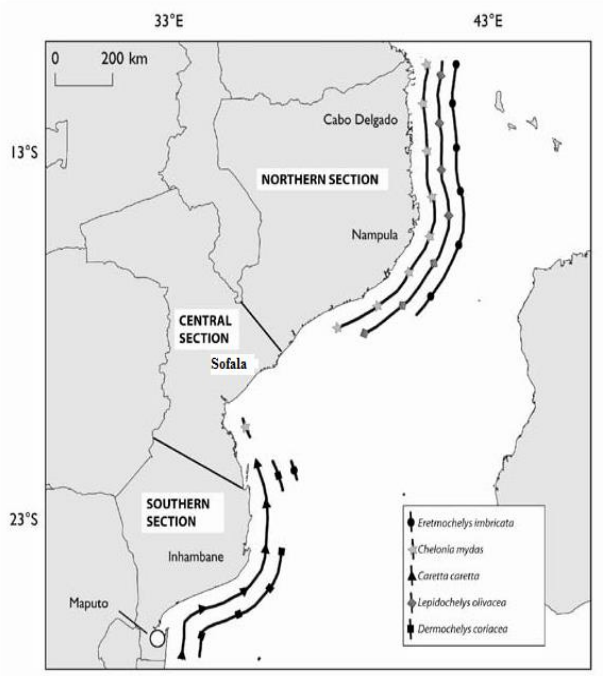


Figure1: Geographic distribution of the five species of marine turtle found in Mozambique



Sourse: Costa et al., 2007

Figura 2: Spawning areas of the five marime turtle species found in Mozambique

Certain southern central and northern areas of the country contribute directly to the conservation of marine turtles through protected habitats. Such is the case with the Maputo Special Reserve, the Bazaruto Arquipelago National Park and the Quirimbas National Park. The Primeiras and Segunds Islands of the north, extending from the coast of Angoche, in Nampula province to Pebane, on the Zambézia coast, benefit from local programs for the protection of these species, though the area has not to date been officially declared a protected one. With the greatest concentrations of the country's Gree, Hawksbill and Olive Ridley turtles, these areas make a significant contribution to the development and conservation of these species.

There are no reliable estimates of the number of marine turtles in Mozambique's waters, but this number is thought to be in decline. Among its causes was the destructive pressure of large human migrations to the coast during the country's civil war, an increace in the number of fisheries since independence, infrastructure construction in sensitive in fragile coastal habitats, destruction and erosion of nidification beaches and a poorly-managed expansion of tourism along the coast that has attracted building activities along the the dunes and 4 X 4 traffic in areas where turtles spawn (Gove e Magane, 1996). These activities also encourage the capture of turtles and their eggs for human consumption, destruction of their nests and the use of turtle shells for adornment and medicinal/magical purposes (Gove e Magane, 1996).

All five referenced marine turtle species are under threat of extinction and protected under Mozambican law. This legislation includes article 37 of the Constitution of the Republic, the Rugulation Law of Forests and Wildlife through decree 12/2002 of June 6, the Sport and

Recreational Fishing Regulation of decree 51/99 of August 31, the Law of Environmental Policy of decree 20/97 of October 1, the Regulation on the Assessment of Environmental Impacts of decree 45/2004 of October 17, and the General Marine Fisheries Regulation of decree 43/2003 of December 10 (Louro *et al.*, 2006).

The present study provides the results of a rapid assessment of the current situation faced by marine turtles in the Primeiras and Segundas Islands Archipelago, especially in the Moma and Angoche districts. O presente trabalho descreve os resultados de uma avaliação rápida da situação presente da tartaruga marinha na zona do Arquipélago das Ilhas Primeiras e Segundas, mais especificamente nos Distritos de Moma e Angoche. The study limits itself, then, to the Segundas Islands Archipelago, where it sets out to estimate and assess the number of species in the area, its state of conservation and utilization, and proposals for monitoring and management efforts.

Objectives

A rapid assessment was conducted in the Archipelago of the Segundas Islands with the following objectives:

- Identify the distribution of spawning areas, accidental capture rates, species abundance and the degree of protection enjoyed by the marine turtles of the Angoche and Moma coast in the Province of Nampula;

- Identify by-catch levels of marine turtles and the degree of interference by the various fishing methods during spawning periods, in Angoche and Moma;

- Estimate abundance (density) of marine turtles during spawning periods, along the Angoche and Moma coast;

- Evaluate the efficacy of measures to protect marine turtles and perceptions on the part of the people of conservation measures in Angoche and Moma; and,

-Encourage the marking of marine turtles found spawning or accidentally captured in fishing nets.

Methodology

Methods

<u>Frequency with which Artisenal Fishermen Encounter Marine Turtles</u>

The region's artisenal fishermen were interviewed in a semi-formal manner. To obtain information about the distribution of species and estimates of the abundance of marine turtles, the PLEO (Specialist Opinion Inference) was employed (Van der Hoeven *et al.*, 2004). The interviewer questioned experienced fishermen (minimum five years) in particular areas in order to calculate species density in a given area on the basis of a semi-structured inquiry.

To allow for a low-cost coverage of the surveyed area, a stratified random sampling method was employed (Baloi *et al.*, 1999). Fisheries closest to one another (Figure 3) having similar characteristics were grouped in strati. Accordingly, the Moma and Angoche districts were each divided into seven strati, some of which corresponded to one, two or three fisheries in keeping with the methodology of Baloi *et al.* (1999) for the studying of artisenal fishing. Nine to ten fishermen were interviewed in each stratum.

