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THE BEHAVIOURS AND NIGHT DISTURBANCES OF THE GREEN TURTLE IN PENANG ISLAND, PENINSULAR MALAYSIA

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ABSTRACT

This paper focuses on the observation and behaviours of green turtles for one breeding season at Penang Island. Green turtle breeding behaviours and morphological characteristics were studied at Pantai Kerachut and Teluk Kampi, situated at Penang Island, the northern island of Peninsular Malaysia between December 2012 and August 2013. The findings revealed that from the eight green turtles landed; 106 were emergences, 38 were nests, and 158 digging attempts were made over the duration of one breeding season. The total clutch size deposited ranged from 170 to 979 eggs per turtle, and total nests ranged from three to eight nests per turtle. The inter-nesting interval ranged from 9 to 29 days, and the average was 13.5 days. Longer inter-nesting intervals were due to disturbances from feral dogs, wild pigs, sea-coated otters and night activities of fishermen (use of wide torch lights, sounds of boat engines) especially at Teluk Kampi. Lack of full-time personnel to control at Teluk Kampi was found to be a cause to nest poaching. Based on these findings and observation, the study suggests that Kerachut Turtle Conservation Centre should hire sufficient staffs to patrol the two beaches in order to prevent from human poachers and animal disturbances.

Key words: Clutch size, Digging attempt, Emergence, Inter-nesting interval

INTRODUCTION

The conservation of the four sea turtle species (green, olive ridley, leatherback, and hawksbill) in Malaysian waters is under the management of Department of Fisheries throughout Malaysia with inclusion of Department of Fisheries Penang. The green turtle (*Chelonia mydas*) is widely distributed in the Penang Island and abundant compared to the olive ridley turtle (Sarahaizad *et al.*, 2012a). The green turtle is listed as a globally endangered species listed by the International Union for Conservation of Nature, IUCN red list (IUCN, 2015), with an estimated decline of 37-61% worldwide (Mortimer *et al*., 2011). A Turtle Conservation Centre was established at Pantai Kerachut to protect these species from being endangered (Sarahaizad *et al.*, 2012a). Through the establishment of Kerachut Turtle Conservation Centre by Penang Department of Fisheries, successful conservation efforts to preserve turtles have been made in recent years since 1995 until present (Sarahaizad and Shahrul Anuar, 2014). For example, in order to prevent the poaching of turtle eggs, the Penang Department of Fisheries purchased the sea turtle eggs from licensed eggs collector and those eggs were incubated in the hatchery (Sarahaizad and Shahrul Anuar, 2014).

Green turtle breeding behaviours were observed at Pantai Kerachut and Teluk Kampi for one breeding season. Pantai Kerachut and Teluk Kampi are known to be the most preferred beaches for green turtle landings in Penang Island, basically every month, yearly (Sarahaizad *et al.*, 2012a). However, little information regarding the breeding behaviour of these turtles is known. The objectives of this paper are 1) to determine the breeding behaviours of green turtles including emergences, digging attempts, nesting, and clutch size, 2) to determine the inter-nesting interval and morphological characteristics of green turtles at Pantai Kerachut and Teluk Kampi and, 3) to identify night disturbances that distract the green turtles nesting activities.

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MATERIALS AND METHODS

Study sites

Penang Island is located at the northern region of Peninsular Malaysia where the two study sites, Pantai Kerachut (5º 27' 4" N, 100º 10' 58" E) and Pantai Kampi (5º 26' 20" N, 100º 10' 46" E) are located at the Southwest of Penang Island (Figure 1). The total length of Pantai Kerachut is 558 m, the sand colour ranges from white to dark brown and the slope gradient is 15° (Sarahaizad *et al.*, 2012b). The average evening temperature for one breeding season (December 2009-August 2010) was 28.9°C with an average wind speed of 2.44 m/s, whereas the average morning temperature was 27.5°C with an average wind speed of 3.23 m/s (Sarahaizad *et al.*, 2012b). In addition, the relative humidity is approximately 86% in Pantai Kerachut (Sarahaizad *et al.*, 2012b). Teluk Kampi (Figure 1) is the nearest and adjacent to Pantai Kerachut, and the distance is approximately 300 m from Pantai Kerachut (Sarahaizad *et al.*, 2012b). The slope gradient of Telok Kampi is 10° and the length of the beach is 810 m (Sarahaizad *et al.*, 2012b). The average evening temperature was 30.4°C with a wind speed of 0.94 m/s, and the average morning temperature for one breeding season was 27.0°C with a wind speed of 0.58 m/s (Sarahaizad *et al.*, 2012b).

