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Source: Journal of East African Natural History, 92(1) : 127-134

Published By: Nature Kenya/East African Natural History Society

URL: [https://doi.org/10.2982/0012-8317\(2003\)92\[127:OOSTNO\]2.0.CO;2](https://doi.org/10.2982/0012-8317(2003)92[127:OOSTNO]2.0.CO;2)

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## OBSERVATIONS OF SEA TURTLES NESTING ON MISALI ISLAND, PEMBA

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### ABSTRACT

A nest-recording programme has collected data over five years from turtles nesting on Misali Island, off the west coast of Pemba, Tanzania. Five species of sea turtle are known to occur in Zanzibar waters, two of these species nested regularly on the island, with green turtle nests outnumbering hawksbill turtle nests by a factor of roughly 3 to 1. The highest number of nests in one year was recorded in 1999 (66) with as few as 8 in 2001. Most green turtles nested in April whilst most hawksbills nested in March. 58% of nests were found on a single beach (Mpapaini). The hatching success of nests over the study period exceeded 70%. Data indicate that Misali Island is an important nesting site within Zanzibar and also suggest that it may be of East African regional importance.

### INTRODUCTION

Five species of sea turtle are known to occur in the Western Indian Ocean Region (WIOR): green turtle *Chelonia mydas* (Linnaeus, 1758); hawksbill *Eretmochelys imbricata* (Linnaeus, 1766); loggerhead *Caretta caretta* (Linnaeus, 1758); olive ridley *Lepidochelys olivacea* (Eschscholtz, 1829); leatherback *Dermochelys coriacea* (Linnaeus, 1766) (Frazier, 1976). Major threats to these populations are well established and include: the incidental catch of sea turtles in fishing nets, the killing of adults and juveniles by harmful fishing practices, the direct harvesting of adults and eggs by man, predation of eggs and hatchlings and the destruction or modification of suitable nesting habitat. Sea turtles are protected under international law and, in Tanzania, under 1988 Fisheries Legislation that prohibits their capture. Despite this, nesting populations of sea turtles in Tanzania continue to decline (Frazier, 1976; Jiddawi & Muhando, 1990; Thiagarajan, 1991). Effective management and conservation strategies are therefore required in order to ensure their long-term survival. The foundation of such strategies is an assessment of relative population size, without which threats to turtle populations cannot be accurately evaluated.

All of the species known to occur in the WIOR have also been recorded from Zanzibar waters. Although the leatherback turtle has been noted as nesting on Zanzibar (Frazier, 1976) the paucity of information on this species suggests that Zanzibar is not an important nesting site for this species. Similarly, whilst the olive ridley turtle has been reported from Zanzibar waters (Frazier, 1976) there are no records of the species nesting in the Zanzibar region and there is only one confirmed nesting record from the whole of Tanzania, on the now submerged Maziwi Island (Frazier, 1976). Furthermore, the loggerhead turtle does not appear to nest in Tanzania (Frazier, 1976). Therefore, it is only green and hawksbill turtles that have been observed to nest in significant numbers in Tanzania. Both of these species have been confirmed as nesting on Zanzibar beaches (Khatib, 1998).

On Pemba, recent information regarding nesting activity is based on reports collated either from interviews with local fisherman or from village-based observer programmes (Clark & Khatib, 1993). Such studies are extremely useful in determining the presence or absence of nesting sea turtles over large areas, however there is a lack of sufficiently detailed information (e.g. accurate and standardised nesting counts) with which to gauge the significance of Pemba's beaches as turtle nesting sites within Zanzibar and the wider East African region. Furthermore, there is anecdotal evidence that suggests that Misali Island may be an important nesting ground for green and hawksbill turtles.