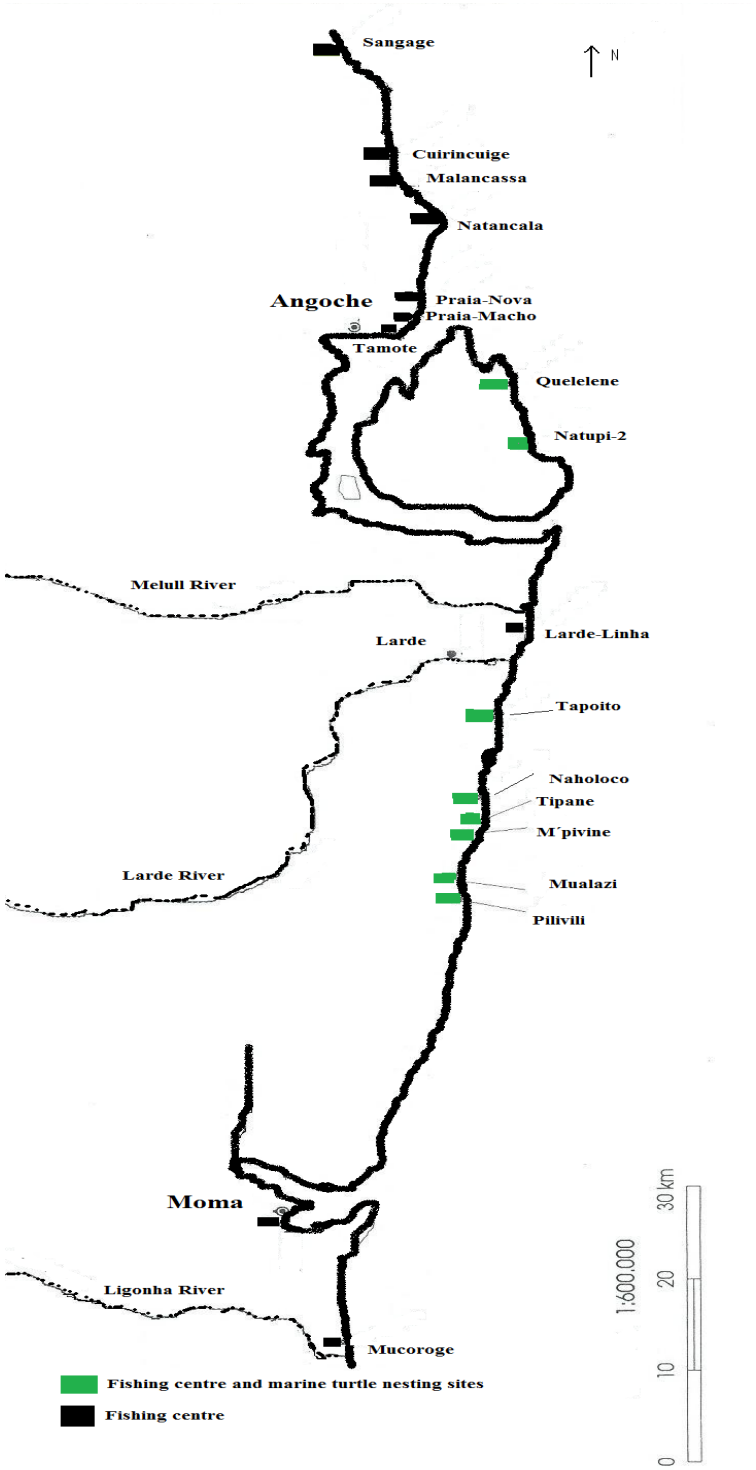


Figura 3. Fisheries along the Districts of Moma and Angoche

Turtle spawning areas

Fisheries outside of marine turtles spawning areas

Accidental Capture Estimate in Fishing Nets

Nine to ten fishermen were interviewed at each fishery center that utilized beach seines and gill nets. The average capture rate for turtles was measured for the summer months. Summer has a duration of six months (October to March, 182.5 days); therefore:

$$\text{Average daily capture} = \frac{\text{Nº of captured turtles}}{\text{Net (fishing method)/dia}}$$

Turtle captures/net (fishing method)/year = Average daily capture/net (fishing method) x 182.5 days

Monitoring

The marking (or tagging) of all turtles was carried out with the assistance of community inspectors and fishermen of the Primeiras and Segundas Islands. Data from the turtle markings were recorded in prepared files with basic information pertaining to to each captured turtle, including: species identification, marker number, marking date, method of capture, carapace length, geographic location, condition of the marked turtle and other relevent information. These taggs are placed on the turtles fron flipper with an applicatior. Each tag identifies the project and its address. The tags are made of titanium and are marked with the code "MO", followed by four digits and the address: Departamento de Ciências Biológicas UEM, P.O. Box 257. Maputo, Mozambique.

Marine Turtle Nesting

The nests are identified and later marked with stakes by patrolling inspectors. A file is then prepared in which the discovery date is recorded so as to estimate the eclosion date and the indicate the area of discovery.

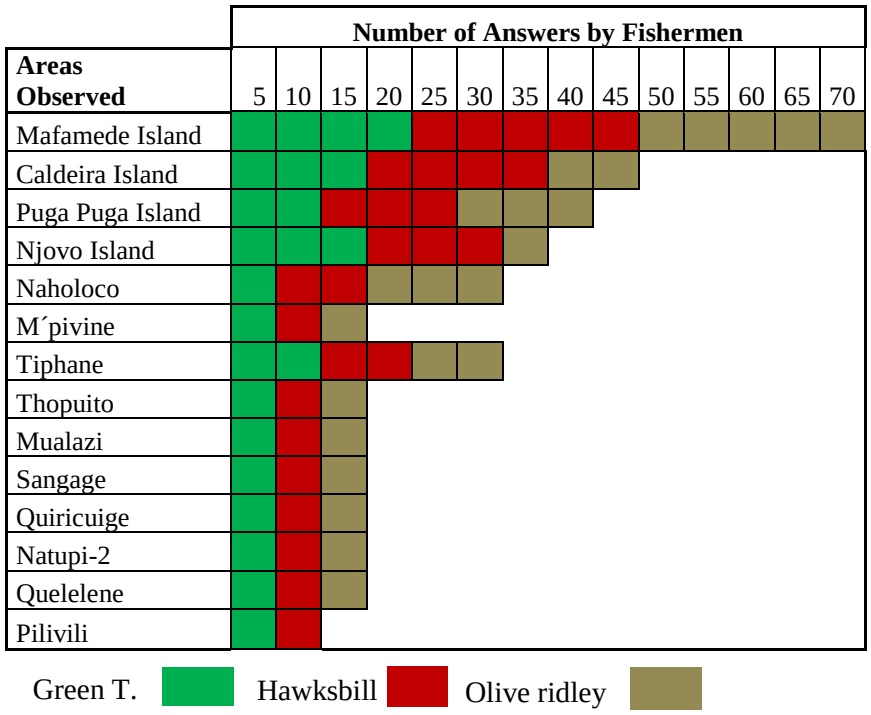
Results

Frequency with which Artisenal Fishermen Encounter Marine Turtles

One hundred and thirty-three fihermen of the Angoche and Moma districts were interviewed. Ninety-one of these fishermen employed beach seines, 25 gill nets and 17 used longlines. All fishermen were of the male sex and from the districts of Moma, Memba, Mongicual and Angoche. Their ages varied from 15 to 76 years, with an average of 42.02. Years of fishing experience of these men ranged from five to 50, with an average of 21.93.

