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Sea turtles of Madagascar – their status, exploitation and conservation

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Five species of sea turtles are known from Madagascar's coastal waters. Fishermen on the western and south-western coasts take green turtle Chelonia mydas, *loggerhead turtle* Caretta caretta *and olive ridley* Lepidochelys olivacea *for their meat. The hawksbill turtle* Eretmochelys imbricata *is taken mainly for its shell and for making stuffed specimens while the leatherback* Dermochelys coriacea *is seldom caught. Anecdotal evidence of fishermen and dealers in turtle products, measurement of captured animals and personal observations of the authors all point to declines in numbers and average size for green and hawksbill turtles, coupled with marked declines in nesting rates for these and the olive ridley. High catches of green turtles around Toliara prove the importance of coral reef feeding grounds but may be depleting protected populations from Europa Island and elsewhere. Protective legislation exists but has not been enforced. The authors make recommendations for further action.*

Introduction

Five species of sea turtle are known from Madagascar's coastal waters: green turtle *Chelonia mydas*, hawksbill turtle *Eretmochelys imbricata*, loggerhead turtle *Caretta caretta*, olive ridley *Lepidochelys olivacea* and leatherback *Dermochelys coriacea*. The first four species are known to nest on Madagascar and the ranges of all five have been estimated by Hughes (1974), which can be summarized as follows: all five species are sparse or absent along the mid-eastern coast; green and hawksbill turtles are otherwise widely distributed, with the hawksbill turtle extending down the north-east coast to Masoala peninsula; the olive ridley is less common, but has a similar distribution to the hawksbill turtle; the loggerhead turtle is concentrated around the southern half of the island from north of Taolagnaro round to Morondava on the west coast; leatherback distribution is similar to the loggerhead turtle's but sparser and offshore. Petit (1930) reported the importance of turtles to Malagasy fisheries and that population declines were already evident. Hughes (1974) pointed to the apparent decline in numbers of the hawksbill turtle and the disappearance of its nesting sites. Rakotonirina (1987) reported declines in numbers and nesting occurrences for green, loggerhead and hawksbill turtles. Groombridge and Luxmoore (1989) carried out a comprehensive review of the available literature on green and hawksbill turtles and observed the virtual lack of data on nesting sites for either species. The raiding of nests and hunting for meat and shell are believed to be the fundamental causes of declines in the first four species but alteration of habitat, especially nesting beaches and feeding and resting areas, is likely to have had an influence. For example, the harvesting of marine algae (*Eucheuma* sp.) for extraction of colloids near Toliara may reduce available food for green turtles. There is very little published information on leatherbacks.

Legal position

As early as 1923 laws were passed to protect green and hawksbill turtles. Decree 23 May 1923 prohibited the capture of nesting females and individuals with carapace diameters of