This paper summarises the findings of a five-year turtle monitoring programme based on Misali Island, Pemba. The programme's aims were to determine: a) the regional importance of Misali as a turtle nesting site, b) the principle nesting beaches on Misali, c) the current threats to the nesting population and d) to develop a baseline of information from which to improve local management capability and regional co-operative efforts. Although a small island (approximately 0.9 km<sup>2</sup>), the data that has been collected represents an important source of information for sea turtles in Zanzibar, since detailed nesting counts from this region are rare.

## MATERIALS AND METHODS

A nest recording programme was initiated in January 1998 on Misali Island, Pemba. Misali is located approximately 10 km offshore from the west coast of Pemba (S 05°14', E 039°36') (figure 1). Pemba and her larger sister island, Unguja, form the greater part of the Zanzibar archipelago, situated off the east coast of Tanzania in the Western Indian Ocean. Rangers patrol the island's beaches daily to check for signs of turtle activity and record all sightings and data in a turtle logbook. Information collected includes species nesting, date, time and location of the nest, track diameter, carapace diameter (where possible) and remarks relating to hatching success.

## RESULTS

Only green and hawksbill turtles were recorded nesting over the five-year study period. A total of 165 nests were recorded in this time. However, the number of nests recorded per year varied greatly between the different years of the study period (mean 33, range 8 (2001) to 66 (1999), figure 2). The ratio of green to hawksbill nests was 123:42.

Both species were recorded as nesting throughout the year during the study period (table 1). The largest monthly total was seen in March (28 nests over 5 years). However the

peaks for each species differed slightly, green turtles peaking in April, hawksbills one month earlier in March. In both cases there was a steady climb in nesting activity from a low around September to November to the subsequent peak nesting seasons in March and April (figure 3).

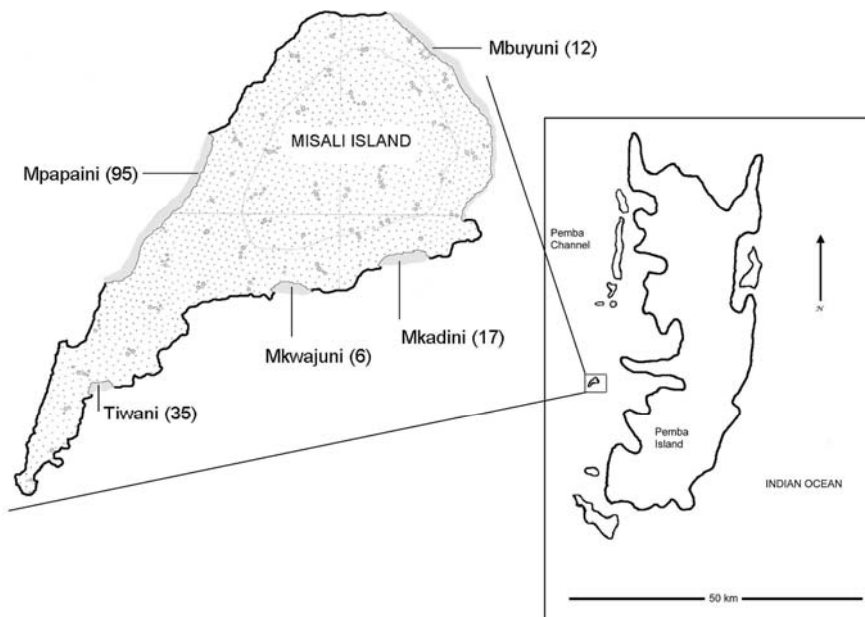


Figure 1. Location map of Pemba and Misali Islands. Figures in brackets after Misali beach names indicate the number of nests recorded (both species) at each beach over the study period.

Turtle nests were recorded from five beaches on Misali Island during the study period (figure 1). The vast majority of turtles nested on one of two beaches: Mpapaini (95 nests) and Tiwani (35 nests). Significant numbers of nests were also recorded from Mkadini (17) and Mbuyuni (12) beaches with additional low numbers of nests recorded from Mkwajuni (6). There was no significant difference between species in the preferred location for nesting.