The three marine turtle species, namely the gree, hawksbill and olive ridley, inhabit the entire region, although they are most frequently encountered by artisenal fishermen on the islands (Tabele 1). The green and hawksbill species are more common than the olive ridley. Marine turtles are found less frequently on the continent.

Table 1: Prsence of Marine Turtles on the Islands and the Continent, Angoche and Moma Districts.



Of the 102 fishermen answering the question “Where do turtles nest?”, 20.6 % responded turtles do not nest, 6.9% did not know and 6.9% had never seen a nest; the remaining 71.6% reponded turtles nest primarily on the Segundas Istands.

In fact, The three marine tutle species nest on all of the islands. Of the 11 continental locations identified, the hawksbill turtle nests in all of them, the gree turtle in all but Natupi-2, and the olive ridley in all but two, Pilivili and Quelelene. According to the fishermen, turtles emerge from the less-mentioned areas of the continent but do not spawn there. On the other hand, these species are more frequently observed at open sea and while laying eggs on sandy beaches. There have been very few sightings in areas of the sea with rocky seabeds (Table 2).

	Circumstances		
	Sandy Beaches	Open Sea	On/Between Rocks
Green	58	80	11
Hawksbill	62	82	8
Olive Ridley	52	77	8

Table 2: Number of interviewees mentioning circumstances in which marine turtles were observed in Angoche and Moma

Almost all of the fishermen idicated the summer months (particularly October, November, and December) are those for spawning, although those in some fisheries centers mentioned winter months (August and September) as well. For each species of marine turtle, the surveyed fishermen also mentioned that the majority nest in the summer, with very few doing so in the winter or throughout the year (Figure 4). Of the 31.01% of fishermen able to identify the marine turtles' nesting season, 29% mentioned only the month of November, while the others mentioned August (21%), September (21%), October (15%) and December (15%).

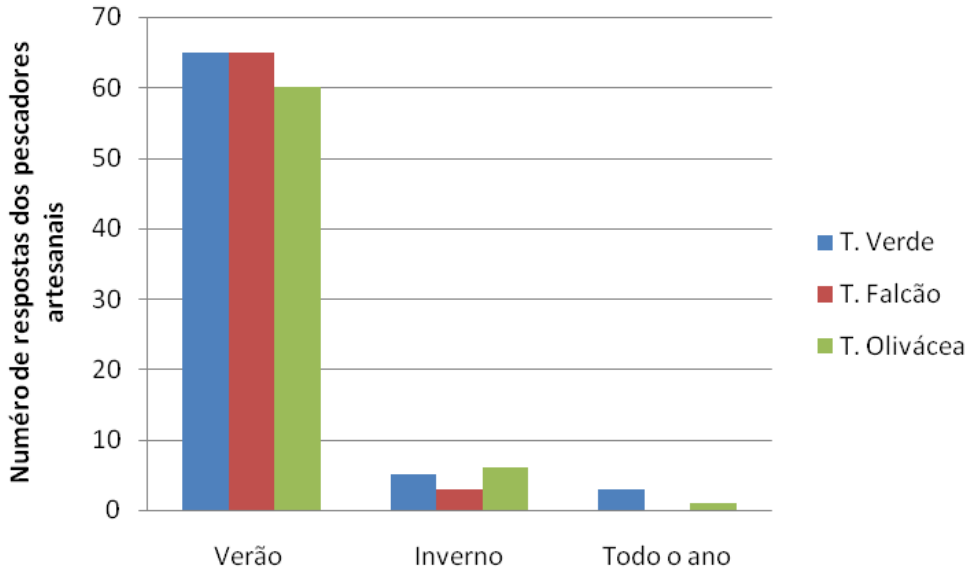


Figure 4: Response frequency of those fishermen mentioning different nesting periods for marine turtles species, in Angoche and Moma.

Season and Frequency of Incidental Capture of Marine Turtles and their Interaction with the Various Fishing Methods

Of the fishermen interviewed, 48.6% claim to capture marine turtles in their nents and lines. Most of these employ the beach seine method of fishing, with a small number using gill nets. Marine turtles are caught in all types of fishing gear. The average catch rate per net is greatest in the case of beach seines (Table 3), and significanly greater than that of gill nets in all instances.

Table 3: Average dialy incidental capture rate of marine turtles during summer months, per fishing method, in Angoche and Moma.

Fishing Method	Daily average capture rate/net	Average capture rate/net/year	N
Gill Net	0.72	131	25
Beach Seine	5.5	1004	91

Beach seines yeild the greatest impact (Figure 5). Between seven and ten marine turtles are captured on the islands in beach seines each day, while only one to three are so captured each day on the continent. Gill nets are responsible for the incidental capture of one to three marine turtles on both the continent as well as the Islands. Fishermen of all fisheries centers identify the summer as the season of most frequent incidental marine turtle capture, despite claims in some areas of high capture levels durnig the winter months (Natupi-2, Quelelene, Sangage and Quiricuige).

