



International Journal of Fisheries and Aquatic Studies

E-ISSN: 2347-5129

P-ISSN: 2394-0506

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.549

IJFAS 2018; 6(6): 193-198

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www.fisheriesjournal.com

Received: 28-09-2018

Accepted: 29-10-2018

Pushpa Palaniappan

Borneo Marine Research
Institute, Universiti Malaysia
Sabah, Jalan UMS, Kota
Kinabalu, Sabah, Malaysia

Nur Nabila Naqiah Nazuhar

Borneo Marine Research
Institute, Universiti Malaysia
Sabah, Jalan UMS, Kota
Kinabalu, Sabah, Malaysia

Muhammad Ali Syed Hussein

Borneo Marine Research
Institute, Universiti Malaysia
Sabah, Jalan UMS, Kota
Kinabalu, Sabah, Malaysia

Quantifying the nesting density and assessing the potential threats to sea turtles in Kuala Penyu, Sabah, Malaysia

Pushpa Palaniappan, Nur Nabila Naqiah Nazuhar and Muhammad Ali Syed Hussein

Abstract

There are 3 species of sea turtles that have been reported to nest in Sabah – the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and olive ridley (*Lepidochelys olivacea*). The most abundant sea turtle nesting areas are on the east coast of Sabah, specifically at the 3 islands of the Turtle Islands Park in Sandakan (Selingan, Gulisaan and Bakkungaan Kechil); and Sipadan off Semporna. The Kuala Penyu district, located on the west coast of Sabah, was historically known to host abundant nesting turtles, and efforts are now being undertaken to revive the population of sea turtles in this area. This study quantified the nesting density of sea turtles from Kuala Penyu to Menumbok, and assessed the potential threats to these turtles. Interviews and beach surveys were conducted from December 2014 until March 2016 to gather evidence and local knowledge as well as historical data of the turtles in this area. It was found that nesting is very sporadic and only one hawksbill turtle nest was reported during the entire duration of this study. Also, the main threats to the turtles here are illegal harvesting of turtle eggs and incidental capture of turtles in fishing gear.

Keywords: Hawksbill turtle nest, illegal harvest, incidental capture, Borneo

1. Introduction

Sea turtles belong to the order Chelonii, so-called because of the bony plates on the outer surface of the body. At present, only two families of sea turtles have survived - the Dermochelyidae where only species exists, and the Cheloniidae with six species [1]. Sea turtles are air-breathing animals that spend almost all of their life in the sea. All turtles have a similar life cycle [2]. They breed at specific areas where conditions are appropriate for the hatching of eggs deposited in the sand. Hatchlings emerge from the sand after approximately two months, depending on the species and nest temperature. These hatchlings crawl toward the sea and are rarely seen again until almost 20 years later. Sea turtles return to nest several times within a season, at intervals of ten days to two weeks. Each clutch of eggs contains an average of a hundred eggs. Many sea turtle populations throughout the world are in serious decline. In ancient times, they were able to roam the seas freely but are now threatened by excessive commercial exploitation, habitat destruction, pollution and incidental drowning in fishing gear [3-5].

Only four species of turtles, that is the leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and olive ridley (*Lepidochelys olivacea*), were reported to nest in Malaysia [3]. Three species are known to nest in Sabah – greens, hawksbills and olive ridleys [6]. Among the species, the green turtle seems to be the most prominent as it is able to nest in many of the beaches here. Historical records indicate that many of the world's green turtle nesting colonies have been greatly reduced to paltry numbers of individuals [7]. Taking this into consideration, the Government has taken steps to conserve the turtle resources in Malaysia. Sea turtle conservation programmes carried out in several parts of the world have shown that serious long-term conservation efforts can contribute towards the recovery of once depleted populations. On the Tongaland coast of KwaZulu-Natal in South Africa, a 32-year protection and monitoring programme on the leatherbacks have resulted in a five-fold increase in the population where an initial of twenty nesting females per season has increased to over one hundred per season [8].

