2017 ANNUAL REPORT

Lang Tengah Turtle Watch

Help save sea turtles from extinction

Pulau Lang Tengah

SUMMARY

91 — **Volunteers hosted**

12 — **Total nests**

- From 26 landings
- Lowest since 2013

1,148 — **Total eggs saved**

- From 11 nests (Nest 12 expected to emerge during the monsoon after the team had left

7 — **Nesting mothers identified**

- 4 green turtles
- 3 hawksbill turtles

88.62 — **Average hatching success (%)**

4,337.8 — **Waste removed (kg)**

CONTENTS

ACKNOWLEDGEMENTS

Lang Tengah Turtle Watch team would like to express their deepest gratitude to the Department of Fisheries, University Malaysia Terengganu and Reef Check Malaysia for their help, guidance and trust into the organisation and its efforts on Lang Tengah Island. The support provided by every party is crucial for the successful conduct of the operation of our projects. In addition, Lang Tengah Turtle Watch would also like to thank all volunteers for their help in patrolling the nesting beaches on Pulau Lang Tengah as well as collecting crucial nesting and landing data.

THE PROJECT

Since its inception in 2013, Lang Tengah Turtle Watch has witnessed considerable growth in nest numbers as well as volunteers and personnel recruited to the project. However, this season recorded 26 landings, the lowest by far, with 12 nests from seven individual adult female turtles. In contrast, 2016 nesting season had the highest record number of 184 landings, with 88 nests from 39 individual adult female turtles. Various reasons may have attributed to the marked decrease in landings and nests this season. The project recruited interns of local and international origins to assist the staff members in overseeing the daily camp activities on camp and to record and collate data gathered.

Volunteers

During the volunteer period from 6 March to 9 October 2017, a total of 91 volunteers, with a ratio of 4:6 local to international volunteers, participated in the volunteer program. The decrease in the number of volunteers is attributed to the prolonged minimum stay of seven days compared to previous years. This opens up more time for volunteers to be more engaged in the awareness, education and research opportunities carried out such as the fish diversity and shark survey that was established this season. The commitment of both local and international volunteers is vital to raise environmental awareness for the conservation of nature.

Project Expansions

This season, Lang Tengah Turtle Watch has established a Malaysian Sea Turtle Photo-ID Network in collaboration with Ecoteer, a community and conservation project based in Pulau Perhentian. The collaboration was initiated with the hopes of having a better understanding on the sea turtle population on the east coast of Peninsular Malaysia and to survey the movement of sea turtles between neighbouring islands. Sea turtles encountered on nesting beaches and underwater were photographed and processed prior to being inputted into the the database. Interactive Individual Identification System (I3S), a free photo-ID software that uses natural markings to identify individual animals was used to analyse the photographs of facial scale patterns of sea turtles. High resolution photographs that clearly depict the facial scale patterns of the turtle were inputted into the database and shared with Ecoteer to check for any matches between the islands. Thus far, an adult female green that nested on 2 June 2017 at Turtle Bay, Pulau Lang Tengah was discovered to have been feeding on Perhentian Besar Island since 2013. This shows that collaboration between local conservation organisation is crucial to gain a better insight on the life history and ecology of the animals.

The staff of Lang Tengah Turtle Watch and divers from Summer Bay Resort were trained by Reef Check Malaysia to carry out coral reef surveys to assess their health. The project collaborated with Summer Bay Resort in October to conduct coral coverage surveys around the island before the monsoon season hits and seeks to continuously assess the coral reefs and record the seasonal change in the state of the coral reefs around the island.

Our waste management initiative was continued on the island by organising a bi-monthly recycling trip with the local resorts to encourage them to adopt sustainable waste management practices. This season, 1,165.8 kg of recyclable waste was removed from Pulau Lang Tengah and sent to RD Papers, a recycling centre at Gong Badak, Terengganu, for processing. We also continued our effort to remove waste from Batu Bulan by carrying out weekly clean-up with the volunteers. Approximately 2,700 kg of non-recyclable waste and 472 kg of recyclable waste was removed from Batu Bulan this season.