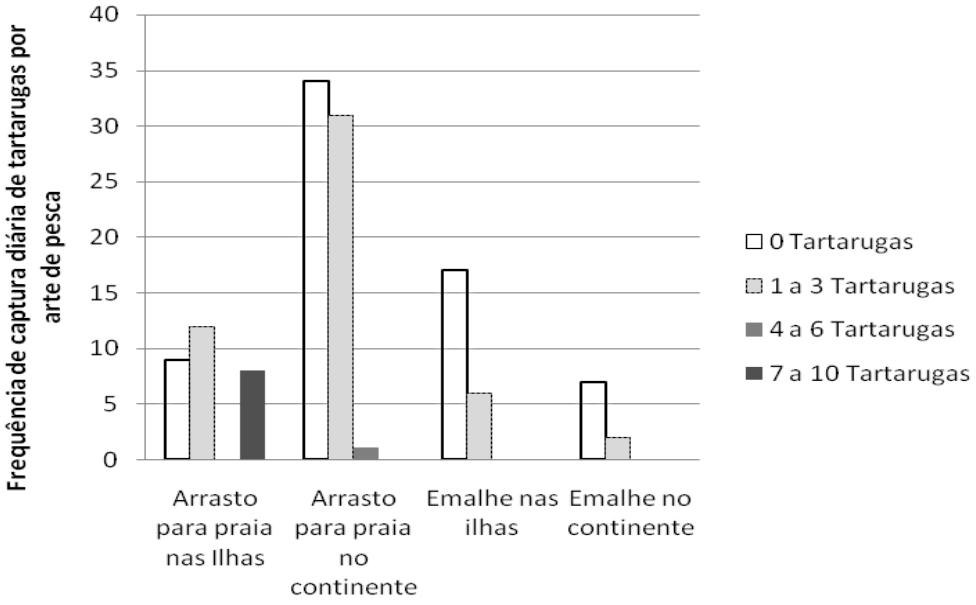


Figura 5: Incidental capture frequency of marine turtles according to fishing method, in the Angoche and Moma coasts

The green and hawksbill turtle are the most frequently-captured in beach seines and gill nets. The olive ridley turtle is caught more often inbeach seines than gill nets (Table 4). Highly significant differences are evident in the levels of capture of turtle species by the three fishing methods (x^2= 88.299; g.l=14; p=0.000).

Table 4: Number of turtles most captured, according to gear employed, in Angoche and Moma.

Fishing Method	Green Turtle	Hawksbill Turtle	Olive Ridley Turtle	Total
Gill Net	35	38	11	84
Beach Seine	14	10	1	25
Total	49	48	12	109

Degree of Damage Caused by Turtles and the Presence/Knowledge of Marine Turtle Protective Measures

A majority (87.9%) of fishermen surveyed in almost all of the fisheries have never been had their gear damaged by marine turtles. Only a small number of reports of such damage was recorded in Larde (12%), Mulola (6.25%), Naholoco (18.75%), Natupi-2 (6.25 %), Pilivili (6.25 %), Polea (18.75 %) and Thopuito (31.25 %). There were very significant differences among fisheries in the number of fishermen negatively affected by marine turtles (x^2 = 30.108; g.l = 13 e p= 0.005).

In general, the fishermen are not inconvenienced by the presence of marine turtles. No geral os pescadores não sofrem com a presença de tartarugas. Those that report damage, such as some longline fishermen, often mention the turtles' destruction of poles and snapping lines.

Table 5: Percentage of fishermen who suffered and did not suffer loss because of turtles, by fishing method, in Angoche and Moma.

Fishing Method	No loss	Loss
Gill Net	90.1%	9.9%
Beach Net	95.2 %	4.8%
Longline	64.7%	35.3%

In Angoche as well as Moma, all (100%) of the fishermen are aware that marine turtles are protected. Although most do not know anyone fined for having captured a marine turtle (except in the Moma-sede, Mulola, Naholoco and Tiphane fisheries), they are of the opinion that the confiscation of nets and boats is the ideal method of best protecting the species. Education was mentioned by the fihermen (36.84%) Quelelene, Polea, Mucoroge and Mulola (Table 6) as an appropriate measure for the reduction of turtle captures.

Table 6: Knowledge of fishermen having been fined and prefered protective measure, in Angoche and Moma.

			Frequency, those Fined			Recommended measures	
District	Fisheries	Number of Responses	No	Heard about	Yes	Confiscate	Educate
Angoche	Angoche sede	10	9	0	1	6	4
	Mulola	10	3	0	7	4	6
	Natupi-2	10	8	0	2	7	3
	Polea	9	6	0	3	2	7
	Quelelene	9	6	0	3	9	0
	Quiricuige	9	6	0	3	5	4
	Sangage	9	7	0	2	6	3
Moma	Larde	10	7	0	3	7	3
	Moma sed	10	2	2	6	8	2
	Mucoroge	8	3	2	3	0	8
	Naholoco	10	0	0	10	10	0
	Pilivili	9	6	0	3	6	3
	Thopuito	10	5	0	5	5	5
	Tiphane	10	1	0	9	9	1
Total		133	69	4	60	84	49

Many fishermen refer to the Posto Captaincy (a maritime authority), as the entity responsible for protecting turtles, though some also mentioned the CCP's and the IDPPE (Figure 6) as having some role in this regard. Significant differences are apperent regarding the indication of entities responsible for protecting marine turtles in Angoche and Moma (x^2= 45.015; g.l=30, p=0.038).

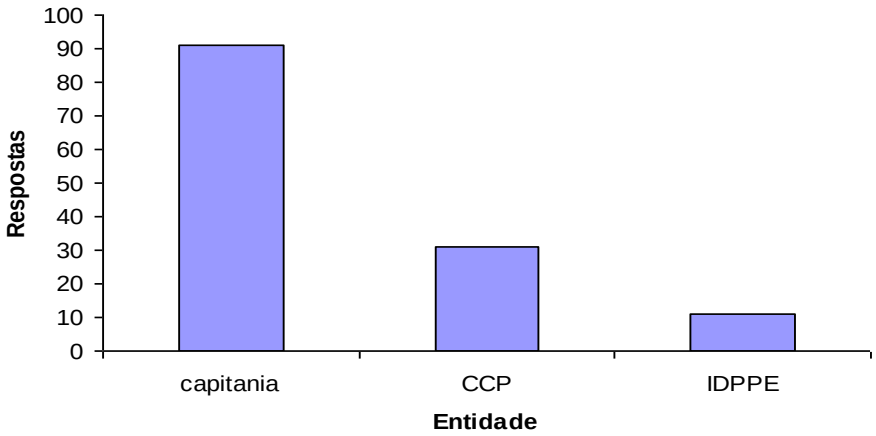


Figura 6: Fishermen's perception of the entities charged with the protection of marine turtles, in Angoche and Moma.

