

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.

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

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### 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

sea turtles during their nesting period and captive sea turtles during their rehabilitation period? This will provide a baseline for their health status.

2. How do the stable isotopes in the skin and blood of wild sea turtles vary and compare? This will help us understand their diet and habitat.

3. How do human interactions (tourism-related activities; e.g., boat tours, snorkelling, feeding, and beach recreation) alter the blood profiles of wild sea turtles? This will help us understand if human activities are impacting their health.

## METHODS

The research methods used in this study involved fieldwork, sample collection, and observations in the waters around Malaysia. The research was carried out from November 2021 until October 2022 at specific locations known to be important foraging and nesting habitats, and rehabilitation centres for sea turtles in Malaysia.

Wild turtles were captured by a team of scuba and free divers (Figure 1) in shallow waters at foraging sites, and post-oviposition at nesting sites; captive turtles were taken out of tanks at rehabilitation centres. The goal was to complete the capture and release process for each turtle in under 30 minutes to minimise stress. Turtle species, curved carapace length, and body weight were



Figure 1. Some of the research team from the Faculty of Science and Marine Environment and the Sea Turtle Research Unit at Universiti Malaysia Terengganu who performed comprehensive health assessments on sea turtles in the South China Sea region. From left to right: Firdaus (Abang Pie), Xin Li, Shazwani, Sharmani, Mustaqim, Aziz (Abang Man), Nicholas, Sanim, Syam, Pey Chen, Zharfan, Afif, Farhan, and Hafiz (Iman). (Photo credit: Adry)

recorded before a comprehensive health assessment was conducted for each turtle. This included a physical examination and assigning a body condition score. An assessment of external organisms like barnacles and algae was also performed, along with a check for visible injuries or signs of disease, such as fibropapillomatosis (FP). Photographs of each turtle's head scale pattern and other physical characteristics were taken for identification. This photo identification method was used to avoid assessing the same turtle multiple times during the study.

Blood samples were collected from the turtles for clinical pathology (Figure 2). The blood samples were collected from the dorsal cervical or subcarapacial sinus and were immediately stored in a cooler (2-8°C). The samples were later analysed for various blood parameters, including electrolytes, blood gases, and haematology profiles. A handheld blood analyser was used for these tests. Another portion of the blood and collected epidermis samples were stored for stable isotope analysis. The body condition index for each turtle was calculated using Fulton's K (Bjorndal *et al.*, 2000; Nishizawa & Joseph, 2022).

Systematic field surveys were also conducted to observe and document human interactions with sea turtles, including boat traffic, fishing activities, recreational tourism, and any direct physical encounters. This study utilised a standardised observational protocol to ensure consistency in data collection. Interviews were conducted with local community members, fishers, tourists, and conservationists to gather qualitative data on their perceptions and experiences regarding interactions with sea turtles. This qualitative information can provide context and depth to the quantitative data obtained



Figure 2. Syam Samsol transferring blood into an EDTA tube for preservation and subsequent laboratory analyses. (Photo credit: Afif Azmi)

through blood profiling.

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

## **FINDINGS TO DATE**

### **Baseline Health Profiles**

The study aimed to establish baseline health profiles for sea turtles in Malaysian waters, focusing on their nesting and foraging grounds and captive centres. Blood samples and physical examinations were conducted. The results showed that the turtles had wide variations in their blood values but generally fell within expected ranges based on previous studies. Green turtles and hawksbill turtles showed differences in blood urea nitrogen concentrations, possibly due to their dietary habits. The study also identified the presence of fibropapillomatosis disease in the Celebes Sea region and documented a new occurrence of the *Chelolepas cheloniae* barnacle on the turtle's carapace. Meanwhile, captive turtles were mostly diagnosed with skin lesions, possibly due to water quality, dietary intake, and inter-species competition. Turtles appeared to be in good health based on body condition assessments. These findings provide valuable reference data for monitoring and conserving threatened turtle species in the region.

### **Impact of Human Interactions**

The study focused on the effects of provisioning (feeding) and ecotourism activities on sea turtles in Terengganu, Malaysia. The research examined how these interactions influenced the behaviour and growth of sea turtles. The study postulated that provisioning could lead to declines in individual turtle health over time and potentially result in imbalanced tourism-related interactions. The outcomes of the study demonstrated the detrimental effects of provisioning on sea turtle health, highlighting the importance of

maintaining a balance between meaningful human-wildlife interactions and the protection of the turtles.

## **RELEVANCE FOR SEA TURTLE CONSERVATION**

Establishing baseline health profiles for sea turtles in Malaysian waters provides crucial reference data for monitoring the health of these threatened species. Understanding what constitutes normal health parameters allows conservationists to identify deviations and potential health issues more effectively. This knowledge is instrumental in designing conservation strategies tailored to the specific needs of these turtle populations.

The research identified the presence of fibropapillomatosis in local turtles. Detecting and documenting the disease's occurrence in the Celebes Sea region is vital for disease management and intervention. Early identification of diseases is a key component of conservation efforts, as it enables the implementation of strategies to prevent further spread and minimise the impact on turtle populations.

The study highlights the potential detrimental effects of provisioning and tourism-related interactions. Understanding these impacts on sea turtles' health and well-being can guide the development of responsible ecotourism practices and help strike a balance between human-wildlife interactions and the preservation of the turtles' health and ecological roles.

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