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POST-EMERGENCE VIGOUR OF GREEN TURTLE, *Chelonia mydas*, HATCHLINGS IN TERENGGANU, MALAYSIA.

P. M. Palaniappan[1], H.C. Liew[2] & E.H. Chan[2]

[1]Borneo Marine Research Institute, Universiti Malaysia Sabah, Locked Bag 2073, Kota Kinabalu, 88999, Sabah, Malaysia.

[2]Sea Turtle Research Unit, Faculty of Science and Technology, Kolej Universiti Sains & Teknologi Malaysia, 21030 Kuala Terengganu, Malaysia.

ABSTRACT. *A study on sea turtle hatchling vigour upon emergence from its nest in relation to retention period was conducted. Six retention periods, commencing from 0 hr to 5 hr, in Pulau Redang and Rantau Abang, Terengganu were used. Terrestrial locomotion of the hatchlings traversing the beach from their nest to the surf was used as a measure of their vigour. A total of 120 green turtle,* Chelonia mydas, *hatchlings were tested. The results obtained indicated that hatchlings released immediately upon emergence had maximum vigour in comparison to those that were retained. Average hatchling speed in Pulau Redang and Rantau Abang at 0hr was 12.48 ± 1.15 cm/s and 12.56 ± 0.98 cm/s (mean ± SE) respectively. A clear decline in speed was evident after the first hour of retention period. Average speed declined to 7.98 ± 0.63 cm/s and 9.25 ± 0.60 cm/s by 5 hr at Pulau Redang and Rantau Abang respectively. These data indicate that retention of hatchlings affects their vigour and that the best conservation measure is to release them upon emergence from their nest in order for them to continue onto their next phase of life with maximum energy.*

KEYWORDS. *Chelonia mydas*, hatchling speed, retention period, sea turtle, vigour

INTRODUCTION

Sea turtle hatchlings exhibit a locomotor behaviour called the "frenzy" that is characterised by a dash from the nest to the sea upon emergence where they will swim continuously for three to five days. Hatchlings emerging from their nests must traverse the beach to reach the surf. It is during this activity that they become easy prey to predators lurking in the vicinity. Bennet (1978) believed that the behaviour of hatchling sea turtles came about through great selection pressure in the form of predation while traversing the beach and during the initial hours in the sea.

At present, practices in the hatcheries in Terengganu and elsewhere in the world include retaining hatchlings in wire or plastic meshes until morning before releasing them. Long-term effects of this practice have yet to be studied. Hatchlings being released at present may not be able to survive the conditions in the open sea. The chances of their returning to nest in the future may also be at stake. Taking all these factors into account, it is therefore of the utmost importance to make every hatchling entering the sea count. These hatchlings have to be as healthy as possible and be given the best chance to survive the long swim ahead.

The main aim of this project was to study the effect of retaining green turtle (*Chelonia mydas*) hatchlings for various periods of time before releasing them, by measuring hatchling vigour during the frenzy.

MATERIALS AND METHODS

Field experiments were conducted on an island beach in Pulau Redang (05° 54.36'N, 103° 00.08"E) and on a mainland beach in Rantau Abang (04° 52.14'N, 103° 23.60'E) in Terengganu (Fig. 1) between the months of August and October 1993, as this was the peak period of hatchling emergence on these beaches. Hatchlings from Pulau Redang were from two *in-situ* nests whereas those from Rantau Abang were incubated in two hatchery nests.

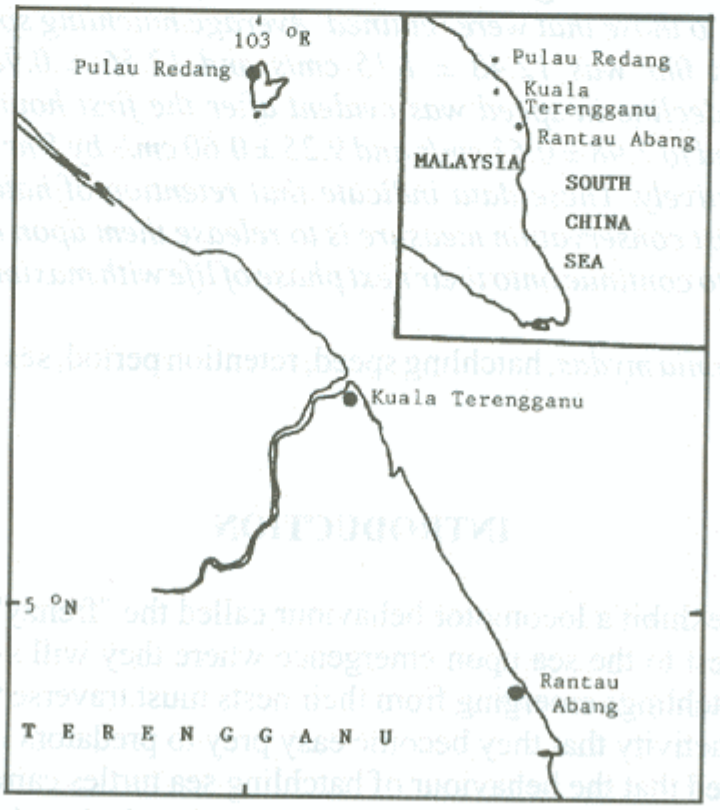

Figure 1. Map of the field study sites (Pulau Redang and Rantau Abang) in Terengganu, Malaysia.