Intensive nocturnal surveys and morning track counts

Two types of field surveys were conducted from December 2012 to August 2013, which consisted of intensive nocturnal surveys and morning track counts. During the intensive nocturnal surveys, the researchers counted tracks and verified nests at night, and morning track counts were performed in the morning (Wang and Cheng, 1999). Pantai Kerachut and Teluk Kampi were surveyed four times every night, by walking along the beach between 1900 and 0600 hours. During nest verification, the researchers walked along the sandy beach using minimal light to verify emergence tracks. Emergence time is defined as the time adult turtles emerge from the water (Chen and Cheng, 1995) until they reach a nesting site. Once the turtles have emerged from the water, the source of light is switched off to avoid disturbances. Strict procedures regulated by Kerachut Turtle Conservation Centre were followed to avoid distraction (noises, footstep, torch light and camera) during nesting activities. The number of visitors involved in nest verifying should also be limited to avoid disturbances.

Upon completion of nest verification, the following data were recorded after the turtles completed nesting; number of emergence tracks, digging attempts, nests, and clutch size. Clutch size

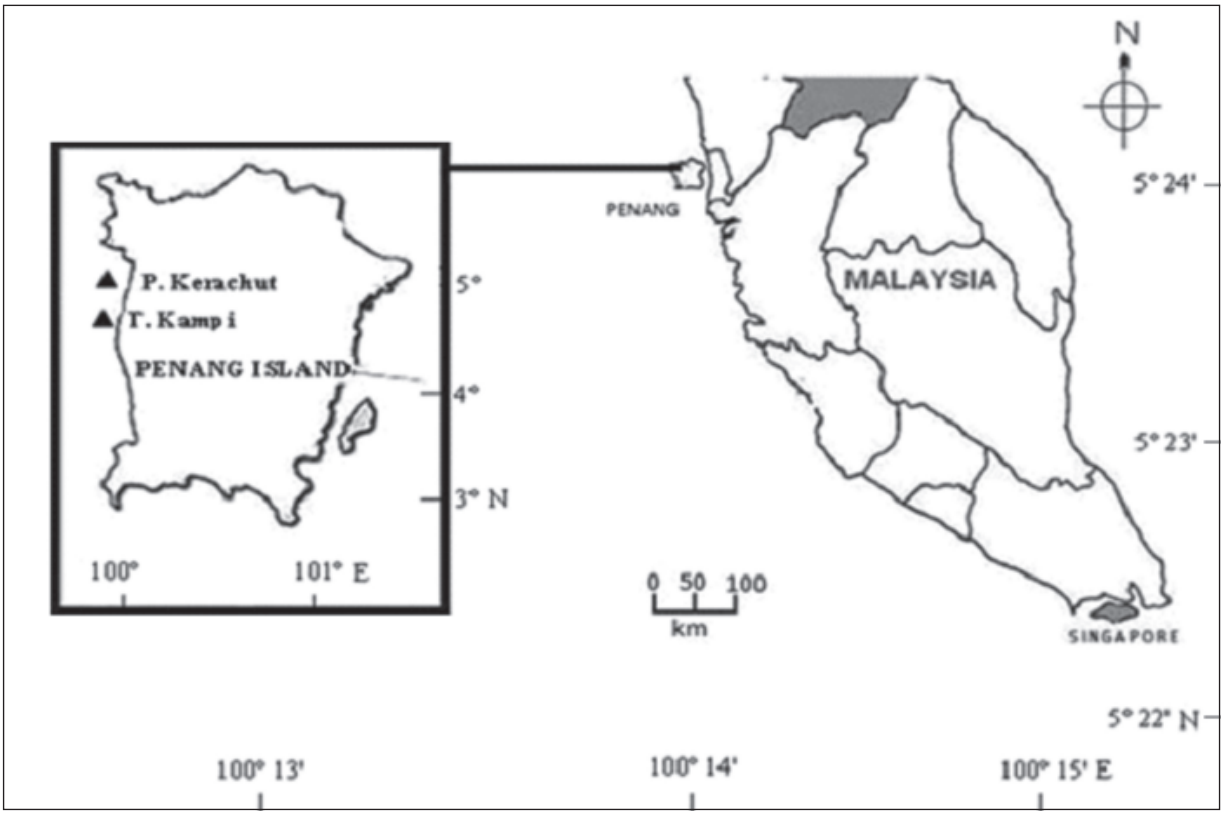

Fig. 1. Map of Penang Island situated in the northern region of Peninsular Malaysia. The surveyed beaches are marked with a square for Pantai Kerachut and a circle for Teluk Kampi.

(Hitchins *et al.*, 2004; Van De Merwe *et al.*, 2006) refers to total number of eggs in one nest. Digging attempts refer to few trials made by adults but unable to deposit eggs, also known as 'fake nests' (Sarahaizad *et al.*, 2012b). After the clutch size was counted and recorded, the eggs were transferred to the hatchery next to the Kerachut Turtle Conservation Centre for further *ex-situ* incubation. Nests that were far from the sea, might expose the eggs to land predators such as monitor lizards, ants, and crabs (Chan, 2010).