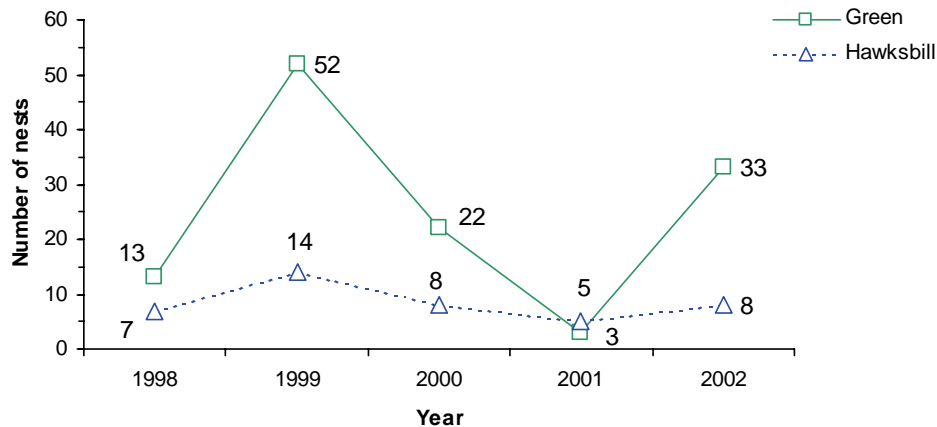


Figure 2. Number of nests recorded in each year of the study period, both species.

Table 1. Number of nests recorded in each month for each year over the study period.

Month	1998	1999	2000	2001	2002	Green	Hawksbill	Mean	Stdev	Total
Jan	4	2	3	2	0	4	7	2.50	1.48	11
Feb	3	3	3	4	5	14	4	5.33	0.89	18
Mar	5	12	2	0	9	19	9	7.83	4.93	28
Apr	3	15	3	0	6	22	5	8.17	5.77	27
May	0	16	2	1	0	16	3	5.83	6.87	19
Jun	0	6	3	1	1	10	1	3.50	2.39	11
Jul	3	6	3	0	3	14	1	4.83	2.12	15
Aug	1	4	1	0	3	8	1	2.83	1.64	9
Sep	0	2	0	0	5	7	0	2.33	2.19	7
Oct	0	0	3	0	2	4	1	1.50	1.41	5
Nov	0	0	3	0	1	2	2	1.00	1.30	4
Dec	1	0	4	0	6	3	8	2.33	2.68	11
Total	20	66	30	8	41	123	42			165

The average number of eggs per nest was slightly larger for hawksbill turtles (155, range 116 to 188). However, large numbers of eggs were also recorded from green turtle nests (139, range 93 to 183). On average, the hatching success of individual nests (the proportion of eggs from each nest that had hatched) exceeded 70% for both species. The mean number of hatchlings that emerged from each nest over the study period was 113 (green) and 121 (hawksbill). The average incubation period was 78 and 69 days for green and hawksbill turtles respectively (table 2). Given the seasonal peaks observed in nesting activity (March and April) subsequent peaks in hatching activity would be expected to occur during May and June.

