

2022

ANNUAL REPORT



LANG TENGGAH TURTLE WATCH

TANJONG JARA RESORT

2022 IN A GLIMPSE

LTTW @ TJR TEAM

3

STAFF MEMBERS

9

INTERNS

MILESTONES

17,441

HATCHLINGS RELEASED

1,459.3

KG OF TRASH REMOVED

GREEN SEA TURTLES

206

NESTS SAVED

20,066

EGGS SAVED

82.7%

HATCHING SUCCESS RATE

PAINTED TERRAPINS

87

NESTS SAVED

1,434

EGGS SAVED

76.3%

HATCHING SUCCESS RATE

COLLABORATORS AND SPONSORS



TANJONG JARA RESORT
UNMISTAKABLY MALAY



MAKASSAR GLOBAL INNOVATION AND CREATIVITY CENTRE



YAYASAN



TOGETHER WE MAKE IT BETTER



UNIVERSITI SAINS MALAYSIA



CONTENTS

ACKNOWLEDGEMENTS	01
OUR STORY	02
OUR PROJECT SITES	03
03 Lang Tengah	
04 Tanjong Jara	
05 Chakar Hutan	
06 The Resthouse Perhentian	
OUR PEOPLE AT TANJONG JARA	07
07 The Team on the Ground	
08 Research Assistant Interns	
OBJECTIVES	09
HATCHERY MANAGEMENT AND TURTLE MONITORING	10
11 Nest Adoption Programme	
16 Nest Inspections	
17 Hatching and Emergence Success Rate	
19 Hatchling Releases	
21 Green Sea Turtle Population	
21 Nesting Population	
23 Stranding	
24 Nest Temperatures and Sex Ratios	
26 Fungal Diversity	
COMMUNITY AND TOURIST ENGAGEMENT	28
29 The Visitors' Hut at Tanjong Jara Resort	
30 Beach Clean-Ups	
32 School Programmes	
33 Corporate Social Responsibility	
CONCLUSION	34
REFERENCES	35

ACKNOWLEDGEMENTS

The conservation and research work by Lang Tengah Turtle Watch (LTTW) was carried out in collaboration with the Department of Fisheries (DoF) and Tanjong Jara Resort. The educational outreach activities were successfully organised with the support of the Department of Education and schools. We are extremely thankful to our rangers as well as the licensed tender holders who worked tirelessly to patrol the nesting beaches and relocate the nests with care to our hatcheries.

We specially thank YTL, Ministry of Finance, MaGIC, Yayasan Sime Darby, Heriot-Watt University Malaysia, Save Our Blue Ocean, Miracle Spectrum and Simplify for their very generous donations, fundraising efforts and/or in-kind support. We are extremely grateful to all the adopters who have supported our adoption programmes, which enabled us to increase our conservation and awareness raising efforts such as saving more turtle eggs. We also express our appreciation to corporations including Hapag-Lloyd, ADA Biotech, ZUS Coffee and Precious Plastic Malaysia, as well as international schools including Dulwich College Singapore, Alice Smith International School and International School of Kuala Lumpur in supporting our programmes.

We also thank all our collaborators including Fuze Ecoteer, Universiti Malaysia Terengganu's Sea Turtle Research Unit (SEATRU) and Laboratory for Pest, Disease and Microbial Biotechnology (LAPDiM), Turtle Conservation Society of Malaysia and Geng Platik Ija (GPI), whom we work closely with in research, conservation and/or outreach activities.

The work was carried out by our dedicated team of staff members and interns – Nur Abidah Zaaba, Nur Isandra Shazlynn Shamsul Azmil, Amir Aizat, Audrey Symplicius, Nadia Sufi Suraya, Gowena Goh, Chia Zhan Le, Puteri Nuraida Syuhada, Amin Hamzah, Amira Hasanah, Rachel Yap and Long Seh Ling. We would also like to thank our Admin Assistant, Chen Suet Yen, and our Operations Coordinator, Eileen Nyeow @ Yau Yee Ling, who supported us from the KL Office, as well as staff members and interns from other project sites who occasionally extended their help when needed.

Lastly, we extend our gratitude to Hayati Mokhtar, Raphe van Zevenbergen and Dato' David Morais, founder, co-founder and directors of LTTW, for their continuous support.