Tagging and Monitoring of Marine Turtle Nests

The tagging and monitoring of marine turtle nests occurs at different times of the year. Tagging, in fact, is performed year-round, while nest monitoring is conducted during the summer months. The number of nests recorded during this phase does not correspond to the total actual number of nests in this area. Throughout the 2005 – 2007 period (Figure 7), 118 adult marine turtles were tagged. This number corresponds to the two marine turtle species, the green and hawksbill, tagged on three islands, the Ndjovo, Puga-puga and Mafamede. The green turtle is the most common; indeed, 101 specimens were green turtles, 15 hawksbill and two were not identified. Figue 7 illustrates occurance trends, where each species most frequently appears and during which season (months) of the year. Note that they should appear in greater numbers during the nesting season.

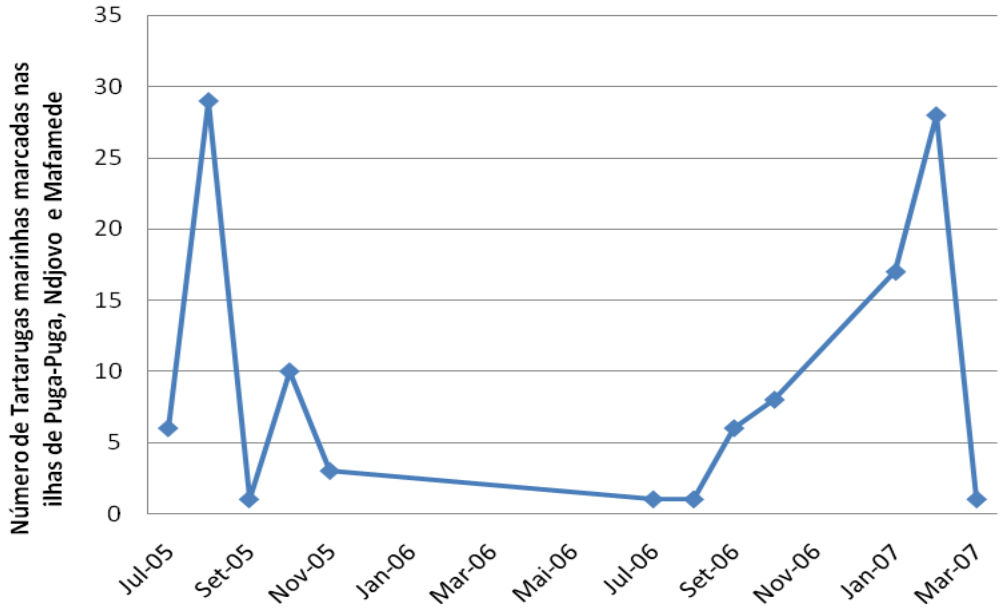


Figure 7: Number of turtles tagged on three islands, Puga-puga, Ndjovo and Mafamede from July 2005 to March 2007. Note that this data apply to only three particular months of the year.

Of the 101 green turtles tagged, 89 were found on the Island of Puga-puga, 16 on Ndjovo and two on Mafamede. As regards the Hawksbill turtle, eight were found on Ndjovo, six on Puga-Puga and the rest on Mafamede. Two of the 118 turtles delivered by the artisenal fishermen were noticed spawning a few days later (Tabela 7, appendant).

Six marine turtles were recaptured after being tagged. It is noteworthy that one of these turtles had been tagged on Mayotte Island in 1994 with the code "May 6091", and recaptured three months later on the same Mayotte beach. According to information obtained from the island's tagging project director, this turtle had never again been encountered. Twelve years later, in August of 2006 on the Island of Puga-puga after having abondoned the waters off Mayotte Island. Chronicles of such events are impoprtant to the proper management of the marine turtle in this region of the East African coast.

The remaining five turtles were found on the islands of Puga-puga and Mafamende. Of these, three were to spawn on puga-puga, one on Mafamede and another was recaptured on Puga-puga, in the net of an artisenal fisherman.

From June to November 2006, twelve, five and three nests were recorded on the islands of Puga-puga, Ndjovo and Mafamede, respectively.

Though there was insufficient information to record the number of eventual hatchlings, the record shows that three nests, or 300 eggs, were destroyed by waves. It was not possible to identify the species of these lost eggs.

Of the three extant species in this area, only the olive ridley was either observed spawning or left traces of nesting activity. Table 7, attached, provides a detailed demonstration of the turtles' tagging and recapture dates on Puga-puga, the island with the largest recorded

number of marked turtles and nests, primarily the green turtle, followed by the hawksbill. On Ndjovo Island there is a greater proportion of hawksbills than on the others.

Discussion

Frequency of Marine Turtle Encounters by Artisenal Fishermen

Artisenal fishermen spot marine turtles more often on the islands than they do on the continent. This phenomenon owes itself to the species' attempt at maintaining a safe distance from human population centers, with thier fisheries, boats, agricultural and heavy-sands operations. It has been established (Mrosovsky, 1983) that marine turtles seek out areas of least disturbance, in this case on islands with little human economic activity thanks to their distance from the continent, rough seas and inclement weather during much of the year.

The marine turtle species that most occur and are spotted by fishermen on the islands off of Angoche and Moma are the *Chelonia mydas* (green turtle), *Eretmochelys imbricata* (hawksbill turtle) and the *Lepidochelys olivacea* (olive ridley turtle). This observation is in keeping with that of Hughes (1971) and the tagging and monitoring project that has been active since 1994 through the colloboation of local communities and the fisheries co-management committee.

Artisenal fishermen spot the turtles more often in the open sea than on sandy beaches or rocky shores (Table 2), owing to the habitat-type of the referenced substrata. Another factor could be the proximity of nesting to foraging areas of coral reefs and marine plants.

The fishermen spend most of their day at sea, fishing with trawls and longlines, where they observe marine turtles surfacing for air. Marine turtles often make this ascent for air while foraging and ingesting food, thereby increasing their chances of being spotted by fishermen (Schrichte & Schrichte, 1995). Furthermore, trawlers rarely fish over rocky seabeds, which may explain the low incidence of turtles populations reported in such areas.