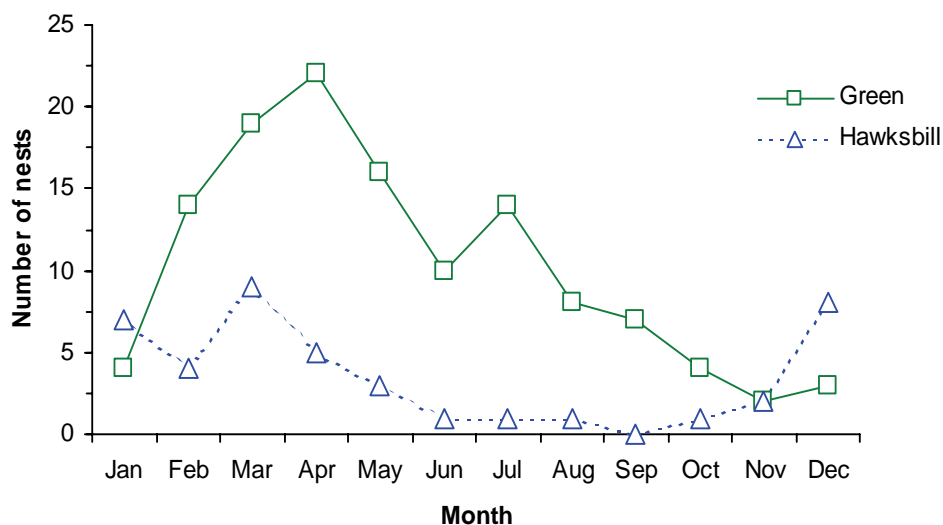


Figure 3. Seasonal distribution of turtle nesting activity over the study period, both species.

Table 2. Summary of hatching data recorded over the study period.

Species	Green	Hawksbill
No. hatching events recorded	19	8
Mean No. eggs	139.44	155.33
Range eggs	(93-183)	(116-188)
Mean No. hatchlings	112.94	121.00
Mean unhatched	26.50	34.67
% Mortality	19.00	22.32
Mean incubation (days)	77.83	69.33

## DISCUSSION

### Number of turtles nesting on Misali Island

Population size estimates from more than twenty years ago put the total of nesting green turtles in the whole of Tanzania at approximately 200 to 300 females (Frazier, 1976, 1982). The majority of these were thought to nest on a single island (Maziwi Island, lying approximately 10 km offshore from the Tanzanian mainland between the islands of Unguja and Pemba). The remainder were thought to nest primarily on the small islands near Mafia (less than one hundred) with a relatively small amount of nesting occurring on the mainland beaches (Frazier, 1976). At this time, Maziwi Island was considered to be the most important green turtle breeding ground in East Africa (Frazier, 1976). The island was submerged by high tides in the early 1980s (Fay, 1992) and has been reported to be no longer suitable for nesting (Howell, 1993). Following the loss of such an important breeding ground, conservation efforts must focus on the remaining key sites in the region where concentrated numbers of nests are found.

Besides Maziwi Island, there are very few sites in Tanzania where concentrated numbers of nests have been recorded. Along the mainland coastline, although nesting is known to occur in many locations, nests are typically recorded in relatively low densities at each site. For example, at Mkwaja (100 km south of Tanga) the highest annual nest count in nine years of monitoring was 26 nests along a 5 km stretch of beach (B. Fox, pers. comm.). In the Saadani region, twenty days of observation during August-September 1991 found five green turtle nests along a 1.5 km stretch of beach (Howell, 1993). There are reportedly good nesting beaches along much of the Mtwara coastline but interviews with local resource users suggest that disturbance and heavy exploitation has led to most nesting occurring offshore (Howell, 1993).

On the largest of the offshore islands, Unguja, the vast majority of nesting sites around the island have less than five nests recorded per year (Khatib, 1998). In the same study, the highest number of nests recorded per year at a single location was 18 at Mnemba Island, followed by 17 at Matemwe. The total number of nests recorded from the 12 most important nesting sites in all of the coastal areas of Unguja was 52 (predominantly green with some hawksbill nests). By some contrast, the Mafia Island group has higher numbers of turtles nesting, with an average of 150 green and between five and ten hawksbill nests recorded per year between 2001 and 2003 (C. Muir, pers. comm.). Juani Island on the east coast of Mafia has the highest number of nests recorded from a single island within the Mafia group, where