Correspondence

Pushpa Palaniappan

Borneo Marine Research
Institute, Universiti Malaysia
Sabah, Jalan UMS, Kota
Kinabalu, Sabah, Malaysia

In St. Croix, U.S. Virgin Islands, a conservation programme involving saturation tagging and protection of nests from erosion, tidal inundation, predation and poaching, which has been carried out since 1981 has similarly shown a population increase from about twenty nesting leatherbacks per year to over fifty in the mid-1990s [9].

The green turtles of the Sabah Turtle Islands in Malaysia have also experienced a population recovery through strict conservation measures that were implemented since the 1960s [3]. Conservation measures include strict enforcement and the compulsory acquisition of the Turtle Islands by the Sabah Government where the islands were later reconstituted as a state park, which led to complete protection of all the eggs that were deposited there. In 1988, the nesting population showed initial signs of recovery and in 1991, a record of almost 13,000 egg clutches were laid by these turtles. More than 4 million hatchlings have been released into the wild over a period of 15 years. Sabah Parks, the administrator of the Sabah Turtle Islands received the distinction of being the co-recipient of the J. Paul Getty Wildlife Conservation Award in 1997 for their efforts in conserving the green turtle resources of Sabah. The green turtle nesting population of the French Frigate Shoals in the Hawaiian Islands were also reported to have shown an upward trend from the early 1980s, which was attributed to their protection under the U.S. Endangered Species Act [10]. The French Frigate Shoals, managed by the U.S. Fish and Wildlife Service, is part of the Hawaiian Islands National Wildlife Refuge.

Kuala Penyu was famous for its sea turtles – the name of this district translates to ‘Sea Turtle Estuary’, however the number of turtle landings or nests were never formally documented. This study focuses on quantifying the nesting density and assessing the potential threats to sea turtles in the Kuala Penyu district, located on the west coast of Sabah (Kuala

Penyu to Menumbok). The specific objectives of the study were to determine the nesting sites and number of landings of sea turtles and to determine potential threats to sea turtles in this area.

2. Materials and methods

A reconnaissance trip was conducted on 4 December 2014 from Kuala Penyu to Menumbok (Fig. 1) and the study area was divided into 4 sections and 20 stations where each Section consisted of 5 stations (Table 1). The main objective of this trip was to scout the beaches of the study area and to determine their suitability as nesting beaches for sea turtles. The potential threats to sea turtles were also noted. The field visits and interview surveys were carried out from January 2015 until March 2016. The respondents were asked a series of questions based on a questionnaire to collect historical data (approximately for the past 10 years) on sea turtles in the Kuala Penyu district. The beach surveys were conducted on 26 November 2015 using the vessel UMS Stenella. Data collected during the surveys were noted in a data sheet. The surveys were conducted on the day of the full moon to ensure that we could view the conditions of the beach during the highest tides, giving us the turtles’ point-of-view as they made their way up the beach (the process of nesting is exhaustive and the adult female uses up a lot of energy during this time (she is unable to eat during the nesting season as her body is full of eggs and stored fat for energy). She has to crawl up the beach, dig the body pit and egg chamber, lay the eggs, cover the egg chamber then camouflage the nest. The whole process takes about 3 hours. The turtle tends to go ashore with the high tide in order to avoid having to make a long crawl to the beach during the low tide). Significance was at the 0.05 level for all the statistical tests used to analyze the data collected in this study.