A majority of fishermen reported summer as being the nesting season for the region's turtles (Figure 6). As some turtles begin their nesting in mid-June and early July, a number of fishermen believe the winter to be the species' primary nesting period. In 2005, for example, the first nest belonging to a green turtle was recorded on June 20, on the island of Puga-puga (Table 7).

Season and Frequency of Incidental Capture of Marine Turtles and their Interaction with the Various Fishing Methods

The beach seine is the fishing gear most responsible for incidentel marine turtle catches; indeed, this fishing method yields an average daily catch rate of 5.5 marine turtles per day, in the nets of Angoche and Moma's artisenal fishermen. This number corresponds to the average daily capture rate during the summer season, when marine turtles seek out the

arenaceous beaches on which to lay their eggs. Angoche and Moma's spawning areas are located in the very centers of fishery activitity. On the other hand, beach seine fishing is the method employed by the greatest number of fishermen in both Moma (497 nets) and Angoche (497 nets), and that which yields the greatest fish catch (Santos, 2007). The inordinate frequency of incidental catches in beach seines may be explained by the proximity of marine turtles to the islands. The catch levels of marine turtles along the coasts of Moma and Angoche are ideed high when compared to, say, Chacete (2005), and less so in relation to Chan. But these incidental catch rates are truly excessive and frightening when we consider the sad fate of marine tutles that, when caught in these nets, die of slow asfixiation. Estas capturas são excessivas e assustadoras se assumirmos que grande parte das tartarugas presas nas redes morre por asfixia. The fishermen that were interviewed, however, claim to release the living turtles that they inadvertently capture.

The hawksbill and green are the marine turtle species most frequently caught in beach seines and gill nets (Table 4), probably owing to characteristics of their habitat in relation to the areas where this particular fishing gear is employed. The hawksbill turtle inhabits coal reefs, whereas the green turtle prefers coastal waters with abundant seaweed (Magane, 2002). Beach seines are commonly used in arenaceous fisheries, and gill nets in rocky and/or coralline areas (IDPPE, 2000). Simply owing to its relative scarcity in Mozambique, the olive ridley turtle is found much less frequently in fishermen's nets than the aforementioned species. Indeed, the olive ridley is more common to areas of northern South America, Southeast Asia and other regions of the East African coast (WWF, 2000). The Segundas Islands, situated in the Angoche and Moma districts, is the site of the greates number of marine turtle catches (Tabela 4), likely because it is to these areas, with less human activity and ideal for foraging, that turtles flock in the summer months to spawn (Hughes, 1971).

Damage Caused by Marine Turtles and the Existence/Knowledge of Measures Designed to Protect the Species

The low incidence of damage to fishing gear attributed to marine turtles (12.1 % of fishermen reporting damage; see Table 5) means that the species affect on fisheries is innocuous and that they are harmless to mankind

A large majority of the surveyed fishermen were of the opinion that, istead of awareness campaigns, illegal marine turtle capture should be discouraged through net and boat confiscation (Table 6). This view suggests that, despite the awareness campaigns in place at many fisheries and general knowledge of marine-turtle protection efforts, many fishermen persist in deliberately capturing turtles for sale or consumption. It is generally believed, then, that awareness efforts have taken their course and that people are cognizant of the illegality of deliberately capturing and killing marine turtles. Fishermen furthermore report that an efficient system of supervision would end these deliberate killings. Fishermen know that, should they be caught hunting marine turtles illegally, their nets will be confiscated from six months to one year, causing them significant economic hardship. Despite the existence of CCP's (Community Fisheries Counsils), local communities fail to partake in conservation activities and there are no monitors to educate people regarding these programs.

The basis of any solid conservation program for marine turtles would involve local communities as an integral component. To achieve success and sustainability, a protection program must be community-based. The first point of contact between communities and

conservation programs are the local monitors, trained according to principles of ecology and marine-turtle conservation (Hill & Garnier, 2004). Community involvemet in the protection of turtles is not always achieved, usually for two reasons: the difficulty in defining the right balance between community authority and government action, and a lack of understanding of the heterogeneous nature of these communities, particularly those composed of mutiple ethnicities and religions whose interests and objectives frequently clash (Malleret, 2004).

The Captaincy, charged with protecting Mozambique's territorial waters, has traditionally been the entity responsible for protecting marine turtles. According to the fishermen, this institution has been in existence since colonial times.

Tagging and Monitoring of Marine Turtle Nests

More than 90% of turtles tagged on the islands from 2005 to 2007 were brought in by the fishermen who inadvertently captured them in their nets (Table 7). The tagging and nest monitoring program was implemented only on the islands, while the coastal districts of Moma and Angoche were left for the program's second phase.

As referenced above, a large proportion of the taggesd turtles are of the green species, largely because of its occurance in artisenal fisheries, especially in the coral reefs and seaweed canopies of these areas. The hawksbill species is found more often in coral reef areas. In any event, the hawksbill is everywhere rarer and under more threat to its survival than the green turtle.

Tagged specimens found in fishing nets have carpaces of more than 50 cm, with some as large as 1,002 cm. This phenomenon suggests that the region's turtles are adult specimens.

It is known that marine turtles migrate from their nesting to feeding sites. Perhaps this factor explains the frequency with which they are viewed in January and and Febuary, as nesting begins in June and ends in November or December. Research on the green turtle suggests that, once a turtle has identified a foraging area, it continues to mark its territory over a long period (Godley *et al*., 2002). A green turtle tagged MO1228, for example, was caught in a fishing net on July 15, 2005 and recaptured on October 19 of the same year, all off of Puga-puga Island. Another specimen was caught in a fishing net on August 6, 2005 and found nesting, one month later, on September 12, 2005. Thise may suggest that, besides utilizing this as a foraging site, marine turtles come to nest here as well (Table 7).

Though few turtles were tagged in 2006, it is apparent that they occur in this region independent of the June to December nesting period. In 2007, in the space of two months, more than 50 turtles, all brought in by local fishermen, were tagged. This increace stemmed from the awareness program instituted by the inspectors who colloberated directly with local communities in an effort to reduce marine turtle deaths.