OUR STORY

After our **Founder, Hayati Mokhtar**, sought help from friends, WWF conservation specialists, and Terengganu state government officials, LTTW was born. With enthusiastic interest from local Malaysian volunteers and students from the Universities of Cambridge, Birmingham and University College London, by April 2013 the project was underway.

After visiting her land that surrounds Turtle Bay on Lang Tengah Island in recent years, Hayati Mokhtar soon realised that the pristine East Coast landscape of childhood memory was no longer a reality. Rubbish littered the sand and corals lay bleached in the shallows. This sobering moment led her to form an action-plan, aimed at preserving what she knew was gravely threatened – the turtles.



Whilst in Georgetown – midway through his tour of South-East Asia – **Raphe van Zevenbergen** chanced upon a friend of Hayati’s in an antiques shop. She asked if he had just come from her friend’s turtle watch project as part of the Cambridge crew. He hadn’t, but was most interested to hear more. He called Hayati and was soon on board. Trained in wildlife conservation, Raphe is convinced that private land-owners can play an important role in global species preservation. He was invited to join as **co-founder** – as Hayati felt that she and Raphe saw eye-to-eye.

With the meeting of Raphe and Hayati, LTTW has been able to develop into the successful conservation project we have today. Since the project began it has grown steadily; to date saving over 150,000 turtle eggs from being poached or sold to the market and hosting in excess of 665 volunteers from 23 different nationalities. With new research tasks underway and new initiatives across the project, LTTW will continue to grow and strive towards the protection of our marine ecosystems.

OUR PROJECT SITES

LANG TENGAH



In addition, we also protect the turtle feeding habitats. Visit Tanjung Telunjuk, and you will find proof of our coral rehabilitation effort there. Our coral nursery houses and grows corals that we later plant around the island's reefs. We also conduct surveys to monitor coral bleaching events, fishes and invertebrates on the island. By gathering information on all aspects of the ecosystem, we can evaluate its health and apply management plans properly.

LTTW started at Lang Tengah Island in 2013. Monitoring turtle landings and preventing egg poaching are the project's key objectives. The protection of the turtles that nest on Lang Tengah – predominantly green turtles but also hawksbill turtles – relies on a constant and continued presence on the island that acts as a deterrent to egg poachers. The core activities include living 24 hours a day in the camp, conducting regular patrols on nesting beaches at night, and relocating any nests on other beaches back to the safety of Turtle Bay. We also monitor the in-water turtle populations.

Little was known about the terrestrial and marine life before LTTW began work on Lang Tengah, with records of marine park with the WWF describing the island as "data deficient". Our initiatives on the island help to fill in the blanks for both terrestrial and marine species found along this east-coast archipelago – and our preliminary studies has already yielded some intriguing results.

Volunteers are an essential part of our operation – in fact, we can't do without them. By engaging in the daily running of the project, volunteers enable us to help save the turtles and collate our scientific data throughout the season. If you are up for an adventure – get in touch!

TANJONG JARA



In July 2016, we expanded our conservation efforts to the mainland; where we operate hatcheries and a Visitors' Hut in collaboration with YTL at Tanjong Jara Resort in Dungun. At this project site, we work with local rangers and other stakeholders to relocate eggs into our hatcheries that we run in collaboration with the resort. Our goals for this project are similar to those of our founding project on Lang Tengah.

We have traditionally employed two to four local rangers to patrol nesting beaches, take biometric data of the nesting turtles, and finally relocate the eggs into the safety of our hatcheries in order to prevent poaching.

However, alongside our normal operations, we also carry out activities to raise awareness among Tanjong Jara Resort's guests, local communities, and schools.

Guests of Tanjong Jara Resort can enjoy an array of turtle-related activities offered; Turtle Talk, Nest Inspection, Hatchling Release, and Turtle Kids Club with our team members.

CHAKAR HUTAN



The project site at Chakar Hutan, Kerteh is yet another expansion of conservation effort to save more turtle nests in Terengganu. LTTW collaborates with the DoF and WWF-Malaysia at Chakar Hutan in monitoring the nesting beach and managing a hatchery and an information centre

On average, Chakar Hutan beach records up to 300 nests per year. A 24-hour guarded hatchery was established in July 2022 to relocate nests laid on this beach, which were previously transported to the Ma'Daerah Turtle Sanctuary about 10 minutes from Chakar Hutan.