METHODOLOGY

Study Area

Pulau Lang Tengah lies approximately 20 km off the coast of Terengganu in Peninsular Malaysia. Like many of the neighbouring islands and much of the mainland of Terengganu, Pulau Lang Tengah is in important sea turtle nesting site for the endangered green turtle (*Chelonia mydas*) and the critically endangered hawksbill turtle (*Eretmochelys imbricata*; International Union for Conservation of Nature [IUCN], 2015).

Pulau Lang Tengah has three beaches: Turtle Bay, Lang Sari and Summer Bay. They cover a distance of coastline measuring 70 m, 400 m and 500 m respectively (Figure 1). All three beaches are located on the southern side of the island. Both Turtle Bay and Lang Sari are south-facing, while Summer Bay is west-facing. The northern coast of Lang Tengah is composed of granite rocks which is unsuitable nesting habitat for sea turtles. All three beaches provide ecologically suitable nesting habitat for sea turtles, with reports of landings occurring on all of them. However, Summer Bay is subjected to high levels of disturbance from light and noise pollution due its heavy commercial development. Light and noise pollution are major deterrents to nesting individuals and therefore we consider Turtle Bay and Lang Sari to be the principal nesting beaches on Lang Tengah.

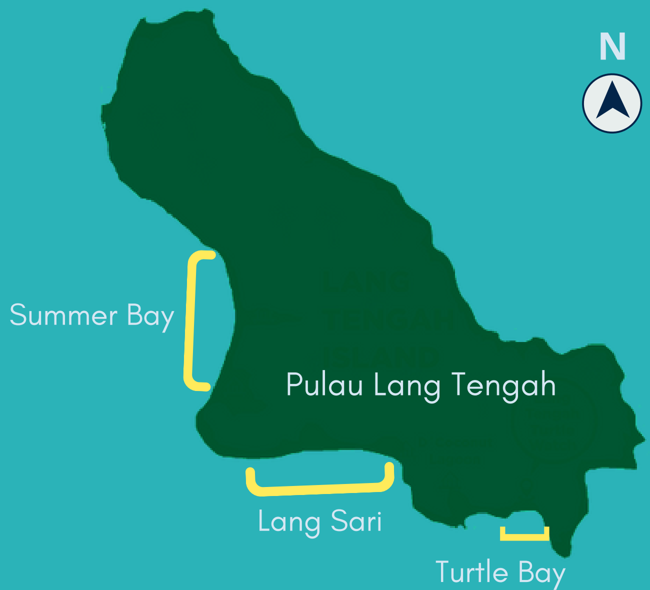

Figure 1. Map of Pulau Lang Tengah, with nesting beaches highlighted.

Night Patrols

Patrols were conducted on an hourly basis at Turtle Bay and Lang Sari, every night from 9 p.m. to 6 a.m. Staff, interns and volunteers are split into groups of two people were to patrol the nesting beaches. The average nesting time for a green turtle is between 1-2 hours. Patrolling once an hour ensures that no nesting female is missed and that disturbance to the beach is minimal.

Any nest found on Lang Sari or Summer Bay was carefully relocated to Turtle Bay, with the depth of the egg chamber and bush/shrub coverage mimicked as closely as possible to the original nest. This is done in order to minimise anthropogenic influence within the incubation process. Once back on Turtle Bay, the nests were marked and monitored. Nesting females on Turtle Bay are rarely interfered with, unless the case arises that an individual begins to dig a body pit on top of, or in close proximity to an existing nest. In this case the individual is carefully guided to an area where it is safe to nest. This again emphasises the importance of hourly patrols, particularly late in the season when Turtle Bay has a high amount of active nests.

Nest Monitoring

Nest monitoring is an activity undertaken by the volunteers, interns and staff of Lang Tengah Turtle Watch. Each nest is first checked 45 days after being laid, and subsequently checked every three days until emerging from the sand and entering the sea. This time period allows for constant and thorough monitoring of the eggs, with as little human interference and chance of contamination as possible.

Aside from scheduled checks after the 45-day incubation period, all nests are inspected daily for any visible signs of predation from ghost crabs (*Ocypode ceratophthalmus*), Asian water monitor (*Varanus salvator*), insects such as ants and termites, and human poachers. On closer inspection, if a predator is deemed to have reached the egg chamber and impacted the nest, the entire clutch will be relocated to a newly dug nest, with as similar characteristics to the original as possible. Fungus, although not defined as a predator, can also have an adverse effect on turtle eggs. At any sign of infection during the nest checks, contaminated eggs will be removed into a quarantine nest next to the original, and checked systematically as if it were a separate nest.