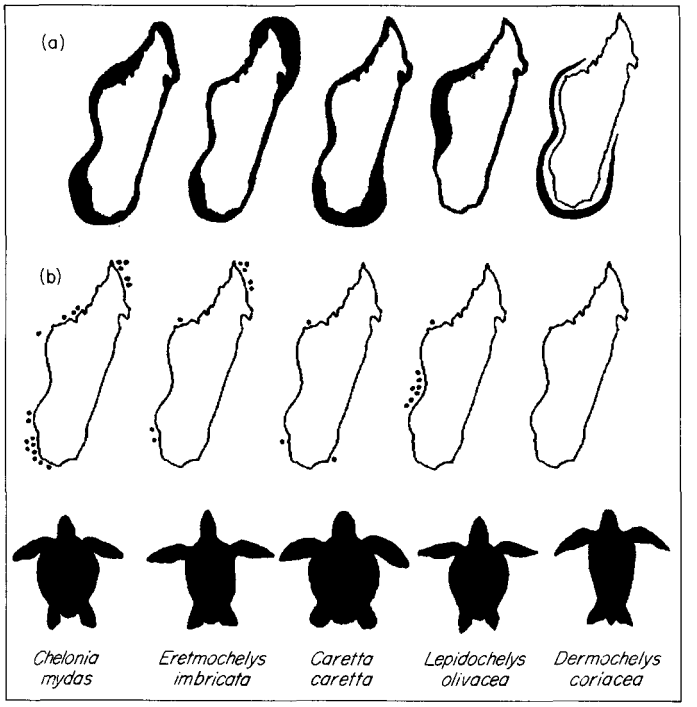

Figure 1. Maps of Madagascar and species silhouettes showing: (a) estimated foraging distributions of five species of marine turtles based on Hughes (1974), the 1989/1992 surveys and received information; (b) known nesting areas based on 1989/1992 surveys and received information.

less than 50 cm, measured beneath the plastron. Decree 24 October 1923 declared protected nesting sites on the islands of Nosy Anambo (Diego Suarez), Nosy Iranja (Nosy Be), Chesterfield (Morondava), Nosy Trozona and Nosy Ve (Toliara), and Europa. These laws do not appear to have been enforced and only Europa (a French possession) is protected. Madagascar ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora in 1975 (Decree 75-014) and a decree of 1988 (88-243), while specifically naming only the leatherback, appears to grant all marine turtles absolute protection from exploitation. This law is not enforced for domestic exploitation and is inconsistent with the granting in some areas of licences to sell turtle meat.

Objectives of the studies

The objective of the principal study carried out in 1989 was to establish the status of sea turtles in Madagascar by: identifying known nesting sites; locating important feeding areas; and estimating levels of exploitation. The objective of a subsequent but briefer study in 1992 was to repeat some of these investigations in the Toliara area only.

Study area and methods

Based on previously published work on Madagascar's sea turtles (Petit, 1930; Decary, 1950; Hughes, 1973, 1974; Rabesandratana *et al.*, 1985; Bonnet, 1986; Rakotonirina, 1987), Madagascar's coast can be divided into two zones: the mid-eastern coast, comprising wave-battered rocky shores suitable only for migratory passage and the remainder, providing feeding grounds and vast stretches of beach suitable for nesting. The 1989 study covered the six population centres identified in Figure 2. The 1992 study covered the coastal zone of Toliara between Beheloka (60 km to the south of Toliara) and Morombe (200 km to the north). Investigations were carried out using the following methods: questioning fish-

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ermen directly, questioning artisans and traders in turtle products; and direct observation.

Turtle fishery

Economic importance and traditions

The hunting of sea turtles is a long-established economic activity of Madagascar's coastal peoples, testified to by the elaborate (but now disappearing) associated cultural traditions. Rakotonirina (1989) described in detail the ritual practices accompanying turtle hunting. Prows of *pirogues* (outrigger sailing canoes) are painted black to represent dried turtle blood, and marked with notches or lines to declare the fisherman's tally. Traditionally, turtle meat was eaten only by the hunter's family and selected villagers. Imprecations were made to ancestors and to God before the animal was slaughtered and choice cuts were reserved for elders or 'amulet bearers'. Failure to observe these rites was considered to bring bad luck. The rituals are still practised by older fishermen and in remote areas, but are largely ignored by younger fishermen close to major population centres, particularly where capture is incidental to fishing.

Turtle fishing still has undoubted economic importance, while egg collection has virtually ceased with the decline in nesting. In 1992 fishermen near Toliara claimed that the cooked meat of an adult green turtle of over 100 kg could fetch as much as 200,000FMG (over $US100), double the price of 1989. The meat is considered a delicacy and sold fried in small pieces in Toliara town. The carapaces of larger animals may be kept for domestic use. The meat of smaller turtles is home-consumed, while the carapaces are sold as ornaments for about $US1.00. The price for shell from the rarer hawksbill turtle ranges from $US2.00 to as much as $US20.00/kg depending on quality and locality. Unusual applications of turtle products include the use, in the Mahajanga region, of green turtle excrement in chicken feed to eliminate intestinal parasites.