72 green turtle nests were recorded in 2002 and a further 47 in 2003 (C. Muir, pers. comm.). On Misali Island, 52 green and 14 hawksbill nests were recorded in 1999 (this study). Early indications are that the average hatching success of nests at Misali exceeds 70%, suggesting that the reproductive success of these nests is high. To the authors' knowledge there are no other outstanding locations within the country where nesting densities reach similar levels. Such figures are therefore highly suggestive that Misali is one of the few remaining sites certainly in Zanzibar and probably in Tanzania where green, and to a lesser extent, hawksbill turtles nest in large numbers at a single location. Furthermore, if Maziwi Island was once the most important green turtle breeding ground in the whole of East Africa with less than one hundred females nesting annually (Frazier, 1976), but is no longer suitable for breeding, then Misali in its own right must be an important green turtle breeding ground in the East African region, and possibly also in the WIOR.

### Threats to turtles and their nests at Misali Island

Whilst nesting sites in other parts of Tanzania and, particularly on the mainland, may have already been degraded by human activity (Frazier, 1976; Thiagarajan, 1991; Howell, 1993), the situation on Misali is currently considerably more encouraging. Both the terrestrial and marine environments of Misali are 'relatively undisturbed' when compared to other coastal areas in Zanzibar (Horrill *et al.*, 1994, pers. obs.). Whilst threats to sea turtles on Misali do still exist, they appear to be of significantly less concern than those experienced on Unguja (Khatib, 1998) and the mainland.

Natural threats include the predation of hatchlings and beach erosion. Predation of hatchlings by the ghost crabs *Ocypode ceratophthalmus* (Pallas, 1872) and *O. ryderi* (Kingsley, 1881) occurs on the island (P. Pizzolla, pers. comm.). However, predators that may be a threat to nests on the Tanzanian mainland, such as the honey badger *Mellivora capensis* (Schreber, 1776) and genet *Genetta sp.*, (Howell, 1993) are absent from Misali. Furthermore, no signs of nest predation were observed over the study period (S. Uleid, pers. comm.). Evidence therefore suggests that predation is not a particular concern at Misali.

Beach erosion occurs in response to the shifting wind patterns that alter the longshore drift dynamics around the island during the Kuzi and Kaskazi monsoon seasons (June to September and November to March respectively). The beach profiles and sand depths on at least two of the major nesting beaches (Mbuyuni and Mpapaini) can alter radically during these times (pers. obs.). Subsequently, areas of beach that are normally above the high water mark may be sporadically washed at certain times of the year when the wind patterns change. Although the total number of nests affected by this process each year is very small (no more than five, S. Uleid, pers. comm.), inevitably some nests are still inundated or washed during spring tides. Beach erosion was responsible for the destruction of Tanzania's former premier sea turtle nesting site, Maziwi Island (Fay, 1992). Although evidence suggests that beach erosion is not a significant problem at present, it has the potential to drastically reduce the area of available nesting habitat given the small size of the island.

Anthropogenic threats may be of more immediate concern. The whole of Zanzibar has a long history of sea turtle utilization, once acting as the major clearing house for turtle shell from all over the Western Indian Ocean (Frazier, 1982). The average total catch of turtles per annum by fishermen on Unguja alone has been estimated to be as many as 1000 (Thiagarajan, 1991). Fishermen on Misali and the surrounding coastal areas of Pemba are commonly skilled at catching turtles (on an opportunistic basis), as traditional knowledge has been passed down the generations. On Misali, the evidence is that anthropogenic threats are well controlled and do not currently pose a significant threat to the nesting females or their

nests. The presence of rangers on the island does much to negate egg collection activities and the capture and killing of nesting adults. There are no records of egg collection occurring over the study period and it is unlikely that this activity occurred without going unnoticed (S. Uleid, pers. comm.).