A week after the eggs had hatched and emerged from the nest, a post-hatch inspection (PHI) was carried out in order to determine how many individuals had successfully hatched. Notes were also taken on other developmental aspects, such as unfertilised eggs or underdeveloped embryos.

Tagging

Once a female has finished laying her eggs and is covering the egg chamber with sand, it is possible to attach tags to her flippers. The metal tags are secured between the second and third scales away from the body of the turtle, on the trailing edge of the flipper (Figure 2). If it is not possible to secure the tag between the second and third scales, then it will be secured between the third and fourth. However, the further away from the body of the turtle that the tag is placed, the more likely it is that the tag will detach itself over time (Eckert & Beggs, 2006).

A method known as 'double-tagging' was employed, whereby a tag is placed on both front flippers. This is to ensure the greatest chance of the turtle retaining at least one of its identity tags over the course of its migration period. If one of the tags is missing upon an individual's return to the nesting beach, then another tag is inserted and the identification form for that individual is updated.

Only staff trained in tagging sea turtles were allowed to undertake this procedure. In the event of their absence and the arrival of a new mother, the tracks in the sand were measured at their widest point. When a subsequent new mother came ashore her tracks were also measured to see if they matched those of the previous, untagged mother.

Following the tagging procedure, the curved carapace length (CCL) and curved carapace width (CCW) were measured according to the guidelines set out by Wyneken (2001).

Figure 2. A turtle with a flipper tag (taken from National Band & Tag Company, see https://www.nationalband.com/sea-turtle-flipper-tags/).

Nest Temperature

Temperature and humidity data was collected with the use of iButton. The buttons were secured in a mesh parcel and attached onto the nest marking stick. It was vital that the buttons were placed as close to the centre of the clutch as possible. Turtle eggs have a metabolism and thus produce their own internal heat (Chan, 2006). A reading from the centre of the nest will therefore provide a more accurate reading for the overall nest temperature to be averaged. Temperature data used came from the middle third of the incubation period. An average green turtle incubation period is 60 days, if this is the case; data is collected from day 20-40. All iButton temperature data followed this pattern. It is during this time in the egg incubation that the temperature-dependent sex determination (TSD) is most heavily influenced (Spotila, 2004).

RESULTS

Nesting

The 2017 nesting season recorded 26 landings from both nesting beaches, out of which 12 nestings were recorded from seven adult female sea turtles. The amount of landing and nesting documented was the lowest since 2013 and seven times lower compared to the 188 landings and 88 nests recorded in 2016. Table 1 provides detailed information on the seven nesting mothers, of which four were green turtles and three were hawksbill turtles. All nesting turtles were identified for the first time this season. The number of nests laid by each mother varies greatly, from one nest laid to five nests laid during the course of the season. Of the 12 nests laid, two nests were only discovered after the eggs were laid, and the turtle had already returned to sea. Thus, there were two unidentified nesting turtles. 17G001 laid the most nests, with 547 eggs from five nests throughout April and May.

Table 1. List of nesting mothers with ID number and nesting details.

Individual	Left Tag	Right Tag	Number of nests laid	Total eggs laid	Average number of eggs per clutch
17H001	2422	2423	2	242	121
17G001	MYT0685	MYT0686	5	547	109.4
17G002	N/A	N/A	1	58	58
17H004	3692	3693	1	118	118
17G003	N/A	N/A	1	73	73
Unidentified Turtle 1	N/A	N/A	1	110	110
Unidentified Turtle 2	N/A	N/A	1	N/A	N/A

Figure 3 shows the number of nests per month while Figure 4 depicts the number of eggs laid per month. The months of April and June yielded the highest number of nests, with three nests laid on both months. The most number of eggs laid was recorded in April with 341 eggs. The number of eggs laid in September is unknown at the time of report writing, as the nest was found after the turtle returned to sea and the nest has yet to emerge and be inspected. Eight nests were laid on Turtle Bay while four nests were laid on Lang Sari.

