ARTICLES

DO THE REDANG AND PERHENTIAN MARINE PARKS, MALAYSIA, PROVIDE SUFFICIENT PROTECTION TO INTERNESTING FEMALE GREEN TURTLES?

DANIEL QUILTER[1,2]

[1]Sea Turtle Research Unit (SEATRU), Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia

[2]Perhentian Turtle Project, Perhentian Islands, Terengganu, Malaysia

daniel@fuze-ecoteer.com

INTRODUCTION

An understanding of movements of sea turtles at their breeding and nesting grounds can help guide decision-making of marine park boundaries so that essential habitat is protected. The marine parks in Peninsular Malaysia extend to 2 nautical miles from the low-water line. Within the marine parks, fishing activities are prohibited; however, other boat-based activities, such as scuba diving and snorkelling, may still interfere with breeding and nesting turtles. The state of Terengganu has the highest green turtle nesting numbers in Peninsular Malaysia (Lang Tengah Turtle Watch, unpubl.; Perhentian Turtle Project, unpubl.; SEATRU, unpubl.; WWF Malaysia, unpubl.), with Redang Marine Park (3,000-6,000 nests per year) (Department of Fisheries, unpubl.) being the most significant rookery. Perhentian Marine Park is the second most important offshore rookery in Peninsular Malaysia, with 350-500 nests per year (Chan, unpubl.).

To date, only one turtle tracking study has been published on the internesting period for green turtles in Peninsular Malaysia. Liew & Chan (1993) successfully tracked three individual female turtles using biotelemetry equipment during the 1992 nesting season at Chagar Hutang, Redang Islands. There have been no published tracking studies of recreational boats in Malaysia to examine the waters used by both turtles and boat traffic. In 1999, Hays, *et al.* (1999) studied internesting green turtles in the Ascension Islands and found that nesting turtles stayed within 5km of their nesting beach and remained largely stationary during the internesting period. A similar study by Sloan *et al.* (2022) of green turtles nesting at Sanibel Island, Florida USA, in 2017, 2018 and 2019 showed different results. Nesting turtles were mobile, travelling between 11 and 30km per day. Six of the 14 tracked turtles went to the same seagrass patch 30km from the nesting beach and repeated the trip during subsequent internesting periods, suggesting that they foraged between nesting events. These studies suggest that there are at least two types of behaviour during the internesting period, the first being the turtles stay very close to their nesting beach and remain relatively sedentary and do not forage, and the second being that they are mobile and forage. The type of internesting behaviour could affect their interactions with vessels in the area.

The present study has two objectives: 1) to identify if the 2 nautical mile boundary of the marine parks in Malaysia is sufficient to protect nesting green turtles during their internesting period, and 2) to explore if tourism related boat traffic within the marine parks is a potential threat to interesting sea turtles. This research will provide evidence to improve current in-water conservation actions for nesting sea turtles in Peninsular Malaysia.

METHODS

Between May and July 2023 (peak season for nesting green turtles), an active acoustic tracking study was conducted in both the Redang and Perhentian Marine Parks. Acoustic tags were deployed on turtles nesting at Chagar Hutang, Redang Marine Park (n=24, ~10% of the Chagar Hutang nesting population), and at three beaches in the Perhentian Marine Park, Tanjung Tukas beach (n=6), Tiga Ruang beach (n=7), and Pasir Hantu village beach (n=1) (~25% of the nesting population at each beach). One acoustic tag (MM-M-16-50, 76 kHz, Lotek) was attached to each turtle with a removable harness after oviposition was completed (Figure 1). The harness had a metal ring positioned underneath the plastron which would rust and allow the harness to fall off if not removed by hand. Two photos were taken of each turtle, one of each side of the turtle's head, to capture the scale patterns for future identification. During the study, a turtle was opportunistically found near the main seagrass bed in the Perhentian Marine Park; an acoustic tag was attached to

Figure 1. Attaching the harness to hold an acoustic transmitter. A team of three people was sufficient, and the harnesses stayed on for over 20 days without coming loose. There were no observed abrasions or skin damage to the turtles. (Photo credit: Syamsyahidah Samsol)

allow the tracking of this animal.