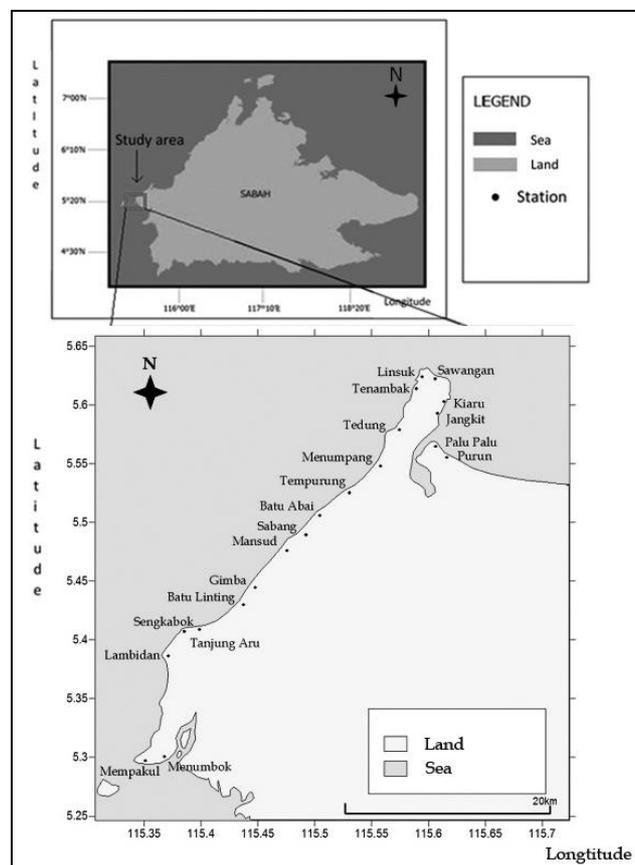


Fig 1: Map of the study area showing the 20 stations in the district of Kuala Penyu, located on the west coast of Sabah, Malaysia.

Table 1: Details of the sampling stations in Kuala Penyu, Sabah.

Section/Station	Name (GPS Location)	Section/Station	Name (GPS Location)
1/1	Purun (5.56°N, 115.62°E)	3/11	Batu Abai (5.53°N, 115.52°E)
1/2	Palu Palu (5.57°N, 115.60°E)	3/12	Sabang (5.51°N, 115.50°E)
1/3	Jangkit (5.59°N, 115.61°E)	3/13	Mansud (5.49°N, 115.48°E)
1/4	Kiaru (5.60°N, 115.61°E)	3/14	Gimba (5.47°N, 115.47°E)
1/5	Sawangan (5.62°N, 115.61°E)	3/15	Batu Lintang (5.46°N, 115.45°E)
2/6	Linsuk (5.62°N, 115.59°E)	4/16	Tanjung Aru (5.41°N, 115.40°E)
2/7	Tenambak (5.61°N, 115.58°E)	4/17	Sengkabok (5.40°N, 115.38°E)
2/8	Tedung (5.58°N, 115.57°E)	4/18	Lambidan (5.38°N, 115.37°E)
2/9	Menumpang (5.56°N, 115.56°E)	4/19	Mempakul (5.30°N, 115.35°E)
2/10	Tempurung (5.53°N, 115.54°E)	4/20	Menumbok (5.30°N, 115.37°E)

3. Results and Discussion

The reconnaissance trip that was conducted on 4 December 2014 was very useful. We found the location of the hawksbill turtle nest (104 eggs) that was deposited in Menumpang (Station 9) in April 2014. The protection of this nest marked the commencement of the Turtle Hatchery Programme by the Sabah Wildlife Department. A second hawksbill nest (112 eggs) was deposited in Bedungun (located close to Tedung (Station 8) on 1 June 2014. The beach area in Bedungun was found to be ideal for sea turtle nesting activity – as it had a wide and almost flat beach which would enable turtles to crawl up easily to deposit their eggs near the vegetation ^[11]. During this trip, we found many beaches that were suitable for the nesting activity of sea turtles, however there were also man-made obstacles in the form of sea walls and beach debris that prevented sea turtles from nesting on the beach. Seawalls do pose a problem for loggerhead sea turtles in Florida, USA in terms of landing area, however they found that beach erosion is a more serious threat to established nesting beaches ^[12]. Eroding beaches would cause 100% mortality of nests located low on the beach. Another study conducted in the same year and location also found that the nesting patterns of loggerheads in the same state were affected by seawalls ^[13]. These seawalls were constructed to prevent erosion caused by the rising of sea levels and frequent storms.