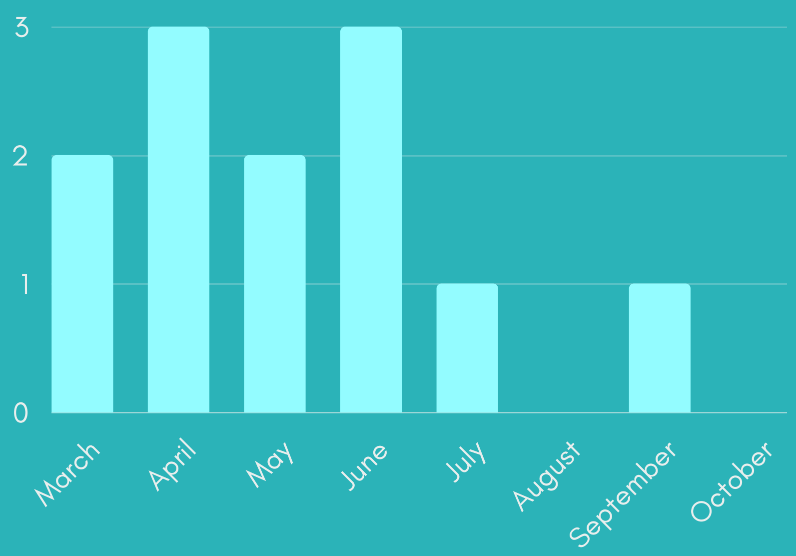

Figure 3. Number of nests laid in each month during the 2017 nesting season.

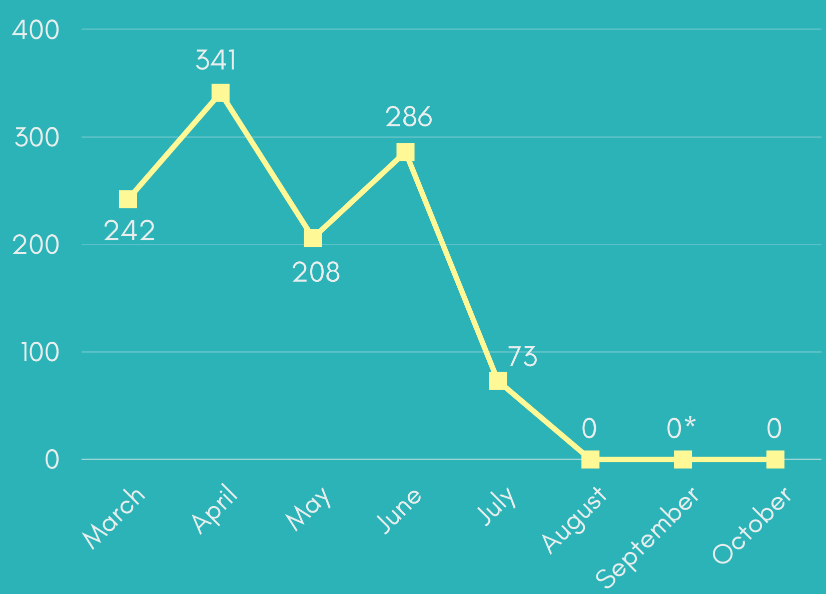

Figure 4. Number of eggs laid in each month during the 2017 nesting season.
* Number of eggs unknown; nest was found after turtle returned to sea and had not been inspected at the time of writing.

Fertilisation, Hatching and Emergence Success Rates

At the moment of writing, the fertilisation, hatching and emergence success rates were calculated for 11 nests and are presented in Table 2. The success rate defined is based on Research and Management Techniques for the Conservation of Sea Turtles (Miller, 1999). Fertilisation success rate is defined as the percentage of eggs fertilised over the number the number of eggs laid. Hatching success rate is defined as the percentage of turtles hatched out of the shell over the number of eggs laid. Emergence success rate is defined as the number of turtles emerged from the nest over number of eggs laid. The average fertilisation, hatching and emergence success rate for the 2017 season are 98.01%, 88.62% and 88%, respectively. Nests 3 and 11 have the highest success rate of 100% in all aspects while nest 10 has the lowest success rate with 91.53% for fertilisation success rate and 72.04% for both hatching and emergence success rates.