Beaches were surveyed between 0800 and 0930 hours during-morning track count in order to search for nests and digging attempts that might have been overlooked the previous night (Wang and Cheng, 1999). During seasonal bad weather, these surveys were particularly important (Sarahaizad *et al.*, 2012a). The situation of disregarded nests on the previous evening usually occurs during heavy rainfall and rough seas, where nests are difficult to be identified at night and boat transportation was unable to be used for survey at the adjacent beach.

Digging success and nesting success

Digging and nesting successes would be calculated once data on digging attempt, nest and emergence per turtle for one breeding season were recorded. Digging success and nesting success were calculated using the formula below:

Digging success (%) = (number of nests/number of digging attempts) x 100%

Nesting success (%) = (number of nests/ number of emergences) x 100%

Both formulas refer to the study by Wang and Cheng (1999).

Tagging, morphological characteristic and inter-nesting interval

Tagged turtles increase the reliability of data and scientific value (Parmenter, 1993). Both front flippers are tagged after the turtle completes nesting and compact the sand (Sarahaizad *et al.*, 2012a). If the landed turtles had tags on them, the tags were examined, checked for adjustment or replacement (if necessary) and recorded (Broderick and Godley, 1999; Chan *et al.*, 1999). There are two types of tags that are commonly used to tag green turtles: Inconel and Titanium, and an applicator to clip the tag (Wang and Cheng, 1999). In Penang Island, Inconel tags were clipped at both front flippers; between the proximal second and third front flippers scales (Broderick and Godley, 1999). During piercing, females may react by inhaling sharply or withdrawing their limbs, however, these reactions do not harm the reproductive success (Broderick and Godley, 1999). In Malaysia, each tag is recognized by two imprinted letters followed by four numerals (e.g. MY2543, where MY represented Malaysia).

Immediately after tagging process, the morphological characteristics of adult green turtle were measured. The Carapace Curve Length (CCL) and Carapace Curve Width (CCW) were measured using a 2 m flexible measuring tape, while the Straight Carapace Length (SCL) and Straight Carapace Width (SCW) were measured using the 80 cm length calliper.