Most of the available literature on marine debris on beaches dealt with the effects of ingestion by sea turtles ^[14-16]. Beach debris is a hindrance for adult female turtles as it prevents them from easily crawling up the beach, and if a turtle is successful in nesting, the emerging hatchlings would also find it difficult to crawl down the beach without colliding with beach debris. There was only one hawksbill turtle nest reported during the entire study period – on 3 March 2016. The clutch contained 100 eggs and was found in Tempurung (Station 10). The eggs were translocated to the Tempurung Golden Beach Resort in order to be protected. Although the villagers meant well, their efforts are believed to be in vain. The clutch of eggs was split into two, with 50 eggs placed in each nest. The recommended measure is to place the whole clutch of eggs into one nest so as to increase their chances of survival ^[17]. Also, the eggs were placed at a very shallow depth (less than 30 cm), whereas the recommended depth for hawksbill eggs is 45 cm ^[17]. It may be possible that other turtle nests deposited in the district of Kuala Penyu during the duration of this study may have gone unreported.

A total of 90 respondents were interviewed in the Kuala Penyu district and they consisted of various tribal communities (Fig. 2). Although there were several different tribal communities, the highest number of respondents was

Bajau (n = 28). Fig. 3 shows the breakdown of results regarding the consumption of sea turtle eggs and meat by the respondents. We found that all the tribal communities admitted to eating sea turtle eggs and the Dusun (n = 1) and Bisaya (n = 1) tribal communities further admitted to consuming sea turtle meat as well. Further analysis found that there was no significant relationship between the tribal communities and their preferences towards consuming turtle eggs ($\chi^2 = 2.16$, $df = 6$, $p = 0.904$). As highlighted in Fig. 4, all areas of Kuala Penyu had egg-harvesting activities, however Section 2, consisting of the areas Linsuk, Tenambak, Tedung, Menumpang and Tempurung (Stations 6 to 10), exhibited the statistically highest number in the past 10 years ($\chi^2 = 21.68$, $df = 3$, $p < 0.000$). This corresponds to the areas where the sea turtle nests were found and later protected in 2014 and in March this year. According to the Sabah Wildlife Conservation Enactment 1997, it is against the law to consume sea turtle eggs or meat in Sabah. A person who is convicted of collecting or possessing, or selling turtle eggs or meat will be fined Ringgit Malaysia 50,000.00 or imprisoned for 5 years, or both. Many of the tribal communities in the district of Kuala Penyu live in poverty, therefore sea turtle meat and/or eggs may be one of their main sources of subsistence, albeit an illegal one.

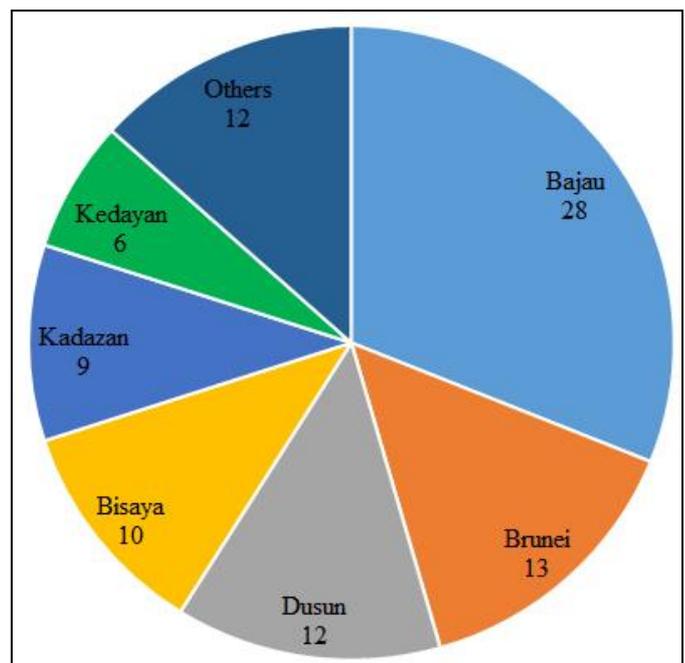


Fig 2: The number of respondents from the different tribal communities interviewed in the Kuala Penyu district.