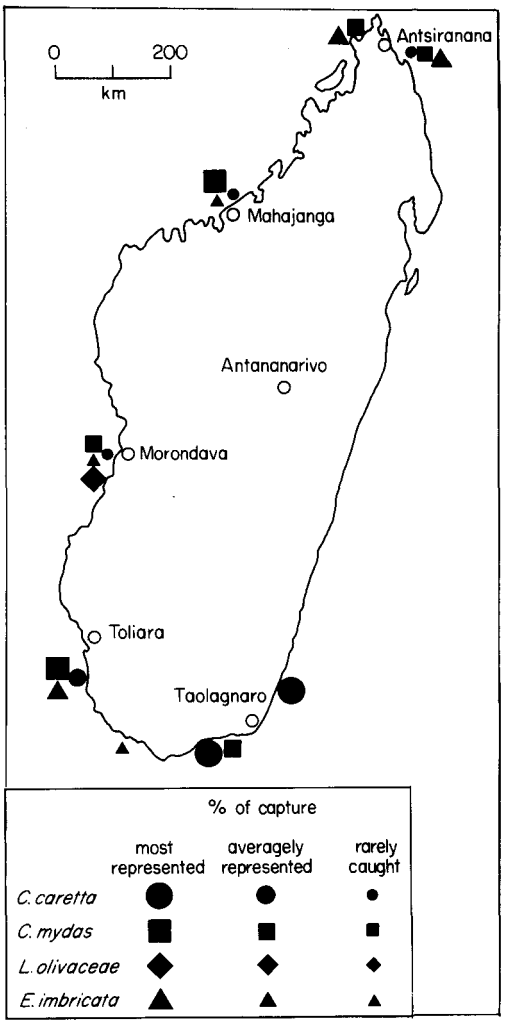


Figure 2. Map of Madagascar summarizing the results of the turtle fisheries surveys in 1989 and 1992.

Capture methods

Capture can be divided into hunting or incidental capture. There are four methods used to hunt turtles.

1. Trapping of nesting females on beaches, which involves noting fresh traces of nesting and waiting for the female to return to lay a subsequent batch of eggs. The eggs are also taken. In the Mahajanga area it is traditional to leave 1–20 eggs in the nest. Hatchlings are not taken (Durbin and Rakotoniaina, 1991). Nests

Table 1. Capture rates by occupational turtle hunters in 1989

Locality	Fisherman	Capture rate claimed	Estimated annual rate	Species represented
Morondava	A	9 per month	63	Olive ridley*
	B	1 per day	210	Green turtle†
Toilara	C	20 per month	140	Green turtle*
	D	6 per week	168	Loggerhead†
	E	20 per month	140	Hawksbill§
	F	20 per month	140	
	G	1 or 2 per day	210	
	H	100 per month	700	
	I	2 per day	420	
Antsiranana (Diego Suarez)	J	2 per day	420	Hawksbill*
	K	3 per day	630	Green turtle†
	L	5 per day	1050	Loggerhead§
	M	2 per day	420	
	N	10 per day	2100	
	O	6 per day	1260	
Mahajanga	P	7 per day	1470	Green turtle*
	Q	12 per day	2520	Hawksbill§
Totals	17		11061	

Key. * Most represented in catch; † averagely represented; § rarely caught.
Average capture rate: 650 turtles per year per fisherman.