Apart from sea turtle conservation, the project also focuses on creating awareness among the public – by engaging the local communities with conservation work, promoting “edutourism,” and at the same time supporting the community’s livelihoods by providing job opportunities and income through turtle conservation tourism.

THE RESTHOUSE PERHENTIAN



The Resthouse, located at Perhentian Islands, is a wooden house, by the sea; entirely on its own, on a promontory – hidden in amongst the trees.

Hayati moved this house from where it was originally; near Ipoh, on the West Coast of Malaysia, about 250 kilometres away. It was built by the British Government between the wars – has not been altered, and is furnished according to the period.

The house is completely made of salvaged wood, and therefore, no rainforest trees were felled in the process. The Resthouse runs on 100% solar power and we make every effort to be as eco-friendly as we can be, given the fragile marine environment of Perhentian Island.

There are 4 bedrooms in the property, which can sleep up to 8 guests, and the house is listed on AirBnB. There is a kitchen for a bit of self-catering – juices and breakfast only – and plenty of tea and freshly ground coffee provided. For lunches and evening meals, there are guest houses nearby offering food, and several good restaurants 3 to 5 minutes further down the beach.

A large portion of proceeds from The Resthouse are channelled into our turtle conservation projects at Lang Tengah Island and Tanjung Jara Resort. The Resthouse has been awarded the AirBnB Green Stays Gold Award 2021. The Awards aim to recognise small, local, sustainable accommodation providers in Malaysia.

OUR PEOPLE AT TANJONG JARA

THE TEAM ON THE GROUND

Seh Ling is our **Principal Officer**, in charge of implementing the best management practices for our hatcheries and nesting mother surveys. Seh Ling brings with her years of turtle experience, being the former project manager of Perhentian Eco Education Project. Her boundless passion for sea turtle conservation has even led her to become one of the founding members of the Perhentian Turtle Project! Seh Ling completed her PhD from Universiti Malaysia Terengganu. Her research investigated the human-sea turtle interaction complex to understand how sea turtles fit into the lives of local communities in protected marine areas.



Site Co-Manager Abidah is one half of the managerial tag-team at Tanjung Jara. She has a marine science background and an absolute love for all things turtle. Abidah has previously worked with sea turtles in Sabah and, as someone who speaks fluent Malay, she is invaluable when liaising with the community around our nesting beaches. Abidah has been with the project since 2019 as a Conservation Officer but with a change in role, she is now in charge of running all the operations at Tanjung Jara!



Site Co-Manager Isandra graduated with a BSc (Hons) in Applied biology from Universiti Sains Malaysia, and had worked on fungal diversity of green sea turtle nest sites as her dissertation. Isandra's journey with LTTW began in 2020 as an intern. She then went on to Juara Turtle Project as the Sea Turtle Programme officer before re-joining us this year. With ample experience in sea turtle conservation, she brings with her a fun-loving and meticulous take on fieldwork that is sure to bring joy to everyone around her!



RESEARCH ASSISTANT INTERNS



AMIR AIZAT



AUDREY SYMPLIICIUS



NADIA SUFI SURAYA



GOWENA GOH



CHIA ZHAN LE



PUTERI NURAIIDA SYUHADA



AMIN HAMZAH



AMIRA HASANAH



RACHEL YAP

OBJECTIVES

LTTW's utmost mission at the Tanjong Jara project site is to promote the long-term survival of turtle populations in Terengganu.

Protection of both endangered green turtle (*Chelonia mydas*) and critically endangered painted terrapin (*Batagur borneoensis*) is conducted through scientifically-sound conservation and outreach programmes, involving various stakeholders on local, state and international level.

This includes:

- Carry out ongoing conservation efforts and long-term monitoring to better understand and conserve the nesting and in-water sea turtle populations.
- Carry out scientific research that helps fill up the knowledge gaps about turtles in Terengganu and Malaysian waters in general.
- Educate and raise awareness among local communities and tourists through educational outreach programmes as well as engagements in research and conservation efforts.



HATCHERY MANAGEMENT AND TURTLE MONITORING

Nesting beach monitoring is a widely implemented monitoring tool in use by the global sea turtle community and is an important component of a comprehensive conservation efforts to assess and monitor the status and trend of sea turtle populations.

The nesting season on the East Coast of Peninsular Malaysia is highly influenced by the monsoon season. This phenomenon occurs every year from November until February, and turtles are less likely to nest at this time. While green sea turtles usually nest between March and September, painted terrapins will only begin laying eggs from June onward.