Date, time and location of each nest were recorded for the entire breeding season. It was possible to calculate the inter-nesting interval. Inter-nesting interval is defined as the number of days between the first day of nesting and until the day of re-nesting of the same adult turtle.

Statistical analysis

The results obtained were analyzed using SPSS version 17. Spearman's Rank Order Correlation was used to calculate the strength of the relationship between two continuous variables (Pallant, 2002). Spearman's Rank Order Correlation was performed to test the relationship between CCL and CCW, and between SCL and SCW. Relationship between clutch size per season and SCL was also measured. In order to compare the mean scores on continuous variable for two different groups of subjects, an independent sample *t*-test was performed (Sarahaizad *et al.*, 2012a). Clutch size distributed between Pantai Kerachut and Teluk Kampi was compared by independent sample *t*-test.

RESULTS

Breeding behaviours

A total of eight green turtles have been identified landing at Pantai Kerachut and Teluk Kampi. Table 1 shows the number of emergences per season, nesting per season, digging attempts, nesting success, digging success, and inter-nesting interval for each green turtle. Emergence per turtle ranged from 6 to 20 emergences (mean = 13.3, SD = 4.4) and total nests per turtle ranged from 3 to 8 nests (mean = 5.5, SD = 1.9). Digging attempts ranged from 15 to 25 diggings per turtle (mean = 19.8, SD = 3.1). Digging success ranged from 17.6% to 38.1% per turtle (mean = 27.5%, SD = 6.7) and nesting success ranged from 26.7% to 66.7% per turtle (mean = 43.1%, SD = 12.0). The highest emergence was twenty emergences made by Turtle 6, MY2579 (Table 1). Turtle MY2579 excavated eight nests at both Pantai Kerachut and Teluk Kampi, which is the highest number of nests collected for one breeding season. The highest

Table 1. Breeding Behaviour of eight green turtles at Pantai Kerachut and Teluk Kampi, Penang Island, Peninsular Malaysia

Turtle	Tag no.	Emergence Per season	Nest Per season	Digging attempt	Digging success (%)	Nesting success (%)
1	MY2576	17	6	20	30.0	35.3
2	MY2582	13	6	19	31.6	46.2
3	MY2561	15	4	15	26.7	26.7
4	MY2543	12	8	21	38.1	66.7
5	MY2577	9	4	19	21.1	44.4
6	MY2579	20	8	25	32.0	40.0
7	MY2522	6	3	17	17.6	50.0
8	MY2580	14	5	22	22.7	35.7
	Total	106	44	158	–	–
	Mean	13.3	5.5	19.8	27.5	43.1
	SD	4.4	1.9	3.1	6.7	12.0

Table 2. Morphological characteristics of eight green turtles at Pantai Kerachut and Teluk Kampi, Penang Island, Peninsular Malaysia

Turtle	Tag No	Body size (cm)				Total nests size	Total clutch
		CCL	CCW	SCL	SCW		
1	MY2576	91.5	67.5	86.4	62.7	6	393
2	MY2582	101.5	91.4	94.2	84.4	6	724
3	MY2561	104.0	95.0	95.2	86.1	4	386
4	MY2543	98.5	96.0	92.0	89.4	8	979
5	MY2577	101.6	90.4	95.2	84.3	4	493
6	MY2579	94.0	87.5	86.3	82.0	8	481
7	MY2522	96.0	89.5	89.0	84.0	3	170
8	MY2580	106.0	98.5	99.0	91.6	5	254
	Mean	99.1	89.5	92.2	83.1	5.5	485.0
	SD	5.0	9.6	4.6	8.8	1.9	259.7

number of digging attempts was 25 diggings by Turtle 6 (MY2579). There is no significant correlation between emergence per season with the component of breeding behaviours in Table 1 (nest per season, digging attempt, and digging success) which provide a significant value of $p > 0.05$. However, a significant correlation was found between emergence per season and nesting success (%), Spearman rank correlation coefficient (r) = -0.71, $p < 0.05$, which means, emergence per season is related with nesting success.