Active tracking was conducted for 25 days in Redang Marine Park and 21 days in Perhentian Marine Park, approximately two nesting cycles. Two hydrophones (connected to a Lotek Acoutrack receiver) were deployed from a slow-moving speed-boat which followed the same transect route each day, when weather permitted, to detect nesting turtles carrying acoustic tags. During the survey an observer was towed in the water and they informed the on-surface team when they saw a sea turtle (Figure 2). The boat team recorded species, sex (if possible), activity, if it was carrying an acoustic tracker, and the GPS location of each individual turtle.

During the same period, GPS units (Protrack PT04W) were deployed on different types of recreational watercraft, 35 vessels in Redang Marine Park and 34 in Perhentian Marine Park. The GPS units recorded the boat movements and speeds every 10 seconds for the same period as the turtle tracking. The boats were observable live via a mobile app and the data were downloaded every week.

All methods were approved by the Animal Ethics Committee of Universiti Malaysia Terengganu, and the research was supported by the Department of Fisheries Malaysia.

Figure 2. a) Research assistants, Maciek Galisz and Nizam Rahman, looking for signals from the transmitters and recording data whilst b) Daniel Quilter is the in-water observer. Roles changed every 30 minutes. (Photo credit: Mann Aziz)

PRELIMINARY RESULTS

Sea Turtle Tracking

In Redang Marine Park, 20 of 24 individuals (83%) were detected within the park boundaries at least five times. The other turtles were not found inside the marine park in the water or seen nesting on any beach during the survey period. Eleven out of the identified 20 individuals that were recorded in the marine park nested at the same beach, Chagar Hutang, for a second nesting cycle; eight were observed nesting a third time at Chagar Hutang after which the acoustic tags were removed. The tracked turtles that were found moving within the Redang Marine Park but not observed nesting at Chagar Hutang most likely nested at other beaches. Hence, their acoustic tags could not be removed in person.

In Perhentian Marine Park, 11 of the 14 (79%) tagged turtles were observed within the park waters at least five times. Only four of the 11 were observed nesting at the same beach where they were tagged. Therefore, 73% of the tagged turtles were found moving within the marine park but not seen nesting at their original nesting beach.

One individual which nested and was deployed with a harness acoustic tag at Tanjung Tukas beach, Perhentian Marine Park, was observed 10 days later nesting at Mat Kepit beach, Redang Marine Park (a distance of 26km) where the acoustic tag was removed. In 2023, a total of three turtles were recorded nesting at both the Perhentian and Redang Marine Parks, one the turtle carrying an acoustic tag and the other two with uniquely numbered metal flipper tags. None of the nesting females observed during in-water surveys of either marine park were recorded foraging or resting in areas with seagrass patches.

Boat Tracking

Only scuba diving boats were observed in the 50% core habitat of the internesting resting areas in Perhentian Marine Park. No snorkel boats or villager boats were tracked in these areas. However, both scuba and villager boats were observed within the 50% core habitat areas, but with low frequency, in Redang Marine Park. The nesting turtles from both marine parks were not found resting in areas of high boat traffic.

RELEVANCE FOR SEA TURTLE CONSERVATION

Behaviour and Habitat Preference of Internesting Green Turtles

None of the internesting turtles in either marine park foraged or rested at known seagrass patches. Similarly, no internesting turtles were observed eating, suggesting they do not eat seagrass during the internesting period. Therefore, conservation actions to reduce disturbance of turtles could be important as the turtles would need to conserve energy during their nesting season, which could last longer than 12 weeks. Similar fasting behaviour was observed by Hays *et al.* (1999) with internesting green turtles at the Ascension Islands.

The study also suggests that 'foraging' and 'internesting' green turtles live in different parts of the Perhentian Marine Park and have limited interactions. This habitat preference difference is important for conservation planners to understand; turtles in different life-stages live in different areas and action plans should be adapted accordingly.

Changing of Nesting Beach

The study has shown that it is common for green turtles to nest at different beaches during the same nesting season and will travel as far as 26km to other nesting locations. The frequency of change of nesting beach is higher in Perhentian Marine Park, most likely due to the many small quiet nesting beaches located within the marine park whereas in Redang there are three large nesting beaches where the majority of the green turtles are known to nest. Therefore, conservation managers need to understand the nesting habits and adapt their beach monitoring technique. For example, rangers in Redang can focus on just three nesting beaches and in Perhentian they need to move among beaches, increasing costs in terms of manpower and transportation. The behaviour of changing of nesting beach needs to be further studied, especially the inter-connectivity between the Redang and Perhentian Marine Parks. We suggest monitoring through a large-scale flipper tagging program with a shared database to allow the full understanding of intra and inter connectivity between the nesting beaches and marine parks.