In 2022, the two beaches surrounding Tanjong Jara Resort – Tahu Tiga and Kuala Abang – were under our supervision, and as such, we were responsible for the protection of all turtles and turtle eggs that ended up on these beaches.

NEST ADOPTION PROGRAMME

The Terengganu State Assembly has unanimously passed the Turtles Enactment 1951 (Amendment 2021) which, amongst other stipulations, imposes a total ban on the sale of all types of turtle eggs including painted terrapins. It also provides for much heavier penalties for offences against these species. The amended enactment has been enforced since June 1, 2022. Despite the ban, the tender system still exists. Therefore, tender holders still hold the right to collect turtle eggs from certain tendered beaches, but with the strict obligation to sell the eggs to the DoF and appointed NGOs including LTTW, for conservation.



In order to save more nests, the Tanjong Jara project runs a Nest Adoption Programme, which allows the guests and members of the public to adopt a turtle's nest. This helps to ensure that turtle eggs do not end up being sold on the black market. The money donated by adopters as well as injection of funds from grants allows the team to approach local tender holders and purchase freshly laid nests.

We are pleased to announce that a total of **293 endangered green sea turtle and critically endangered painted terrapin nests** with a grand total of **21,500** eggs were saved this season. The number of nests saved surpassed the record-breaking figure of 249 nests last year, albeit with a lesser number of total eggs (Figure 1). The breakdown of this season’s egg buyback from tendered beaches, of which its licensed holders we engage with, is reflected in Figures 2 and 3.

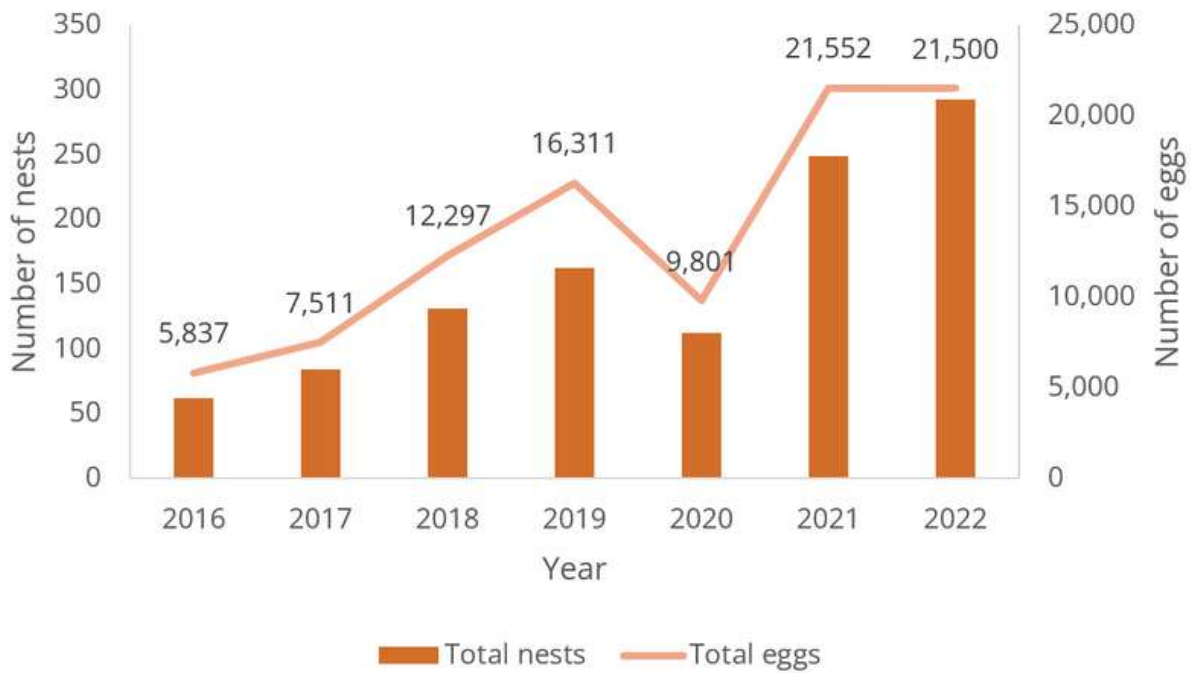


Figure 1. Comparison of green sea turtle and painted terrapin nests and eggs saved from 2016 to 2022.