Table 2. Capture rates by occasional turtle hunters in 1989

Locality	Fisherman	Capture rate claimed	Estimated annual rate	Species represented
Toliara	A	1 per week	52	Green turtle*
	B	40–50 per year	45	Loggerhead†
Morondava	C	5–6 per year	5	Olive ridley*
	D	5—6 per year	5	Green turtle§
	E	1–2 per year	1	Hawksbill§
	F	5–6 per year	5	
	G	10 per year	10	
	H	2–6 per year	4	
	I	5–6 per year	5	
	J	10–20 per year	15	
Mahanjanga	K	20–25 per year	22	Green turtle*
	L	10 per year	10	Loggerhead§
	M	5 per year	5	Hawksbill§
	N	7 per year	7	
	O	10–15 per year	12	
	P	10–15 per year	12	
Totals	16		215	

Key. * Most represented in catch; † averagely represented; § rarely caught.
Average capture rate: 13.4 turtles per fisherman per year.

are easily found and coastal people use the beaches as thoroughfares.

2. Hunting by harpoon, for which the fishermen work in pairs (cf. Frazier, 1981). In certain areas remoras (sharksuckers, Echeneidae) on a light line are used to help locate and chase turtles before they are harpooned.

3. Hunting by diving, generally for smaller animals. The use of spearguns is a recent development near Antsiranana and Toliara.

4. Netting using shark nets involving several vessels and often at night. This method is particularly effective when turtles are aggregated.

There are two principal causes accounting for incidental capture of turtles.

1. Long-line fishing, where the carnivorous species (loggerhead turtle, hawksbill turtle, olive ridley) take bait intended for fish.

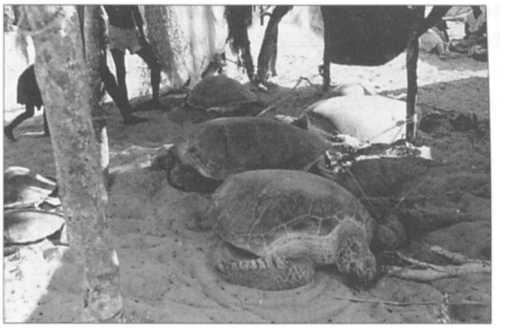
2. Poisoning: fishermen at Beheloka (near Toliara) use latex from *famata* (*Euphorbia laro*) to poison reef fishes; this has been known to kill turtles caught in tidal pools.

Occupational and occasional hunters

Fishermen are either occasional or occupational hunters. Occasional hunters take turtles all year round but incidentally to their normal fishing activities and take mainly immature animals, usually in fishing nets and never by harpooning. Near Toliara occupational hunters hunt all year round but do best when adult turtles are more common (October–March). Shark nets or harpoons are the favoured means of capture. Hallmarks of occupational hunters include decorated pirogues, turtle heads adorning doorways and the presence of large carapaces. Hunters from Soalala hunt only in the dry season (May–October) and are otherwise engaged the rest of the year (J. Durbin, pers. comm.).

Capture rates

Captures by hunting teams can be impressive – on one occasion we saw hunters from the village of Beravina, north of Toliara, net 12 adult green turtles each 1 m or more in length (five male, seven female) in a single night. Table 1 gives capture rates claimed by occupational hunters questioned during the 1989 survey. Hunting teams claimed to take 650 turtles/team/year.



Adult green turtles awaiting sale at Beravina, north of Toliara (*A. Cooke*).

Captures by occasional hunters are harder to assess. Investigations in 1989 suggested an average capture rate of 13.4 per year (see Table 2). Enquiries of fishermen in the Toliara area in 1992 tended to confirm the rate estimated for that region (about 50 per fisherman per year) for 1989. Most of the captured animals (or carapaces) seen were immatures of less than 50 cm carapace diameter (and hence caught in breach of the decree of 24 October 1923).

The capture figures claimed by fishermen deserve scepticism. Over 10 months during the 1989 survey, B.R. counted only 279 turtles for sale in Toliara fish markets. Furthermore, the fishermen's counts did not distinguish between species. While, in theory, details of turtles sold in the market should be recorded by fisheries' ministry officials, the majority are below legal size and the practice has been abandoned in Toliara. The weight of declared hawksbill turtle scale is still recorded, even though the majority must come from animals below legal size.