Boat Traffic

The study provides evidence that internesting turtles do not rest in areas of high boat traffic in either marine park. It is important to note that the preferred internesting resting locations identified in the Redang Marine Park are similar to those identified by Liew & Chan (1992). Combining the results of the two studies suggest that the habitat selection by internesting green turtles has not changed from 1992 to 2023, even though there has been an increased volume of tourism and hence tourism related boat traffic. Therefore, noise from boat traffic could be a disturbing factor for nesting turtles, but other abiotic (low current flow in which to

maintain position, suitable depth for neutral buoyancy) and biotic (proximity to mates) requirements could be more important factors than noise and threats from boats during the internesting period.

Protection by the Marine Parks

The majority (83% Redang MP and 79% Perhentian MP) of internesting green turtles were found within the boundaries of both marine parks during their internesting period and, therefore, protected against threats from commercial fishing vessels which are not allowed to enter. Boat strike from tourism vessels for internesting turtles can also be considered a low threat during the nesting season as the number of vessels entering the core habitat resting zones are low. However, mortality of adult turtles in the Perhentian Islands is high, with 25 individuals found stranded in 2023 when <60 nesting females were identified (Bubbles Turtle Project, unpubl.; Perhentian Turtle Project, unpubl.). Further study is required to understand the locations of foraging and nesting turtles during mating and migration seasons, alongside necropsy and stomach analysis studies of stranded turtles are needed to further understand this problem.

ACKNOWLEDGEMENTS

We would like to thank the Department of Fisheries, Malaysia, for giving permission to run this study and it was funded by the generous Yayasan Sime Darby. I would like to thank my supervisor Associate Professor Mohd Uzair Rusli and all the support from my colleagues at SEATRU. Thank you to my research team of Nizam, Maciek, Amir, Perhentian Turtle Project, Bubbles Dive Resort and all our various boatmen and volunteers during the surveys. Finally thank you to the mother turtles for allowing us to track them.

Literature cited:

Hays, G., P. Luschi, F. Papi, C. Seppia & R. Marsh. 1999. Changes in behaviour during the inter-nesting period and post-nesting migration for Ascension Island green turtles. *Marine Ecology Progress Series* 189: 263-273.

Liew, H.C. & E.H. Chan. 1993. Biotelemetry of green turtles (*Chelonia mydas*) in Pulau Redang, Malaysia during the internesting period. In: *Proceedings of the Twelfth International Symposium on Biotelemetry* (eds. Mancini, P., S. Fioretti, C. Cristalli & R. Bedinids). Pp 157-163. Litografia Felici: Pisa, Italy.

Sloan, K.A., D.S. Addison, A.T. Glinsky, A.M. Benscoter & K.M. Hart 2022. Inter-nesting movements, migratory pathways, and resident foraging areas of green sea turtles (*Chelonia mydas*) satellite-tagged in Southwest Florida. *Frontiers in Marine Science* 8: 775367. DOI: 10.3389/fmars.2021.775367/full.

HEALTH ASSESSMENTS OF SEA TURTLES IN MALAYSIAN WATERS: DETERMINING THE EFFECTS OF ORIGINS AND HUMAN-ANIMAL INTERACTIONS WITH BLOOD PROFILING

SYAMSYAHIDAH SAMSOL

Sea Turtle Research Unit (SEATRU), Universiti Malaysia Terengganu, Kuala Nerus, Terengganu, Malaysia

syamsyahidah@gmail.com

INTRODUCTION

The research project focuses on studying the health of sea turtles, primarily the green sea turtle. The species has a global distribution with distinct regional populations, and the research concentrates on nesting and foraging populations in Malaysia. The significance of this study lies in establishing reference values for wild (nesting and foraging) and captive sea turtles, which can help researchers compare health data across different age groups. These baseline data are currently lacking in Malaysia. Additionally, the research aims to examine the connection between the health of sea turtles in the wild and captivity and their interactions with humans, particularly in the context of ecotourism. Understanding the health of these species can help in their conservation and management.

The main research questions are:

1. What are the normal blood values for sea turtles from the South China Sea and the Celebes Sea, wild