Morphological characteristics

Table 2 shows the results of morphological characteristics and clutch size of eight green turtles. The CCL ranged from 91.5 to 106.0 cm (mean = 99.1 cm, SD = 5.0), CCW ranged from 67.5 to 98.5 cm (mean = 89.5 cm (SD = 9.6), SCL ranged from 86.3 to 99.0 cm (mean = 92.2 cm, SD = 4.6), and SCW ranged from 62.7 to 91.6 cm (mean = 83.1 cm, SD = 8.8). Cumulative clutch size per turtle ranged from 170 to 979 eggs, and the mean was 485.0 per turtle (SD = 259.7). The largest green turtle measured belonged to turtle MY2580, with a CCL = 106.0 cm and a CCW = 98.5 cm.

There is a significant positive correlation between CCL and CCW, with a Spearman rank correlation coefficient of (r) = 0.861, $p < 0.01$. Spearman rank correlation coefficient shows a significant positive correlation between SCL and SCW, (r) = 0.802, $p < 0.01$. This is consistently proven that the increase of length (CCL and SCL) will definitely increase the width of adult turtle (CCW and SCW). However, there is no significant correlation between SCL and clutch size per season, and the Spearman rank correlation coefficient is

(r) = 0.328, $p > 0.05$. Thus, adult length (SCL) does not affect the total number of eggs that will be deposited inside nest. Interestingly, there is a significant positive correlation between digging success and clutch size (Spearman rank correlation coefficient (r) = 0.743, $p < 0.05$) suggesting that the digging success do significantly affects the clutch size. A strong explanation why SCL does not relate to clutch size per season is not identified, but digging success does affect the clutch size. Possibly, the increase in percentage of digging success refers lesser attempts of digging made to build a nest. As digging attempts decreases, turtles may have enough energy stored to deposit the eggs. Thus, more eggs are able to be deposited. A further study will be conducted to prove this situation.

Clutch Size and Inter-nesting Interval

Table 3 shows the complete records of clutch size and inter-nesting interval for one breeding season of eight turtles at Pantai Kerachut and Teluk Kampi. A total of 44 nests were laid at both beaches, including six nests that were poached at Teluk Kampi. The largest clutch size was 144 eggs, and a total of 144 eggs were deposited three times; 27 January (MY2561), 29 March (MY2543), and 20 April 2013 (MY2543) by different turtles. The smallest clutch size was 48 eggs, deposited by turtle MY2522 on 28 June 2013. Turtle MY2543 deposited the largest cumulative clutch size that is 979 eggs from eight times of nesting and accounting for 25.2% from overall 3880 eggs collected. The lowest cumulative clutch size was by turtle MY2522, which laid 170 eggs from three times of nesting and accounting for 4.4% of overall eggs collected. This turtle nested at the end of the season, in June and July 2013. The total number of nests recorded at Kerachut was 23 nests with a total of 2360 eggs, and total nests recorded at Teluk Kampi were 15 nests with a total of 1520 eggs. All clutches were successfully relocated to the hatchery for further incubation. The number of clutch size distributed at Pantai Kerachut (mean = 102.09, SD = 28.99) and Teluk Kampi (mean = 102.13, SD = 26.06) were not significantly different [$t(36) = -0.01, p > 0.05$)].

A total of six nests were poached at Teluk Kampi by human/fishermen poachers. From intensive nocturnal surveys, three nests were stolen during rainy seasons (8 January, 2 February, and 8 May of 2013) and another three nests were stolen during rough seas season (13 June, 30 July, and 18 August of 2013). These nests were stolen between 0300 and 0600 due to unfavorable night time conditions of heavy rain and rough seas. This resulted in six nests being stolen by illegal poachers from nearby residence, prior to morning track counts.