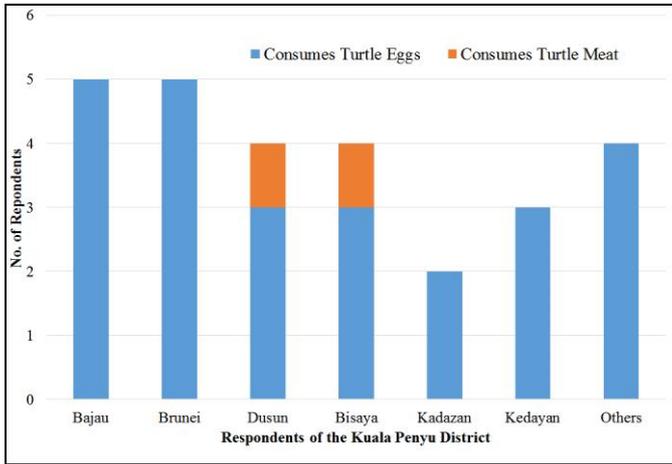


Fig 3: Consumption of sea turtle eggs and meat by the respondents in the Kuala Penyu district.

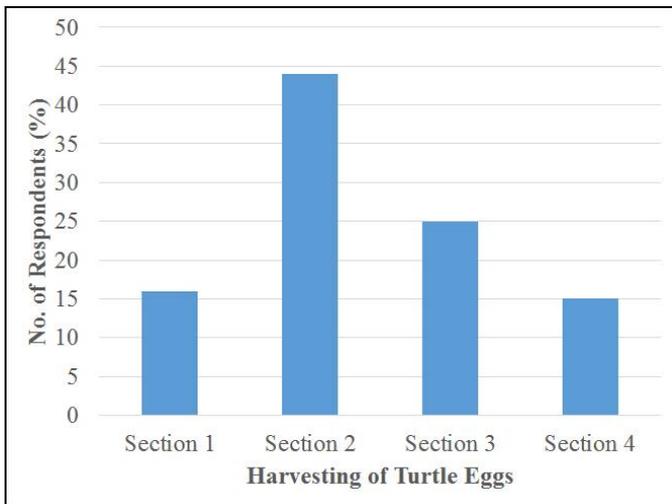


Fig 4: The percentage of respondents who admitted to harvesting turtle eggs in the Kuala Penyu district.

Sea turtles around the world are subjected to various forms of threats on land and at sea in the form of poaching [4] and incidental capture [5, 18-27]. The Kuala Penyu respondents also noted that turtles were victims of incidental capture in fishing gear in all Sections of the study area, however Sections 2 and 4 were more statistically prone to entanglements in fishing gear ($\chi^2 = 26.54$, $df = 3$, $p < 0.000$) as shown in Fig. 5. Table 2 shows the different types of fishing gear used in the Kuala Penyu district by the respondents interviewed. They also mentioned the various threats to the sea turtles in this area – smuggling of turtle parts, oil spill contaminants, effects of marine debris, illegal egg harvest, injuries from boat propellers, illegal fish bombing, and light pollution which may hinder nesting female turtles and hatchlings returning to the sea. Although drag and submerged nets are the dominant types of fishing gear used in the Kuala Penyu district, the greatest threat to sea turtles is trawler nets ($n = 31$) and displayed in Fig. 6. Further analysis showed that these results were statistically significant ($\chi^2 = 87.96$, $df = 7$, $p < 0.000$). The trawler net is a major threat because the turtles that are caught in this net may drown while the net is active (approximately 3 hours). Although the Turtle Excluder Device (TED) is a possible resolution to this problem, it is not widely used in Sabah and has not been made compulsory by the authorities yet.

Table 2: The types of fishing gear used in the Kuala Penyu district.

Type of Fishing Gear Used	No. of Respondents
Spear-fishing	3
Trawler net	12
Drag net	27
Purse seine	6
Submerged net	26
Fishing line	6
Fish trap	1
Cast net	15
Total	96*

*A total of 6 respondents used more than one type of fishing gear.