All of the data pertaining to tagged marine turtles are from the islands of Puga-puga, Mafamede and Ndjovo, as the monitoring and tagging program was not extended to the continent's coastal regions. The need, nonetheless, exists to expand monitoring and tagging programs to these important areas.

Conclusion

Puga Puga, Ndjovo and Mafamede were identified as the three principal island habitats for the marine turtles we are studying. The species of marine turtle forage and nest in this region: the green (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricata*) and the olive ridley (*Lepidochelys olivacea*). Of these, the green turtle is the most abundant, followed by the hawksbill. Turtles have been spotted in 21 areas and their nests found in 15 locales, most commonly on the aforementioned Islands.

On the basis of interviews with the region's artisenal fishermen, data drawn from the monitoring and tagging program (WWF, 2006) and the observations of Hughes (1971), June marks the beginning of the marine turtles' nesting season in this region

The marine turtles of Angoche and Moma fall prey to incidental capture more often in beach seines (5.5 turtles/net/day average) than gill nets (.72/turtles/day/net average). Such incidental catches also occur on the Segundas Islands. The most frequent season for incidental catches is summer, during the months of November and December.

Most fishermen are aware of the marine turtle's protected status and that the Captaincy, the CCP's and the IDPPE are the entities charged with implementing such protection. To further protect marine turtles and their habitat, the fishermen themselves suggest net and fishing boat confiscation and other punishments in cases of illegal turtle capture and killing

The region of the Primeiras and Segundas Islands is a migration route for marine turtles that nest on the Island of Mayotte.

The Island of Puga-puga is refuge to a great number of marine turtles, chiefly the green species.

Recommendations

A system of control and protection of island nesting areas is recommended.

Awareness programs to educate the fishermen operating off of the coast of Moma, Angoche and Pembane, important marine turtle nesting sites, is recommended.

Comprehensive protection of the Primeiras and Segundas Islands, an important marine-turtle migratory destination, is recommended.

Finally, we recommend the employment of sustainable fishing gear with nets that do not cause harm to marine turtles.

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APPENICES

Table 7: Incidental Turtle Catches in Fishing Nets in the Islands of Puga-puga, Mafamede and Ndjovo.

Island Name	Marker Number	Shell length	Shell Width	Recp	Where turtle was found	Species Name	Discovery Date
Puga Puga	**MO1226**				Fishing Net	Green turtle	17-07-2005
Puga Puga	MO1227				Fishing Net	Green turtle	19-07-2005
Puga Puga	MO1229				Fishing Net	Green turtle	19-07-2005
Puga Puga	**MO1228**				**Fishing Net**	**Green turtle**	**19-07-2005**
Puga Puga				**MO1226**	Spawning	Green turtle	20-07-2005
Puga Puga	MO1130				Fishing Net	Green turtle	23-07-2005
Puga Puga	MO1132				Fishing Net	**Hawksbill turtle**	01-08-2005
Puga Puga	MO1133				Fishing Net	Green turtle	01-08-2005
Puga Puga	MO1139				Fishing Net	**Hawksbill turtle**	03-08-2005
Puga Puga	MO1134				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1140				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1142				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1138				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1135				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1141				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1137				Fishing Net	Green turtle	04-08-2005
Puga Puga	MO1136				Fishing Net	Green turtle	04-08-2005
Puga Puga	**MO1149**				Fishing Net	Green turtle	**06-08-2005**
Puga Puga	MO1146				Fishing Net	Green turtle	06-08-2005
Puga Puga	**MO1144**				Fishing Net	Green turtle	06-08-2005
Puga Puga	MO1147				Fishing Net	Green turtle	06-08-2005
Puga Puga	MO1148				Fishing Net	Green turtle	06-08-2005
Puga Puga	MO1143				Fishing Net	Green turtle	06-08-2005
Puga Puga				**MO1144**	Spawning	Green turtle	**18-08-2005**
Puga Puga	MO1101				Fishing Net	Green turtle	19-08-2005
Puga Puga	MO1102				Fishing Net	Green turtle	19-08-2005
Puga Puga	MO1103				Fishing Net	Green turtle	19-08-2005
Puga Puga	MO1104				Fishing Net	Green turtle	19-08-2005
Puga Puga	MO1111				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1112				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1110				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1105				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1108				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1109				Fishing Net	Green turtle	21-08-2005
Puga Puga	MO1120				Fishing Net	Green turtle	24-08-2005
Puga Puga				**MO1149**	Spawning	Green turtle	12-09-2005
Puga Puga	MO1152	87	79		Fishing Net	Green turtle	12-10-2005
Puga Puga	MO1123	102	97		Fishing Net	Green turtle	12-10-2005
Puga Puga	MAY6091	114	105		Fishing Net	Green turtle	12-10-2005
Puga Puga	MO1154	68,5	63		Fishing Net	Green turtle	13-10-2005
Puga Puga	MO1157	105	95		Fishing Net	Green turtle	13-10-2005
Puga Puga	MO1153	85	81		Fishing Net	Green turtle	13-10-2005
Puga Puga	MO1156	110	103		Fishing Net	Green turtle	13-10-2005
Puga Puga	MO1155	43	40		Fishing Net	Green turtle	13-10-2005
Puga Puga				**MO1228**	**Fishing Net**	**Green turtle**	**19-10-2005**
Puga Puga	MO1129	80	75		Fishing Net	Green turtle	31-10-2005
Puga Puga	MO1230	54	48		Fishing Net	Green turtle	25-11-2005