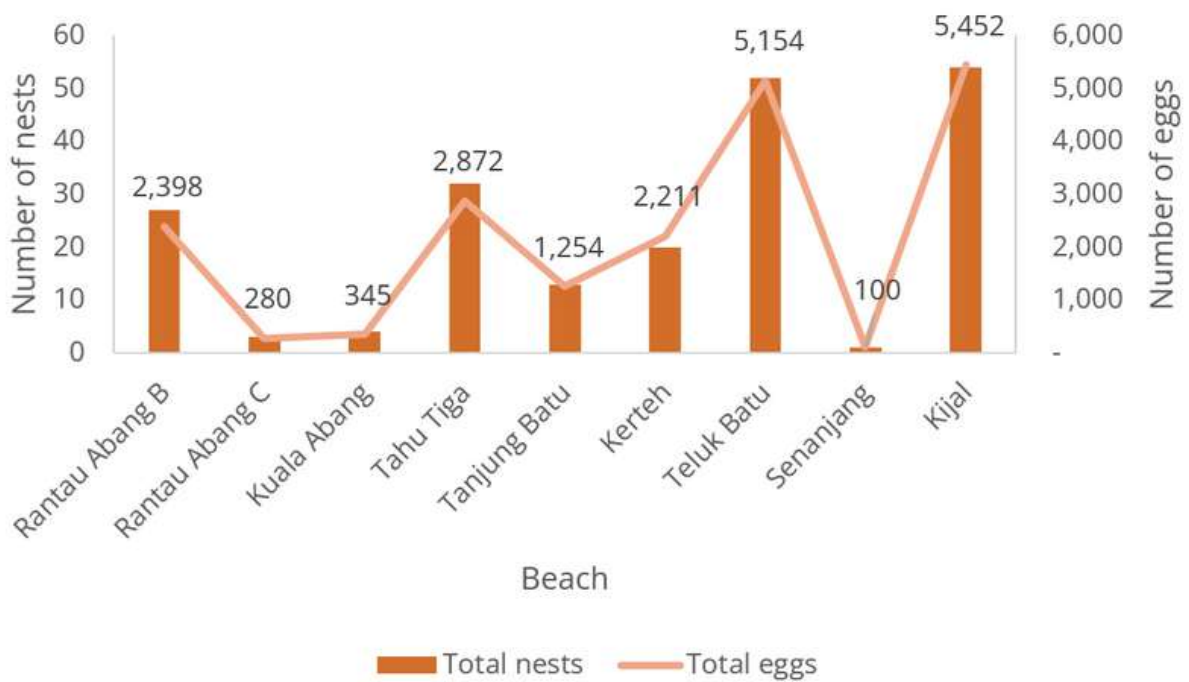


Figure 2. Green sea turtle egg buyback from respective tendered beaches in 2022.