Table 2. Success rate of nests laid and inspected. Data from nest 12 laid in September was unavailable at the moment of writing.

Nest	Type	Number of eggs laid	Success Rate (%)		
			Fertilization	Hatching	Emergence
1	In-situ (then relocated)	118	99.15	67.86	67.86
2	In-situ (then relocated)	124	99.19	89.19	89.19
3	In-situ	118	100	100	100
4	Relocated	113	100	95.58	95.58
5	Relocated	110	100	99.07	97.22
6	In-situ (then relocated)	96	98.96	62.79	62.79
7	In-situ (then relocated)	110	97.27	100	99.06
8	In-situ	110	95.45	100	100
9	In-situ (then relocated)	58	96.55	88.24	84.31
10	In-situ (then relocated)	118	91.53	72.04	72.04
11	Relocated	73	100	100	100
Average			**98.01**	**88.62**	**88.00**

The success rates between in-situ and relocated nests are also compared (Table 3 & Figure 5). An in-situ nest is characterised as a nest laid at Turtle Bay or Lang Sari and was undisturbed until the nest emerged. Relocated nest is characterised as a nest laid on Turtle Bay or Lang Sari and was relocated as the nest was laid in an unsuitable area, such as areas full of roots or coral rubbles, prone to termite infestation, or laid within 2 m from the high tide line. There is no significant difference between the fertilisation success rate of in-situ and relocated nests. However, in-situ nests overall have a higher hatching and emergence success rate compared to relocated nests.

Table 3. Comparison of success rates between in-situ and reloated nests.

Type	Number of nests laid	Number of eggs laid	Average success rate (%)		
			Fertilisation	Hatching	Emergence
In-situ	2	228	97.72	100	100
Relocated	9	920	98.07	86.08	85.34

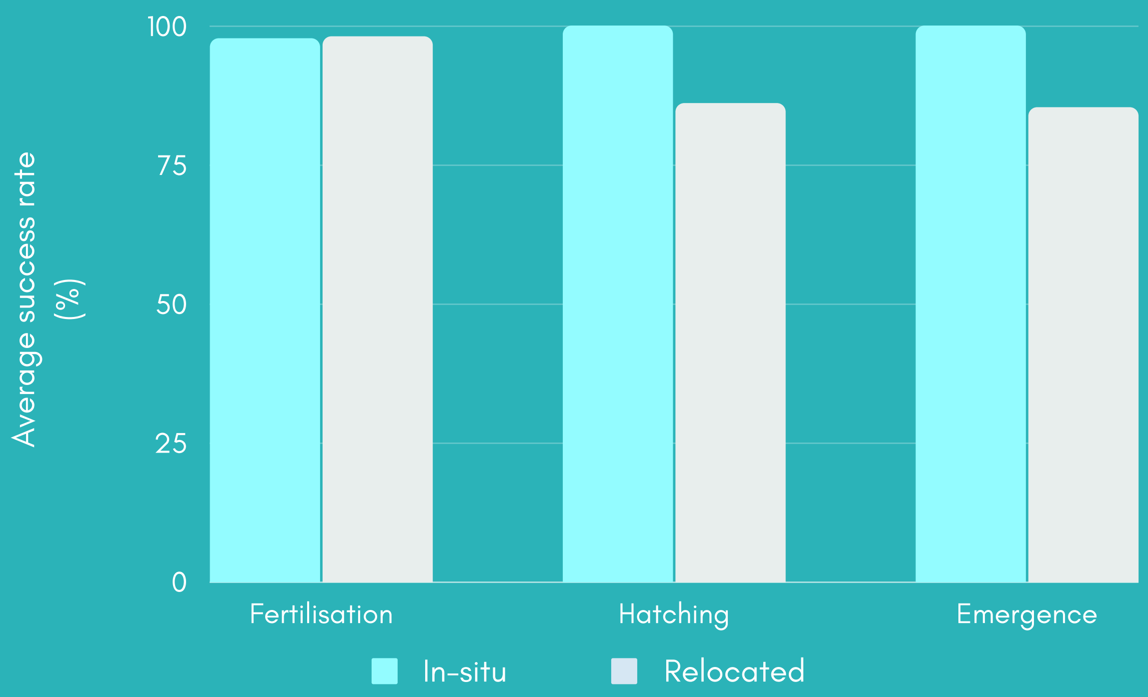

Figure 5. Comparison of success rates between in-situ and relocated nests.