Two incidences of the deliberate capture of nesting adults were recorded over the study period. In a further separate incident rangers disturbed a small group of fishermen attempting to slaughter a green turtle as she made her returning crawl. In all of these cases rangers intervened and the turtle was observed to return to the sea. Such incidents often seem to involve fishermen who are not regular visitors to the island. These groups will not have been influenced by the education and awareness activities that are designed to target the island's primary resource users and as a result, may be unfamiliar with the set-up of the conservation area. However, the vast majority of turtles over the study period were observed to return safely to the water following nesting. Incidental catches of sea turtles from the island's surrounding waters also appear to be uncommon and there is evidence that turtles, when caught, are often returned to the sea unharmed. There is no evidence to suggest that sea turtles are ever the targeted catch but rather that they are a bycatch of the fishing nets set overnight for reef fish, having become entangled as they either forage or emerge for nesting. International legislation such as the Convention on International Trade in Endangered Species (CITES) is currently acting to curb international trade in turtle products and as a result the market for Zanzibar turtle shell has greatly reduced (Howell, 1993).

Despite being leased by the Government of Zanzibar to a private company for hotel development in 1993 (a decision which was subsequently reversed), Misali has so far escaped any large-scale development. There are no permanent buildings in close proximity to nesting beaches. However, structures do exist on two beaches on the island. At Mbuyuni Beach there is one main shelter that houses the ranger station and information centre and several other smaller shelters around a temporary fishermen's camp. There is also a second collection of temporary fishermen's shelters at Mkadini Beach. Shelters are unobtrusive and are generally temporary structures (with the exception of the information centre) and do not have any of the features of more permanent coastal structures (e.g. concrete walls and extensive artificial lighting). However, the small size of the island and beaches raises the possibility that the area of suitable nesting habitat might be decreased by these structures. Additionally, turtles that emerge and nest close to human activity may be at increased risk of disturbance or capture. Significantly there are currently no shelters and very little human activity around the main nesting area at Mpapaini Beach.

Misali was gazetted as a conservation area in 1998 and is actively managed by the Misali Island Conservation Association (MICA) through a team of rangers that are resident on the island on a rotational basis. The main implementations are a 1.4 km<sup>2</sup> non-extraction zone enclosing the waters opposite Mpapaini Beach where fishing (and any other activities that deplete the area's natural resources) are not permitted. The non-extraction zone encloses the major nesting site at Mpapaini Beach, which further reduces the risk posed by fishing nets to turtles transiting this area. Additionally, the entire area of Mpapaini Beach is a designated turtle conversation area, which prohibits any activity with the potential to impact on the beach's qualities as a turtle nesting site.

### **Conclusions and Recommendations**

Results suggest that Misali's beaches are of East African regional importance as a breeding ground for green and, to a lesser extent, hawksbill turtles. Additionally, the superiority of the critical nesting habitat offered by Misali, together with the small size of the island and the management infrastructure already in place, all make Misali an extremely important



candidate for conservation efforts. In order to secure the long-term viability of the breeding ground, Misali must be made a priority for conservation and management initiatives. It should be given a protective status to reflect the importance of the breeding ground and any future plans for construction on or development of the island and surrounding waters, which would be detrimental to sea turtles or their habitat, must be prevented. Data collection methods between different incipient projects within Zanzibar should be standardised and data combined to produce new population size estimates for the Zanzibar region. The Misali Island Sea Turtle Monitoring Programme (MITMP) must be provided with an annual budget sufficient to buy necessary equipment, to enforce conservation measures and to fund future data collection and reporting. This must be used to establish a standardized long-term record of nesting activity, allowing for the eventual detection of trends in the nesting population. At national and international levels, it is vital that Tanzania recognises and fosters Misali's status as a turtle breeding ground, implements measures to afford greater protection to migrating turtles and further engages in international efforts to protect these species beyond the confines of national boundaries.

### ACKNOWLEDGEMENTS

This paper is the result of work conducted during the Frontier-Tanzania Marine Research Programme. Frontier-Tanzania is a collaboration between the Society for Environmental Exploration and the University of Dar es Salaam including the Institute of Marine Sciences. The authors gratefully acknowledge assistance received from the Misali Island Rangers.

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