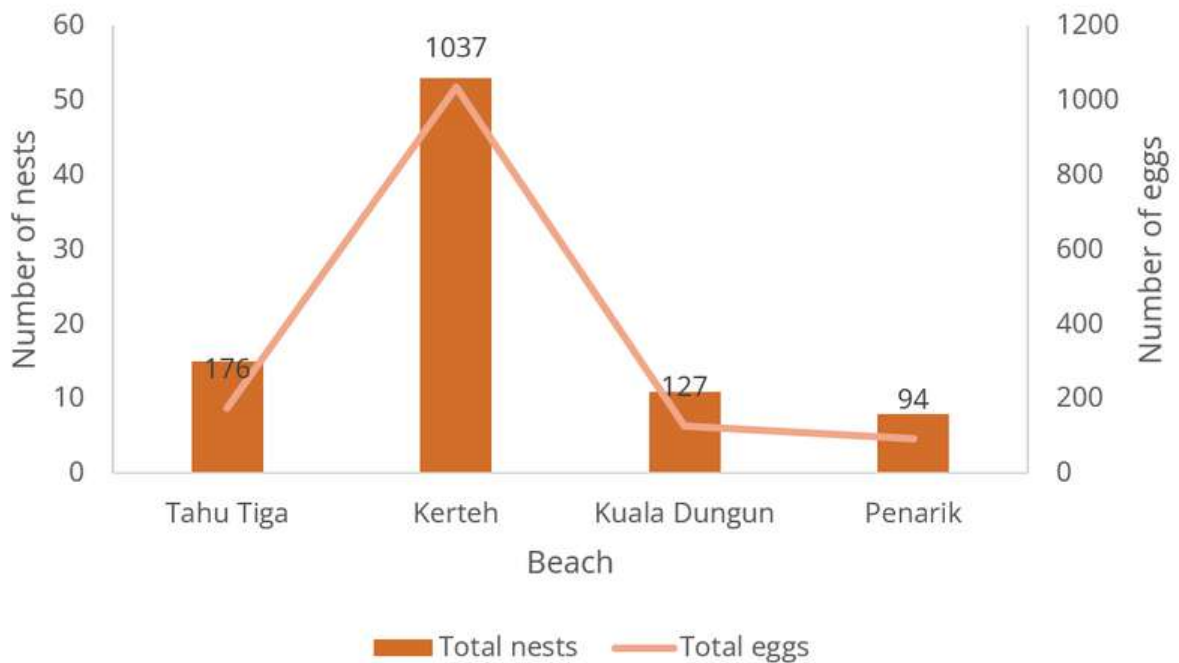


Figure 3. Painted terrapins egg buyback from respective tendered beaches in 2022.

To date, this has been the greatest number of green turtle and painted terrapin nests saved since we started operating at Tanjong Jara Resort in 2016 (Figures 4 and 5). This achievement was made possible with the amended Terengganu Turtles Enactment 1951. Nevertheless, with the ban now in place, it is our sincere hope that it will eventually bring the commercialisation of the eggs of these endangered species to an end.

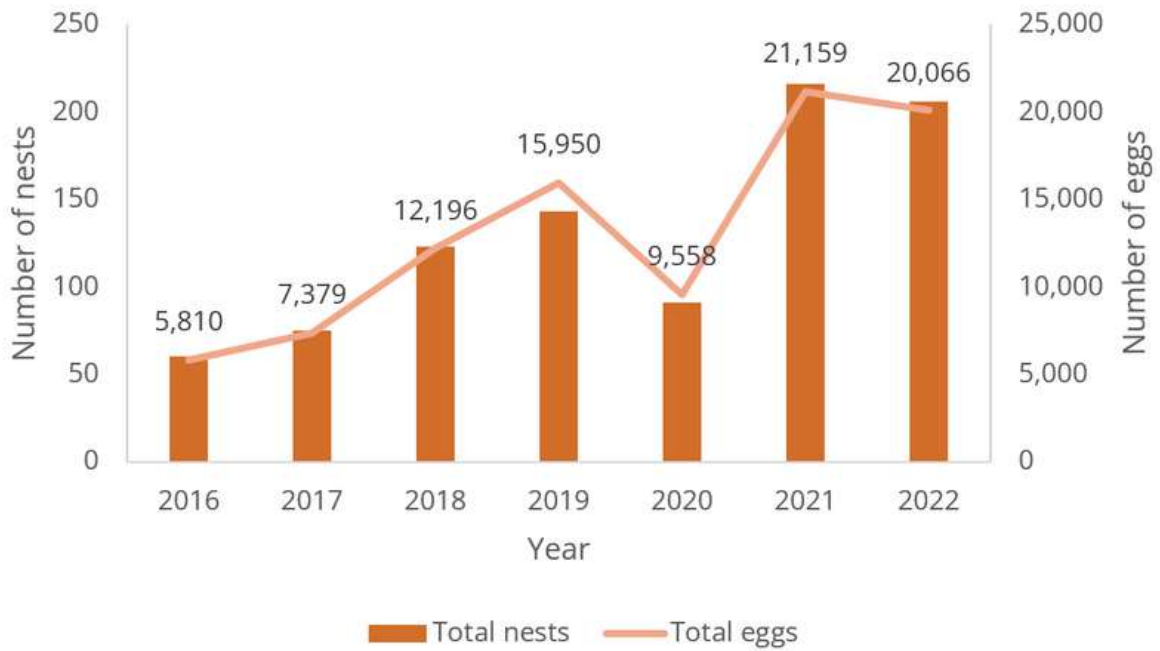


Figure 4. Comparison of green sea turtle nests saved from 2016 to 2022.