Inter-nesting interval of green turtles ranged from 9 to 29 days, and the means ranged from 9.7 to 17.5 days per turtle (Table 3). Turtle MY2543 took 29 days, which is the longest duration due for feral dog disturbance, torch lights and boat engines from fishermen's activities at Teluk Kampi. The inter-nesting interval of this turtle became normal on 29 March 2013 onwards. Interestingly, the landing location of this turtle changed to Pantai Kerachut from previous landing area at Teluk Kampi. Another seven nests were successfully deposited at Pantai Kerachut. The Department of Fisheries staffs had protected the turtles during the nesting process to avoid disturbances.

DISCUSSION

Emergences

According to Wang and Cheng (1999), turtles prefer to reach the vegetation zone upon emerging from the sea. Vegetation at Teluk Kampi comprises of grass, shrubs, and shady trees such as sea lettuce vegetation, and *Scaevola taccada* locally known as 'merambong'. The problem that arises at Teluk Kampi is due to manpower to survey and protect the beach. Fishermen's activities and animal disturbances are high at Teluk Kampi as full-time staff are insufficient to monitor the beaches for the whole night. Therefore, turtles may prefer to land frequently at the adjacent beach, Pantai Kerachut due to the presence of sufficient personnel to control the beachfront from disturbances. Thus, disturbances of feral dogs, poaching, and fishermen are under control at Pantai Kerachut.

It is also suggested, that the serene environment at Pantai Kerachut attracts the turtles to nest. This beach is preferred because of its lesser population and high vegetation. The vegetation at Pantai Kerachut comprises of shady sea lettuce vegetation, scrubs, and grasses that attract the turtles to emerge. Shady trees provide shelter for adult turtle to nest, protecting them from predators.

Frequent landing of turtles at Pantai Kerachut may be caused by the presence of a Meromictic lake. The term 'Meromictic' describes a condition where two layers of liquids, salt water (from the sea) and fresh water from the lake with different densities remains separate. This lake is located along left end of Pantai Kerachut. A similar result was found by Kikukawa *et al*. (1999) at Okinawajima, Japan, where sea turtles prefer to emerge on beaches that have lagoons. According to researchers, turtles may use the lake as landmarks for landing (Kikukawa *et al.*, 1999).

Table 3. Accurate date of nesting, clutch size, nest status, location of nesting, and inter-nesting interval of eight green turtles that landed at Pantai Kerachut and Teluk Kampi, Penang Island. Surveyed was conducted between December 2012 and August 2013

Tag no.	Date of nesting	Clutch Size	Status	Location	Total	Mean	Inter-nesting interval (days)	Mean
MY2576	9-Dec	96	Relocated	P. Kerachut			–	
	21-Dec	81	Relocated	T. Kampi			12	
	31-Dec	78	Relocated	P. Kerachut			10	
	13-Jan	66	Relocated	T. Kampi			13	
	23-Jan	72	Relocated	T. Kampi			10	
	2-Feb	0	*Poached*	T. Kampi	393	65.5	10	11
MY2582	19-Feb	135	Relocated	P. Kerachut			–	
	4-Mar	124	Relocated	P. Kerachut			13	
	15-Mar	114	Relocated	P. Kerachut			11	
	30-Mar	114	Relocated	T. Kampi			15	
	27-Apr	129	Relocated	P. Kerachut			28	
	7-May	108	Relocated	P. Kerachut	724	120.7	10	15.4
MY2561	29-Dec	120	Relocated	T. Kampi			–	
	8-Jan	0	*Poached*	T. Kampi			10	
	17-Jan	122	Relocated	T. Kampi			9	
	27-Jan	144	Relocated	T. Kampi	386	96.5	10	9.7
MY2543	28-Feb	81	*in-situ*	T. Kampi			–	
	29-Mar	144	relocated	P. Kerachut			29	
	9-Apr	132	relocated	P. Kerachut			11	
	20-Apr	144	relocated	P. Kerachut			11	
	30-Apr	104	relocated	P. Kerachut			10	
	10-May	137	relocated	P. Kerachut			10	
	20-May	113	relocated	P. Kerachut			10	
	3-Jun	124	relocated	P. Kerachut	979	122.4	14	13.6
MY2577	15-Feb	137	relocated	T. Kampi			–	
	27-Feb	115	relocated	T. Kampi			12	
	9-Mar	121	relocated	T. Kampi			10	
	21-Mar	120	relocated	T. Kampi	493	123.3	12	11.3
MY2579	11-May	70	*in-situ*	P. Kerachut			–	
	24-May	80	*in-situ*	P. Kerachut			13	
	16-Jun	78	relocated	P. Kerachut			23	
	5-Jul	88	relocated	P. Kerachut			19	
	15-Jul	95	relocated	P. Kerachut			10	
	30-Jul	0	*poached*	T. Kampi			15	
	18-Aug	0	*poached*	T. Kampi			19	
	29-Aug	70	relocated	T. Kampi	481	60.1	11	15.7
MY2522	3-Jun	50	*in-situ*	P. Kerachut			–	
	28-Jun	48	relocated	P. Kerachut			25	
	8-Jul	72	relocated	P. Kerachut	170	56.7	10	17.5
MY2580	24-Apr	85	relocated	P. Kerachut			–	
	8-May	0	*poached*	T. Kampi			14	
	20-May	78	relocated	T. Kampi			12	
	31-May	91	relocated	T. Kampi			11	
	13-Jun	0	*poached*	T. Kampi	254	50.8	13	12.5
	Total	3880	–	–	–	–	–	–
	Mean	–	–	–	–	–	13.5	–