Capture sizes

Measurements were made on spot samples of turtles caught by fishermen from the villages of Anakao and Beravina (near Toliara) on 2 days during 1989. The average carapace

Table 3. Reported nesting areas of marine turtles in Madagascar in 1989–91

Locality (N to S)	Green turtle	Hawksbill turtle	Loggerhead turtle	Olive ridley
Antsiranana (Diego Suarez)	Ambatomainty, Vohémar, Tanambao, Ambolobozy, Tezaheza I., Antongobory I., Andratanaly I., Antsapano, Ampasindava (to SE), Vailava, Andovokonko **Nesting rate:** Declining	Same as for green **Nesting rate:** Declining	None known	None known
Mahanjanga	Andampy, Marosakoa, Ampasimariny, Boeny, Randanova Is.*, **Nesting rate:** Declining	Soalala* Same comment as for Morondava fishermen **Nesting rate:** Declining	Soalala* Ankimony	Soalala* Bosy, Maromoka,
Morondava	None known	Rocky shore zones in the region (so claimed by fishermen). Reported to release egg into the sea on occasion. **Nesting rate:** Declining	South: Reported to release eggs into the sea on occasion. **Nesting rate:** Declining	North: Andranomasay South: Andravoha, Andriamitaroky, Ankevo, Betania (ceased), Nosy-Be I., Antsabora I. **Nesting rate:** Declining
Toliara	North: Andavadoaka region, Salary Avaratra South: Bevoalavo, Lavanono, Itampolo, Beheloka, Anakao, Nosy Ve I. (ceased), Nosy Satrana I., Nosimbrona I. **Nesting rate:** Declining	North: Ifaty (N) (1 in 1992) South: Anakao (beaches just to south (very rarely).	Anakao (S) (very rarely)	None known
Taolagnaro (Fort Dauphin)	None known	None known	Beaches nr Evatraha **Nesting rate:** 20/night	None known

* Durbin and Rakotoniaina, 1991.

lengths were: green turtle (49 animals), 572 mm; loggerhead turtle (eight animals), 822 mm; hawksbill turtle (one animal), 40 mm. Judging by our own observations, these are considered to be representative. Most of the green and all of the hawksbill turtles now caught at Toliara are juveniles. The loggerhead turtles tend to be adults – indeed loggerhead juveniles have not been reported in the Toliara area.

Fishermen's knowledge of turtle abundance, nesting sites and biology

During the 1989 and 1992 surveys, we spent much time in informal discussions with local fishermen, to discover what they knew of turtle abundance, nesting sites and turtle biology.

Turtle abundance (Table 2). Fishermen in the Toliara area regarded green turtles as abundant, although a decline in size was recognized and many more females were caught than males. The adult turtles arriving in large numbers along the Toliara barrier reefs after the nesting season are believed locally to come from Europa, a small French-owned island reserve 200 km WNW of Toliara. If this is true, the turtle fishery at Toliara must be depleting the protected populations on that island. However, no Europa-tagged animals have been reported, whereas two loggerhead and one green turtle, all tagged around Durban, South Africa, were reported to the marine station in Toliara prior to 1987. After the green turtle, the loggerhead turtle was considered the next most common. The hawksbill turtle is regarded as rare and the leatherback rarer still. One leatherback turtle was taken near Toliara in October 1992. The presence of olive ridley has not been confirmed.

The green turtle is by far the most common species caught around Soalala (120 km SW of Mahajanga); hawksbill turtle, olive ridley and loggerhead turtles are caught in small numbers but leatherbacks only rarely. One sighting of a tagged green turtle was reported at Soalala; this was believed to belong to *vazaha* (foreigners) and was not taken. There was some confusion between the loggerhead turtle and olive ridley, both of which were reported to nest in the region. A female turtle caught nesting near Soalala in the 1990/91 season had six costal shields on each side of the carapace (Durbin and Rakotoniaina, 1991) and was most probably an olive ridley.