Puga Puga	MO1231	65	60		Fishing Net	Green turtle	25-11-2005
Puga Puga	MO1231	50	43		Fishing Net	Green turtle	25-11-2005
Puga Puga	MO1454	99	93		Fishing Net	Green turtle	07-07-2006
Puga Puga	MO1172				Fishing Net	Green turtle	09-08-2006
Puga Puga	MO1456	106	93		Fishing Net	Green turtle	07-09-2006
Puga Puga	MO1459	100	87		Fishing Net	Green turtle	07-09-2006
Puga Puga	MO1458	130	112		Fishing Net	Green turtle	07-09-2006
Puga Puga	MO1457	30	24		Fishing Net	Green turtle	07-09-2006
Puga Puga	MO1462	93	87		Spawning	Green turtle	07-09-2006
Puga Puga	MO1460	100	87		Fishing Net	Green turtle	07-09-2006
Puga Puga	MO1461	90	84		Fishing Net	Green turtle	15-10-2006
Puga Puga	MO1462	42	38		Fishing Net	Green turtle	15-10-2006
Puga Puga	MO1467	102	99		Fishing Net	Green turtle	16-10-2006
Puga Puga	MO1465	75	73		Fishing Net	Green turtle	16-10-2006
Puga Puga	MO1466	59	53		Fishing Net	Green turtle	16-10-2006
Puga Puga	MO1463	104	101		Fishing Net	Green turtle	16-10-2006
Puga Puga	MO1464	75	70		Fishing Net	Green turtle	16-10-2006
Puga Puga	MO1468	81	76		Fishing Net	Green turtle	18-10-2006
Puga Puga	MO1413	74	70		Unidentified	Unidentified	16-01-2007
Puga Puga	MO1415	90	86		Unidentified	Green turtle	20-01-2007
Puga Puga	MO1419	61	58		Unidentified	Green turtle	26-01-2007
Puga Puga	MO1418	96	93		Unidentified	Green turtle	26-01-2007
Puga Puga	MO1414	100	97		Unidentified	Green turtle	26-01-2007
Puga Puga	MO1416	84	80		Unidentified	Green turtle	26-01-2007
Puga Puga	MO1417	89	86		Unidentified	Green turtle	26-01-2007
Puga Puga	MO1430	45	43		Unidentified	**Hawksbill turtle**	01-02-2007
Puga Puga	MO1409	98	95		Unidentified	Green turtle	04-02-2007
Puga Puga	MO1410	92	87		Unidentified	Green turtle	05-02-2007
Puga Puga	MO1431	80	78		Unidentified	**Hawksbill turtle**	07-02-2007
Puga Puga	MO1412	69	66		Unidentified	Unidentified	07-02-2007
Puga Puga	MO1048	102	99		Unidentified	Green turtle	08-02-2007
Puga Puga	MO1411	90	88		Unidentified	Green turtle	09-02-2007
Puga Puga	MO1432	48	45		Unidentified	**Hawksbill turtle**	10-02-2007
Puga Puga	MO1420	48	46		Unidentified	Green turtle	10-02-2007
Puga Puga	MO1433	72	70		Unidentified	**Hawksbill turtle**	14-02-2007
Puga Puga	MO1421	43	39		Unidentified	Green turtle	14-02-2007
Puga Puga	MO1407				Unidentified	Green turtle	15-02-2007
Puga Puga	MO1406	66	62		Unidentified	Green turtle	20-02-2007
Puga Puga	MO1422	69	66		Unidentified	Green turtle	25-02-2007
Puga Puga	MO1423	83	80		Unidentified	Green turtle	26-02-2007
Puga Puga	MO1428	65	62		Unidentified	Green turtle	27-02-2007
Puga Puga	MO1427	77	74		Unidentified	Green turtle	27-02-2007
Puga Puga	MO1429	89	86		Unidentified	Green turtle	28-02-2007
Puga Puga	MO1424	66	62		Unidentified	Green turtle	28-02-2007
Puga Puga	MO1426	105	101		Unidentified	Green turtle	28-02-2007
Puga Puga	MO1425	48	44		Unidentified	Green turtle	28-02-2007
Puga Puga					Fishing Net	Green turtle	Unidentified
Puga Puga		83	77		Fishing Net	Green turtle	Unidentified
Puga Puga		65	59		Fishing Net	Green turtle	Unidentified
Ndjovo	MO1173	96	90		Fishing Net	**Hawksbill turtle**	25-07-2006
Ndjovo	MO1179	108	105		Fishing Net	**Hawksbill turtle**	11-10-2006
Ndjovo	MO1276	68	63		Unidentified	Green turtle	02-01-2007
Ndjovo	MO1277	80	76		Unidentified	Green turtle	04-01-2007
Ndjovo	MO1278	90	87		Unidentified	Green turtle	05-01-2007
Ndjovo	MO1234	100	96		Unidentified	**Hawksbill turtle**	05-01-2007
Ndjovo	MO1272	60	57		Unidentified	Green turtle	07-01-2007
Ndjovo	MO1279	45	42		Unidentified	Green turtle	07-01-2007
Ndjovo	MO1280	110	106		Unidentified	Green turtle	08-01-2007

Ndjovo	MO1281	67	69		Unidentified	Green turtle	09-01-2007
Ndjovo	MO1282	94	90		Unidentified	Green turtle	10-01-2007
Ndjovo	MO1283	88	85		Unidentified	Green turtle	14-01-2007
Ndjovo	MO1235	93	90		Unidentified	**Hawksbill turtle**	18-01-2007
Ndjovo	MO1284	81	78		Unidentified	Green turtle	21-01-2007
Ndjovo	MO1285	56	52		Unidentified	Green turtle	23-01-2007
Ndjovo	MO1235	91	88		Unidentified	**Hawksbill turtle**	26-01-2007
Ndjovo	MO1238	76	74		Unidentified	**Hawksbill turtle**	28-01-2007
Ndjovo	MO1274	78	76		Unidentified	Green turtle	04-02-2007
Ndjovo	MO1275	99	95		Unidentified	Green turtle	04-02-2007
Ndjovo	MO1236	68	66		Unidentified	**Hawksbill turtle**	06-02-2007
Ndjovo	MO1237	57	54		Unidentified	**Hawksbill turtle**	08-02-2007
Ndjovo	MO1286	109	109		Unidentified	Green turtle	14-02-2007
Ndjovo	MO1273	84	80		Unidentified	Green turtle	16-02-2007
Ndjovo	MO1271	69	65		Unidentified	Green turtle	17-02-2007
Mafamete	MO1233	124	106		Unidentified	Green turtle	19-03-2007
Mafamete	Unidentified	98	95		Fishing Net	Green turtle	Unidentified
Mafamete	Unidentified	94	81		Fishing Net	**Hawksbill turtle**	Unidentified

Note: Whenever possible, the size, tag number (tagged and recaptured), area found, species name and discovery date was recorded.