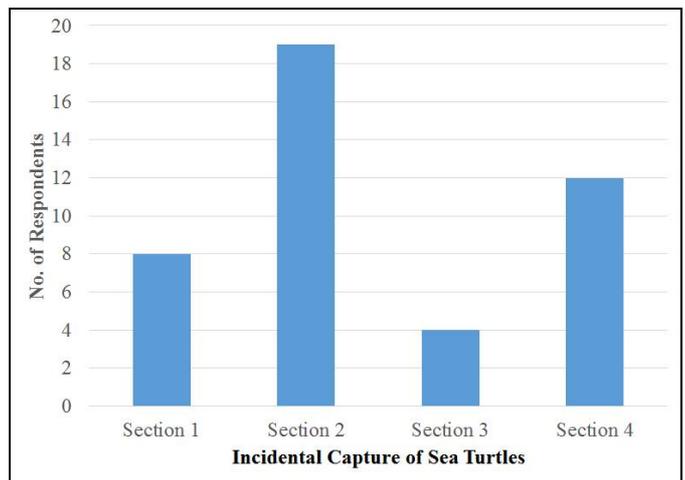


Fig 5: Incidental capture of sea turtles in the Kuala Penyu district.

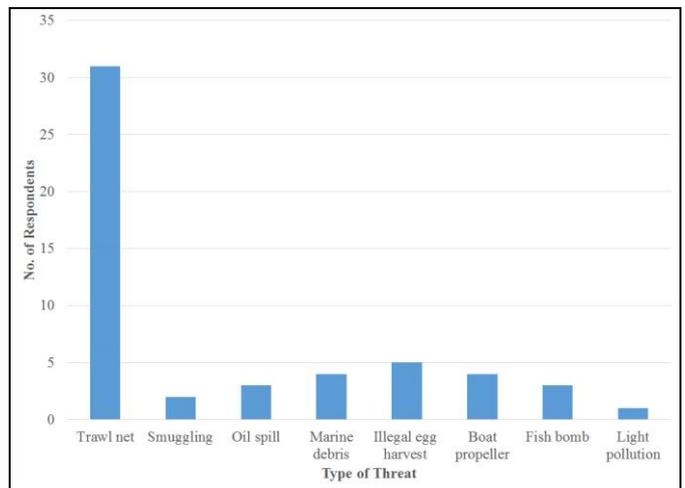


Fig 6: The types of threats to sea turtles in the Kuala Penyu district.

We found that Menumpang (Station 9) and Tempurung (Station 10) were the most ideal beaches for sea turtles to land and nest in the Kuala Penyu district. The sand at these beaches is fine, the beach has no steep incline and has no rocky area, and there were no signs of beach erosion here. Both these beaches had recorded nesting activity in 2014 and 2016. The beaches at Jangkit and Mepakul (Stations 3 and 19) were the least ideal areas for sea turtle nesting activity. These beaches had rocky areas and limited sandy areas for the turtles to nest. There was a groyne constructed in Jangkit to prevent beach erosion and this would have been a hindrance to sea turtles crawling up the beach. In Mepakul, the vegetation line was close to the beach, and nests constructed here would have been inundated by the sea water during very high tides, resulting in the drowning of embryos [28].

4. Conclusions

The district of Kuala Penyu has beaches that are ideal for sea turtle nesting activity, however the findings of this study has shown that the nesting activity is very sporadic. Field visits and interviews conducted from December 2014 until March 2016 found that only one hawksbill nest was reported in March 2016 and it was protected under the Turtle Hatchery Programme which commenced in 2014. Historical data sourced from interviews showed that the respondents noted the threats to sea turtles here were in the form of illegal harvest of sea turtle eggs as well as incidental capture in fishing gear. The results from this study will assist the Sabah Wildlife Department in managing, protecting and preserving the sea turtle resources in this area. It is hoped that Kuala Penyu may be successful in reviving the sea turtle population here someday, as proven in KwaZulu-Natal in South Africa and St. Croix, U.S. Virgin Islands.

5. Acknowledgements

We thank Universiti Malaysia Sabah for financing this study (SGPUMS/SPBK Research Grant No. SBK0181-STWN-2014). Assistance given by the Sabah Wildlife Department, a collaborator of this project, is gratefully acknowledged. The staff members of the Borneo Marine Research Institute (especially En. Ismail Tajul) of UMS; the student volunteers; and all the respondents who took the time to answer our questionnaires are sincerely thanked for their contribution towards this project.

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