The olive ridley is more common near Morondava but the green turtle is also caught, as are hawksbill turtles (in very low numbers) and leatherbacks on rare occasions (A. F. A. Hawkins, pers.comm.).

Near Antsiranana the hawksbill turtle is the most common species but it has declined significantly in recent years. Green and, less commonly, loggerhead turtles are also taken.

Only the loggerhead turtle was reported to be common around Taolagnaro, but it is considered locally to be inedible and is not deliberately hunted. The price for an adult was only 5000FMG in 1989 ($US3.00). Leatherbacks are occasionally caught, but are probably too large and strong for most east coast pirogues, which lack balancers. A captured live leatherback was seen in Taolagnaro in April 1993 (O. Langrand, pers.comm.).

Based on our data and Hughes (1974) we present suggested foraging ranges for all five species in Figure 1(a).

Turtle nesting (Table 3) For all species the nesting season was reported to be during the austral summer (October to January). A reduction in nesting was reported for all species, with marked declines in some areas. Fishermen from Morondava claimed that dozens of olive ridleys used to nest on the beaches near Betania but that the last nest was seen in 1986. Fishermen at Anakao, near Toliara, reported that no green turtles had nested on the island of Nosy Ve (officially a protected nesting site) since 1987.

There was one exception to the reports of declines: a group of fishermen at Evatraha near Taolagnaro (Fort Dauphin) reported a stable nesting rate of up to 20 nesting female loggerhead turtles on rainy nights between November and January each year on beaches to the north of Taolagnaro. A similar claim is reported by Hughes (1974). During the 1992 study one hawksbill turtle nest was fortu-

itously discovered on a stretch of private beach near Ifaty (Toliara) from which 102 hatchlings emerged and were subsequently released at sea. The known past and present nesting areas are plotted approximately on Figure 1(b) where the place-name has been positively identified on a map (SGM, 1948).

An interesting phenomenon was reported independently by fishermen in the south and west. Fishermen from the Morondava area reported female hawksbill turtles releasing eggs at sea off rocky shores, which might be explained by the failure to find a suitable beach. Further south, fishermen at Fitsitike and Anakao near Toliara reported green females releasing eggs in the sea where there are plentiful beaches. Siegel (1991) reports a similar observation by fishermen from Itampolo, south of Toliara. This could result from failing to find a suitable nesting site, in which case there are clear implications for the anticipated development of tourist facilities on the coast, especially in the Toliara and Morondava areas. Beach lighting has been shown to disorientate hatchlings (Raymond, 1984; Witherington and Bjorndal, 1991) and may also disturb nesting females (Mortimer, 1989). Traditional villages, without electricity but right on the beach, may also be disruptive.

Commerce in turtle products

Investigations were made of wholesalers who purchase turtles or shell from fishermen, and of dealers in crafted turtle products. Studies were completed at Toliara, Mahajanga, Taolagnaro, Antsiranana and the capital, Antananarivo. Green turtles, olive ridleys and loggerhead turtles are sold primarily for their meat, although some green turtles are stuffed and small carapaces are sold as ornaments. Most tortoiseshell products were of hawksbill turtle scale from Antsiranana and sold to the public in Antananarivo, with fewer sales being made from shops in Antsiranana. In 1989 prices ranged from $US2 for a comb to $US40 for spectacle frames and $US100 for stuffed specimens. No data were obtained on the sales volume or export of tortoiseshell products. The prices obtainable for turtles or their shells are in inverse proportion to the distance from the nearest accessible market. An adult green turtle will sell for only about 20,000FMG in coastal villages 100 km south of Toliara. There now follows summaries of the position from each region.