Unsuccessful Hatching and Emergence

During PHI, the nest content is divided into several categories – apparent unfertilisation, dead in nest, live in nest, undeveloped, unhatched, unhatched term, as well as predation by crabs, termites, maggots, fungus and monitor lizards. Out of 1,148 eggs that were laid, 231 eggs (20.12%) did not hatch or emerge, of which 94 egg shells or hatchlings (8.19%) were not found during post hatch inspection as a result of raiding by ghost crabs and monitor lizards. The results recorded are presented in Table 4 and Figure 6. Predation by ghost crab accounted for the the highest amount of eggs lost during the incubation process, followed by predation by Asian water monitor (Table 5 & Figure 7).

Table 4. Number and percentage of unsuccessful hatching and emergence.

	Apparent unfertilization	Dead in nest	Live in nest	Undeveloped	Unhatched	Unhatched term	Predated	Not found
Number of eggs	23	5	0	5	3	4	97	94
Percentage (%)	9.96	2.16	0	2.16	1.30	1.73	42.00	40.69

Table 5. Number and percentage of eggs and hatchlings predated.

	Predation				
	Crabs	Termites	Maggots	Fungus	Monitor lizard
Number of eggs	49	0	0	6	42
Percentage (%)	50.51	0	0	6.19	43.30

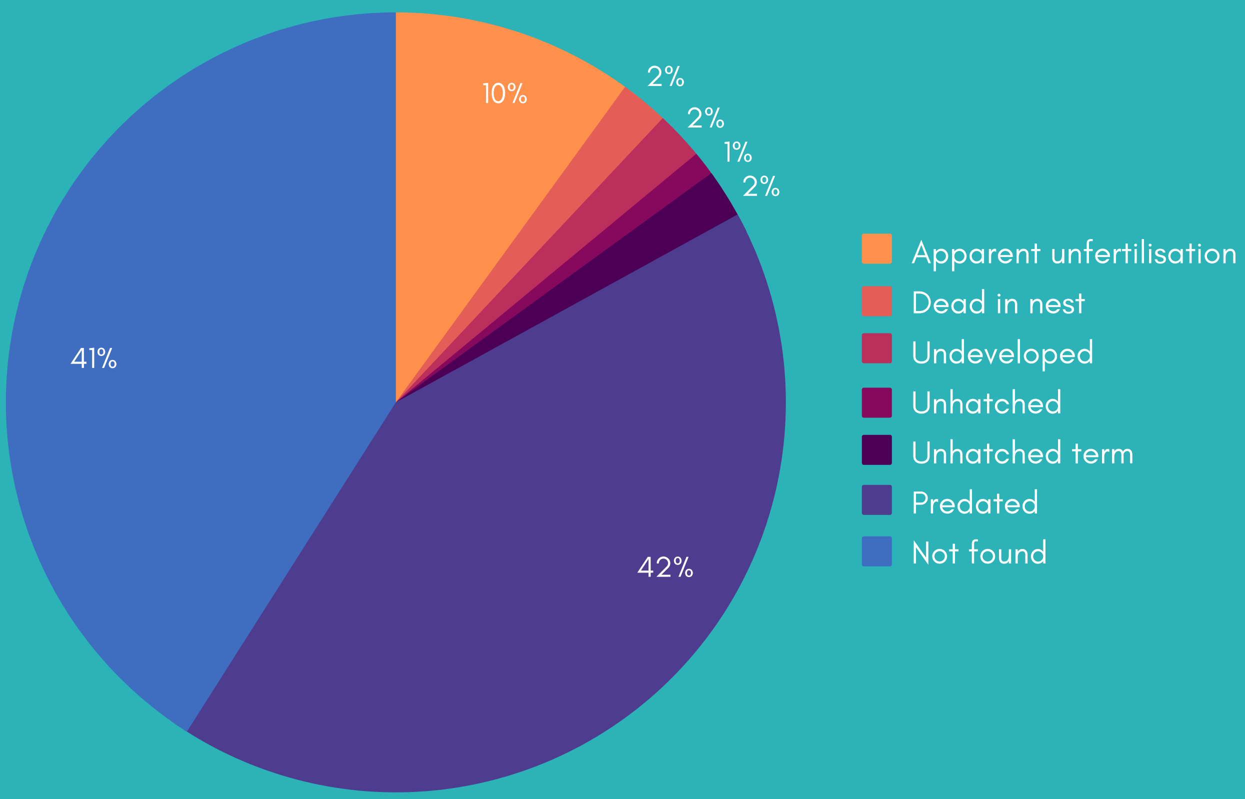

Figure 6. Percentage of unsuccessful hatching and emergence due to various factors.