A total of 120 randomly selected green turtle hatchlings were used in this experiment, where each location was represented by 60 hatchlings, and 20 hatchlings represented each hour of the six retention periods. Ten green turtle hatchlings were used for each retention period at each location, which commenced at 0 hour (hr) and terminated at 5 hr, at each location. The hatchlings were retained in a plastic coated wire mesh, to simulate actual practices, where they maintained a constant terrestrial-locomotor behaviour, until they were released. Body length and width were measured with a vernier calliper and the hatchlings released singularly where the duration, in seconds (s), of its crawl down to the beach-surf interface was recorded. A measuring device was used to determine the distance, in centimetres (cm), travelled by each turtle hatchling. This device consisted of a plywood wheel with a circumference of one metre and a polyvinylchloride (PVC) handle. The wheel was marked with a luminous tape to enable the measurements to be taken easily in the dark. A hand-held counter was also used to record the number of rotations made by the measuring wheel. The speed (cm/s) was derived from the distance and duration data of each turtle hatchling.

All data are presented as the mean ± SE and meet with the assumptions of parametric statistics. This experiment design permitted a One Way ANOVA using retention period as treatments and each hatchling as an individual. Comparisons between the two incubation methods were made using *t*-test (two-tailed). The variable being tested was the speed of the crawl down to the surf. In all statistical tests, significance was evaluated at $P = 0.05$ (Zar, 1984).

RESULTS

In general, the green turtle hatchlings were observed to have high levels of activity followed by a gradual decline marked by short bursts of movement. Hatchling speed for all hatchlings ranged from 5.0 cm/s to 18.1cm/s, with an average of 9.35 ± 0.34 and 10.48 ± 0.29 cm/s for those from Pulau Redang and Rantau Abang, respectively. With regard to incubation method, hatchling speed of those originating from *in-situ* nests was found to be significantly lower than those from hatchery nests ($p<0.05$).

Statistical analysis showed that hatchlings from Pulau Redang and Rantau Abang had a similar trend of significantly different ($p<0.05$) average speeds between the various retention periods (Fig. 2). Further analysis (Tukey's HSD Test) showed that hatchlings released immediately upon emergence had the highest levels of vigour as compared to those retained at longer periods.

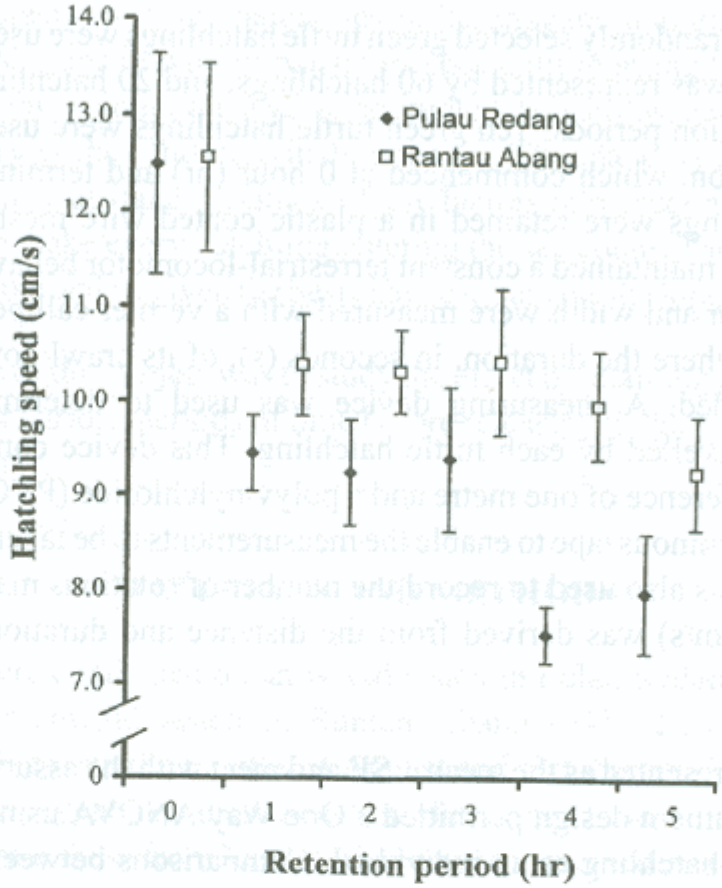

Figure 2. Speed (mean ± SE) of green turtle (*Chelonia mydas*) hatchlings in relation to retention period in two beach locations in Terengganu.