Toliara

At Toliara primarily green turtles and a few loggerhead turtles are caught for their meat, with a very few green and hawksbill turtles for their shells. Cooked green turtle meat and intestine is sold in Mahavatse market for $US0.20 a piece equivalent to about $US2/kg. Eggs sell at about $US0.03 each. Small carapaces of green and hawksbill turtles are sold for about $US1. Sales of stuffed specimens are rare – the main public selling place (also the main retail outlet for ornamental shells) reported a maximum of two sales per month for stuffed juvenile green turtles (at about $US15 each) and occasional sales of stuffed juvenile hawksbill turtles (at $US20 each). Stuffing was performed by taxidermists based in Toliara who reportedly charged about $US8.00 per specimen. Hawksbill turtle scale must be ordered a month in advance and sells at about $US2–4/kg. Scale is mostly of poor quality, being the thin shell of juvenile animals. Most scale comes from around Salary, north of Toliara. There is circumstantial evidence of illegal exportation of shell from Toliara, but the quantities are unknown.

Mahajanga

Meat from green turtles is the most important turtle product at Mahajanga. Sold raw it fetches about $US0.50/kg. In 1989 it was found that licences to sell the meat had been granted to two merchants since 1988. In 1990 fried green turtle meat was being sold in Soalala at $US1-2/kg and hawksbill turtle shell at $US3/kg (Durbin and Rakotoniaina, 1990). There was only one dealer in tortoiseshell, and no tortoiseshell craftsmen. In 1991 scales were sold (at $US4/kg) to dealers who sell on to craftsman in the capital.

Tortoiseshell buyers have ceased to visit the Soalala area. Meat from hawksbill turtle was not liked and considered poisonous (perhaps the result of this turtle's diet, consisting primarily of sponges and medusae). The flesh of olive ridleys, loggerhead and leatherback turtles was eaten, but all were considered to have an unpleasant smell (Durbin and Rakotoniaina, 1991). Green turtle meat was considered to be delicious by all we spoke to.

Antsiranana

Traditionally, turtle meat was not eaten in this strongly Muslim area of Antsiranana but raw green turtle meat has started to find a market by direct sale to consumers at about $US0.50/kg, although no licences had been granted in 1989. Commerce in hawksbill turtle products has long been important and a number of shops in town sell stuffed turtles and tortoiseshell artefacts. One trader reported receiving two freshly caught turtles per day in the high season and that sales of stuffed turtles had mostly been made to European tourists from cruise ships, notably from the former USSR for about $US100 for a stuffed hawksbill turtle. The same trader reported a recent marked increase in the prices of carapaces and scales, as well as a reduction in scale thickness. Good quality scale could cost the craftsman up to $US10–15/kg, with average quality at $US5–10. Most tortoiseshell products are sent to Antananarivo for sale.

Antananarivo

The capital is the main market for tortoiseshell products, while turtle meat is virtually unknown. Traders report that tortoiseshell is becoming increasingly scarce and expensive. They are obliged to pay up to about $US20/kg. Sales are made to tourists and residents alike. While traders knew that export was forbidden, they said it was easy for tourists to take out small items in their luggage. Stuffed specimens, on the other hand, were considered to require an export permit from the Ministry of Waters and Forests and were only rarely sold. At the time of writing there are several stalls selling tortoiseshell items in the town markets.

Conclusions and recommendations

The studies have shown that marine turtles are still present in substantial numbers in Madagascar's coastal waters. However, the marked reduction, or in some cases cessation, of nesting and the reduced numbers and size of animals caught indicate a major decline. The decline in size is most evident for green and hawksbill turtles, which are hunted systematically for their flesh and shells, respectively. The loggerhead turtle appears to be uncommon but may still be represented by substantial nesting populations in the south-east. The olive ridley is at risk because of its localized distribution, but it may be less intensively hunted than the green turtle in its favoured region. The distribution of olive ridley appears to be more localized than suggested by Hughes (1974). The leatherback is rare but occasionally caught along the west and south-east coasts.