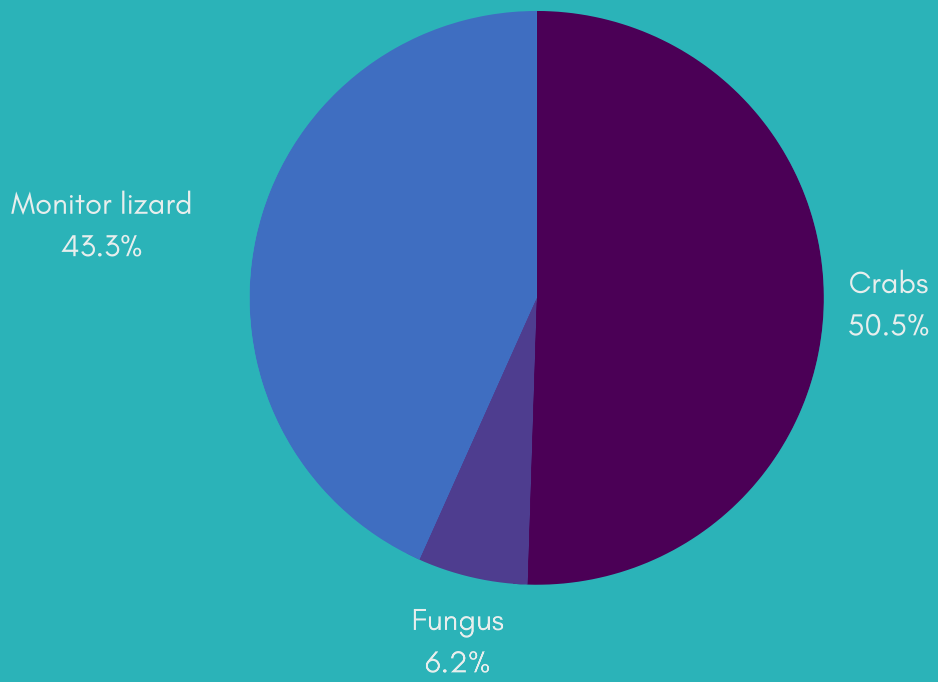

Figure 7. Percentage of eggs and hatchlings predated by different predators.

Nest Temperature

An iButton was placed on top of nest 13 on 17 September 2017 to monitor the temperature and humidity of the nest throughout the incubation period. The average reading during the middle third of incubation period (day 20-40) is calculated to determine the ratio of male to female hatchlings in the nest. Nest 13 had an average temperature reading of 28.61°C, showing that nest 13 would have a higher ratio of male to female hatchlings in the nest.

DISCUSSION

Nesting

The 2017 nesting season has the lowest landing and nesting record since the establishment of the organisation with only 26 landings and 12 nests which is seven times lower compared to 2016 nesting season. The decrease in landing and nesting record could be attributed to multiple factors. Firstly, sea turtles have a natural nesting interval of 2-5 years (Spotila, 2004). The 2016 nesting season was the peak nesting year in Terengganu which recorded the highest record in turtle landing and nesting throughout the region. Thus, it is natural to observe a decrease in landing and nesting in 2017. However, the number of reported turtle death has increased in the neighbouring islands such as Pulau Perhentian and Pulau Bidong. One dead adult female green turtle was found by divers from D'Coconut Lagoon Resort on 15 July 2017 and upon examination by staff of Lang Tengah Turtle Watch, eggs were discovered in the corpse which indicated that the sea turtle was due to nest. A dead adult green turtle was also discovered by divers from Summer Bay Resort at the vicinity of Pulau Bidong two weeks later. In addition, a total of four adult green turtles perished due to being struck by boat propellers at Pulau Perhentian in 2017, one of which was an adult male green turtle (Wan Zuriana Wan Sulaiman, Perhentian Turtle Project Manager, personal communication, 2017).