In term of comparison with other regions, emergences of turtles in Penang Island are less compared to the green turtle from the Island of Sumatera, Indonesia (Stringell *et al*., 2000). The carapace size is relatively similar to green turtles landed in Terengganu (Van De Merwe *et al*., 2009) and in Sumatra, Indonesia (Stringell *et al.*, 2000).

Digging attempts and digging success

In order for nesting to be successful, environmental conditions must support adult activities, interesting habitat, and suitable beach structure for digging (Georges *et al.*, 1993). Madden *et al*. (2008) agree that sand particles positively influences nest site selection of sea turtles. Turtles may have difficulty digging the egg chambers in coarse and dry sand which may cause multiple trials of digging attempts (Mortimer, 1990). The digging attempts at Pantai Kerachut could be related to two factors; the root system within the vegetation zone and the rough sand particles as mentioned in a study by Sarahaizad *et al*. *(*2012b). Certain of nesting site which is compacted with rough and dry sand texture especially as high tide may provide uncomfortable condition for turtles during nesting process. The tough root system at certain nesting sites within the vegetation zone may cause difficulty during nest excavation. This is supported by Wang & Cheng (1999), whose study indicated that digging attempts could be impeded by large trees with roots that grow deep, and penetrate into the sand.

Teluk Kampi, on the other hand showed that digging attempts resulted from disturbances from fishermen's activities, feral dogs, and smooth-coated otters (*Lutrogale perspillata*). The limited time for nocturnal surveys at Teluk Kampi, resulted in uncontrolled disturbances from fishermen and animals. Mortimer (1990); Witherington and Martin (1996); Madden *et al*. (2008) are in consensus that human interference and animal disturbances are possible reasons for the existence of digging attempts.

Inter-nesting interval

The mean inter-nesting interval was 13.5 days. Mean inter-nesting interval in Penang Island was relatively similar to green turtles at Wan-An Island, Taiwan (Chen and Cheng, 1995). At Ma'Daerah Turtle Sancturay, Terengganu inter-nesting interval for green turtles was 11-15 days, similar to Penang island. It is suggested that the delay of inter-nesting interval, was due to the disturbances of feral dog at Teluk Kampi, where the barking of the dogs bothered the turtles nesting activities, resulting in turtle's refusal to nest. In addition, turtles may change the landing location and land on another beach. As there were no-full time staffs at Teluk Kampi, feral dog disturbances were not under control. Additionally, feral dog disturbances at Teluk Kampi were unexpected because the habitat of these dogs is in the forest. There are also feral dogs at Pantai Kerachut, but the situation was controllable as sufficient staff patrol the beach every night.