Exploitation of the hawksbill turtle for tortoiseshell has declined in economic importance due to the decline of Madagascar's economy. However, the trade still survives and could well be revived by an influx of tourists as Madagascar emerges from a period of political instability unless tourist education and enforcement of export restrictions are made more effective.

The barrier reefs of Toliara in south-west Madagascar are an important feeding ground for green turtles, and probably support the largest populations of this species in Madagascar.

Because the feeding and nesting grounds of sea turtles are typically separated by long distances, Madagascar probably provides foraging habitat for both juvenile and adult turtles that have migrated from nesting rookeries elsewhere in the Indian Ocean, from such localities as Europa, Tromelin, Comoros, Seychelles and the mainland coast of Africa. Thus the over-exploitation of turtles on Madagascar is not merely of national concern,

but is also of regional importance. On the other hand, much of Madagascar's southern and south-western coasts are sparsely inhabited due to lack of fresh water and may support as yet unknown nesting populations.

It has been shown repeatedly that exploitation of sea turtles can proceed for many years with little or moderate apparent impact, with numbers then rapidly collapsing because of a long-term lack of recruitment. Such crashes have been reported from the Gulf of Mexico, Ecuador, Malaysia and elsewhere (Agardy, 1992). Such a crash could be imminent or have already occurred in Madagascar, particularly in the cases of the hawksbill turtle and olive ridley.

The high price of turtle meat is encouraging turtle hunting and is likely to be sustained, particularly in areas such as Toliara, where population increase drives fishermen to exploit all available sources of protein. The developing taste for turtle meat in certain areas is perhaps the greatest menace of all to Madagascar's remaining sea turtles.

Recommendations

Research. A co-ordinated programme is needed to gather data on turtle fisheries in Madagascar to facilitate local, national and international resource management decisions. The more sparsely inhabited areas should be surveyed, perhaps by boat, to identify nesting, feeding and resting areas. The sex ratio among captured green turtles should be studied. An investigation should be made into tagging practices on Europa and elsewhere, and a system established to encourage reporting of tagged specimens in Madagascar. The phenomenon of egg release into the sea merits further attention.

Legislation and law enforcement. The legal effect of decree 88-243 as regards sea turtles and ministerial policy in relation to it must be ascertained. If a ban on domestic exploitation was intended its feasibility should be seriously considered. The granting of licences to sell turtle meat needs to be reviewed. In the shorter term enforcement of the decrees of 23 May 1923 and 24 October 1923 may yield a greater conservation benefit. Those decrees should be reviewed and revised as appropriate, for example extending them to protect the olive ridley and banning nest raiding. New laws should be considered for limiting the turtle hunting season (Hughes, 1971) and regulating capture methods, especially spearguns and mass capture with shark nets. Controls on turtle product exports should also be reviewed. An effective enforcement policy should then be developed in collaboration with the relevant authorities.

Nesting sites. Nesting beaches require precise identification and protection by a variety of means including a national policy covering economic activity near nesting areas and a system of protected beaches. Because egg collection is economically unimportant, it may be possible in some areas to persuade fishing communities to stop egg-collecting and instead report precise details of nests to the nearest project representative for a small fee (a nestful of 100 eggs is worth only about $US3 to the finder).

Education and media. An awareness campaign about marine turtles should be launched in schools and through the media to discourage the consumption of turtle meat and eggs and tortoiseshell. Posters are needed for airports and tourist hotels. Environmental magazines (for example *Vintsy* published by WWF in Madagascar) and environmental groups could contribute to the campaign.

Tourist areas. Special attention should be given to those areas where the promotion of turtle conservation through eco-tourism may be possible. Watching nesting and hatching turtles has proven eco-tourism potential and can be the focus of tourism development. The tourist industry, through scuba diving monitors and big-game fishermen, should be encouraged to document turtle sightings. The importation of spearguns should be banned. Legislation is needed to prevent construction on nesting beaches or the installation of features, such as powerful beach lighting, which

are likely to have a negative impact on turtle nesting success.

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