lThe most important highlight of the 2017 season is the overall success rate of the nests monitored with a record of 98.01%, 88.62% and 88.00% for fertilisation, hatching and emergence success rates. Although the success rate in 2017 nesting season is the highest recorded, a proper data comparison cannot be established due to the different formula used for the calculation of the success rate. The methodology of categorising the nest contents during PHI has been significantly improved compared to previous seasons. Unhatched eggs are further differentiated into unfertilised, underdeveloped, unhatched and unhatched term. Hatchlings found in nest are also accounted for under the categories live in nest and dead in nest. This allows for a more scientifically accurate calculation of the success rate of the nest monitored. The high success rate documented could also the result of the low number of nesting which allowed a more stringent control and supervision during nest checks.

The average number of eggs laid by the nesting green turtles on Pulau Lang Tengah is 99, which is close to the global average of 110 eggs (Spotila, 2004). The lowest number of eggs laid was 58 eggs by 17G002. 17G002 displayed an extremely wary behaviour and was sensitive to red light and any minor movements on the beach. The particular individual came up to Turtle Bay twice and nested on its first landing. On its first landing, it raced back to the sea after nesting and its descending track was like of a hawksbill turtle with alternating track mark. During its second landing, it made a quick, sharp turn around the high tide line and returned to sea despite not being approached and no lights was shone.

Predation

Predation was the major factor in unsuccessful hatching and emergence in nests monitored. Majority of egg loss was due to predation by ghost crab and monitor lizards. Ghost crab and monitor lizards were documented predating eggs and hatchling in all 9 relocated nest but no predation was recorded for the 2 in-situ nests. Ghost crabs and monitor lizards have a keen sense of smell. The scent of eggs and hatchlings taken out during nest checks could have lingered on top of the nest. The sand compactness is decreased from nest check activities carried out, making it easier for the scent eggs and hatchlings to diffuse to the top of the nest. These two factors could have made it easier for the predators to detect the location of the nest, and thus increasing the risk of predation. Continuous research is necessary to improve the methodology in nest check to ensure that the disturbance is kept to a bare minimum to increase the hatching and emergence success rate. Nest check frequency can be reduced for once every 3 days to once every 5 days and nest check activity should be halted once hatchlings are found in the nest. Protection of nests could be improved by increasing daytime patrols on Turtle Bay to deter raiding from monitor lizards, and by placing wired mesh net on top and around the nests.

This season, the presence of termites on nests monitored was not documented and no nest was lost due to predation by termite. This figure suggest that termite infestation is less prevalent in 2017 compared to 2016 and 2015 in which 183 (2.31%) and 175 (4.51%) eggs were predated by termites respectively. No poaching was recorded for 2017 nesting season too.

Nest Temperature

The ideal temperature range for nest incubation of sea turtles is 28-31°C (Spotila, 2004). The temperature at which an equal ratio of male to female hatchlings will be produced is called the pivotal temperature and is 29.2°C for sea turtles (Spotila, 2004). Nest incubated at temperature below the pivotal temperature would produce a higher ratio of male to female and vice versa. For nest 13, the average temperature reading was 28.61°C, showing that the emerging hatchlings would be male biased. The iButton was placed at the top of the nest as the nest was only discovered after the eggs were laid under a shaded area, resulting in a lower temperature reading. If the iButton was placed in the middle of the nest and the metabolic heat emitted from the incubating eggs was taken into account, the nest would be expected to have a more balanced ratio of male to female hatchlings. An estimation on the sex ratio can only be made from the temperature reading because a histology test on the sea turtle hatchling's gonad cell needs to be conducted to accurately determine its sex.

CONCLUSION

Despite the low nesting season in 2017, we are pleased to see many improvements in terms of research methodologies. With the new Malaysian Sea Turtle Photo-ID Network that was started, we also hope to slowly move away from the tagging method to photo identification which is a less invasive method of identifying individual sea turtle in 20 years.

New and better research methodologies will be look into to ensure that all research practices carried out for the betterment of the marine conservation efforts that are being conducted.

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