There was a clear decline in speed after the first hour of retention. At 0 hr, the speed of hatchlings from Pulau Redang ranged from 7.81 to 18.08 cm/s with an average of 12.48 ± 1.15 cm/s whereas those in Rantau Abang ranged from 9.54 to 17.95 cm/s with an average of 12.56 ± 0.98 cm/s. Average speed of the hatchlings declined significantly at 1 hr to 9.44 ± 0.40 cm/s and 10.39 ± 0.54 cm/s on the island beach and the mainland beach, respectively. Hatchling speed at both locations was statistically similar across the next retention periods of 2hr and 3 hr.

By 4 hr, hatchling vigour in Pulau Redang ranged from 6.55 to 9.94 cm/s with an average of 7.53 ± 0.30 cm/s as compared to those in Rantau Abang which ranged from 7.82 to 13.77 cm/s with an average of 9.96 ± 0.57 cm/s. Hatchling speed showed no significant difference at the last retention period of 5 hr at both locations. In Pulau Redang, the average speed of the hatchlings was observed to have increased to 7.98 ± 0.63 cm/s although hatchlings from Rantau Abang exhibited a further decline in vigour with an average speed of 9.25 ± 0.60 cm/s.

DISCUSSION

The green turtle hatchlings used in this study originated from two different populations. The island population came from Pulau Redang whereas the mainland population was from Rantau Abang. It is possible that the different activity patterns noted were linked to actual genetic differences between the populations, differences that perhaps evolved in response to migration requirements (Dalton, 1979). Hatchlings from the hatchery nests were observed to be more vigourous than those from the *in-situ* nests. This could be attributed to an initial disorientation of hatchlings emerging from the latter nests. These nests were located at the foot of a beach berm; therefore orientation toward the sea took longer than hatchlings emerging from the hatcheries, where the beach contour was mainly a downhill slope. Incubation method may also contribute to the difference in hatchling vigour.

Hatchlings require large amount of energy to dig out of the nest and to crawl rapidly from the nest to the surf across the open beach. Dial (1987) utilizing lactate content had proven that both emergence and hatchling frenzy of the loggerhead turtle are supported in part by anaerobic metabolism. These hatchlings might be at a distinct energetic and performance disadvantage when they reach the nest surface. Therefore, a time delay in emergence is used to overcome muscle fatigue. Dalton (1979) and Dial (1987) suggest that the frenzy represents a predator-escape mechanism to reduce the duration in which hatchlings are exposed to predators on the beach and the sea. Bennet (1982) further corroborates that reptiles can greatly expand their metabolic power input by supplementing aerobic metabolism with energy derived anaerobically during rapid bursts of activity.

Carr and Hirth (1961) noted that green turtle hatchlings colliding during the initial stages of dispersion from the nest usually tends to increase the speed of terrestrial locomotion and to improve the orientation direction of each group member. Hatchlings in this study may not have exhibited their highest levels of vigour as they were released singularly.

The information gained from this experiment was in conjunction with the statistical analysis to give a clear picture that hatchlings released immediately after emergence had maximum vigour as compared to those retained in the wire mesh. Retaining hatchlings for too long retards their neonatal activity level, where they were observed failing to move when placed on the beach or moving in a sluggish manner. Limpus (1991) observed this with loggerhead turtle (*Caretta caretta*) hatchlings. He stated that the best care of newly emerged hatchlings is to ensure they are free to scramble to the water as soon as possible after their emergence from the nest. Hatchlings display maximum vigour when they emerge from the nest and become less vigorous when retained for only a brief period. The longer they are held in captivity, the greater the amount of stored yolk sac that they will have used before they begin their seaward swim. This will limit the distance they can travel into the open sea before commencing active feeding.

A study done by Pilcher *et al.* (2000) has shown that hatchlings are able to navigate toward the open sea once they have been released and orientate offshore even without the presence of waves. Hatchlings that were retained in this study were observed to be constantly moving in a circular motion. This may affect their ability to orientate themselves once entering the water.

Hatchery staff tend to release hatchlings after sunset on beaches where those released during the day are subjected to excessive predation from lizards, birds and fish. However, nocturnal predators may still attack hatchlings at this hour. Pilcher (2000) reported that 40% to 60% of hatchlings were lost to predation in the first hour at sea. Hatchlings weak from being in constant motion may not have be able to get away from predators. This in turn would further decrease the survival rate of hatchlings entering the sea.

Sea turtle hatchling vigour is affected by different retention periods. The hatchlings may become lethargic and disoriented not only during their move to the water but also at sea. The best conservation measure would be to release the hatchlings immediately upon emergence because the greatest percentage of speed occurs during this hour. A strong decreasing trend was evident during the following 5 hours of the retention period.

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