Recommendations for Night Disturbances

Turtle nest predators include humans and dogs (Donlan *et al.*, 2004; Madden *et al.*, 2008). According to Donlan *et al*. (2004), sea turtle predators are not consistent among the world's nesting beaches; however, dogs and humans are serious threats on nesting beaches. In Penang Island, dogs disturb turtle nesting activities at Teluk Kampi during nest excavation. Smooth-coated otters (*Lutrogale perspicillata*) were observed in groups during midnight at Pantai Kerachut and Teluk Kampi that distracted turtles during the nesting activities. However, these problems are minor disturbances in Penang Island.

Common *palm civet* is also a main threat to eggs and newly hatched hatchlings (Sarahaizad, personal observation). There was an incident where the common palm civet ate the hatchlings of one of the nest on May 2013. Currently, feral dogs were only found to disturb turtle nesting activities at the nesting sites during nest excavation, but no records of nests were destroyed by the dogs. From the observation during the peak of the nesting season (April until July 2013) at Teluk Kampi, feral dogs form a pack (pack of four) on the beach and distract turtle's nesting activities. Madden *et al*. (2008) also suggest that poachers and vertebrate predators visit the nesting site during the nesting period. High nests on the beach may attract predators to attack the nest. Disturbances by feral dogs in Penang Island are relatively similar to the findings by Fowler (1979) in Costa Rica.

No nests were poached at Pantai Kerachut, but six nests were poached at Teluk Kampi. Since the Turtle Conservation Centre is located at Pantai Kerachut, between two to four staffs are positioned to patrol the beach all day, and nocturnal surveys were carried out from 1900 to 0600 hrs every night. During morning track counts, nests were checked as early as 0800 hrs before tourists entered the beach. Therefore, human poachers were unable to steal the eggs at Pantai Kerachut. This shows the importance of hiring sufficient personnel to patrol the beach in order to prevent human poachers and animal disturbances. The commitment of the Kerachut Turtle Conservation Centre in preventing disturbances and eggs from being poached is also vital.

This situation can be compared with Teluk Kampi, where the lack of personnel (only two staff and no full-time staff to carry out nocturnal surveys) has resulted in a high rate of illegal poaching of turtle eggs. There are several factors that caused limited time survey at Teluk Kampi. Among them, boat transportation problems between Pantai Kerachut and Teluk Kampi. Currently, fishermen are hired to ferry the staffs from Pantai Kerachut to Teluk Kampi, and nocturnal surveys are conducted between 0200 and 0400 hours every night at Teluk Kampi. Morning track counts are conducted from 0900 to 0930 hours at Teluk Kampi, which is considered late. Thus, survey time at Teluk Kampi is very limited. The problem of insufficient staff at Teluk Kampi might be solved by following the recommendation as in Chagar Hutang, Terengganu. According to Chan *et al*. (1999), by introducing volunteer programme to help in beach patrol, the problem of insufficient staff to conduct monitoring along the beaches can be solved. Chan (2006) agrees that conservation efforts in Malaysia need to be coordinated and upgraded.

CONCLUSION

In order to prevent the poaching of eggs at Teluk Kampi, it is suggested that Kerachut Turtle Conservation Centre should; 1) hire at least two staff to carry out full-time surveys and monitor the beach to control disturbances at Teluk Kampi, 2) build another turtle conservation post at Teluk Kampi, and therefore nocturnal surveys and morning track counts will be controllable and flexible, 3) provide boat service transportation between Pantai Kerachut and Teluk Kampi in order to improve transportation, communication, and to achieve accuracy of nest verification at night, 4) motivate all staffs and demonstrate a standard method of nests verification in order to standardize the data collection according to the world guidelines, 5) introduce a volunteer programme at least once in a month, and 6) conduct nests verification in groups for organizations that are interested to partake in the programme. All these recommendations are proposed to upgrade the turtle conservation programme in Penang Island.

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