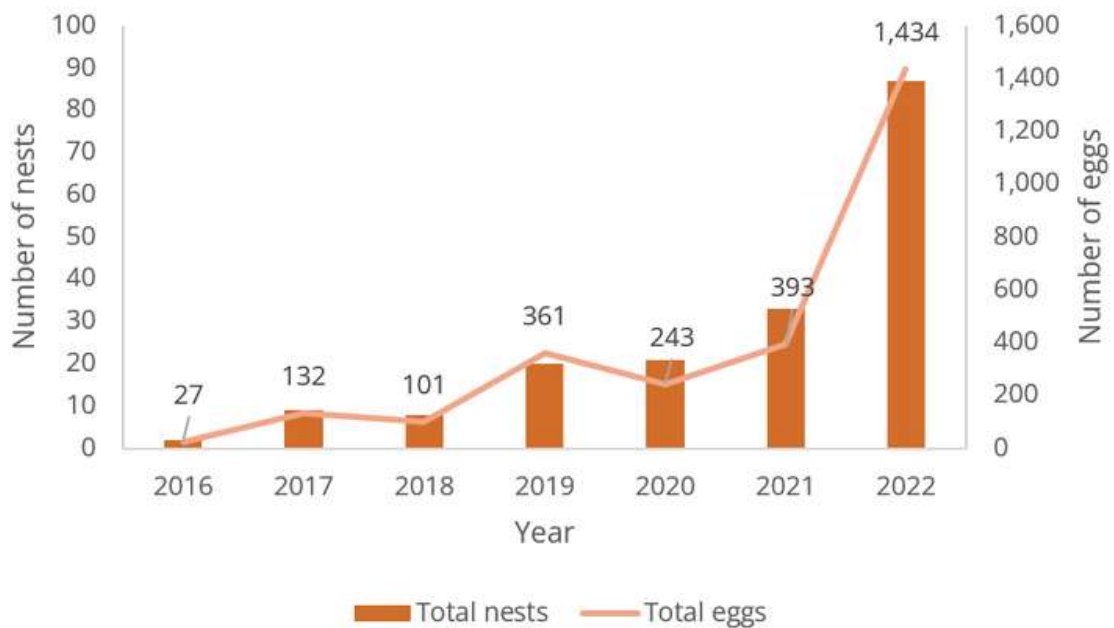


Figure 5. Comparison of painted terrapin eggs nests from 2016 to 2022.

Of these 293 nests saved in 2022, **153 were adopted**, predominantly by guests staying at TJR or via our Online Adoption Programme. TJR guests have historically always shown the upmost support towards our Nest Adoption Programme, and this year was no different. We have already garnered a waiting list for future adopters, and these adopters will receive updates when we adopt a nest for them when the turtle nesting season begins again in mid-March.



NEST INSPECTIONS

The average incubation period for green sea turtle eggs to hatch and for hatchlings to emerge from the nest is two months. Meanwhile, the painted terrapins have a considerably longer incubation period of three months and do not emerge in numbers.

Nest inspection, also known as post-emergence inspection (PEI), refers to the excavation of a nest a few days following the first sign of hatchling emergence. It is conducted to investigate the nest content and save hatchlings that did not manage to crawl out on their own. If there were no emergence signs observed, PEI is carried out on day 70 and day 90 after the green sea turtle and painted terrapin nest was laid, respectively.



PEI provides resort guests with front-row seats to witness our turtle conservation work in person and opportunity to see turtles at every stage of their development, from the egg stage to hatchlings. Furthermore, it also allows us to explain the context of sea turtle conservation in Malaysia, sea turtle biology, and their life cycle.

HATCHING AND EMERGENCE SUCCESS RATE

To determine the hatching and emergence success, we counted the number of eggshells, unhatched eggs, depredated eggs, live hatchlings, and dead hatchlings. We also recorded any abnormalities as well as egg depredation by crabs, ants, termites, monitor lizard, maggots, or fungal infection according to a severity index of Stage 1 to 4.



Hatching success rate was calculated from the number of empty eggshells found during PEI as a percentage of from the total number of eggs laid. Comparison of total number of green sea turtle eggs hatched and the average hatching success on yearly basis is shown in Figure 6. Overall, green sea turtle nests relocated to our Tanjong Jara hatcheries this season reported an average hatching success rate of 82.66% (SD \pm 21.0 from 204 nests), slightly higher if compared to previous years. This year, 4 nests recorded 100% of eggs hatched. Meanwhile, for the emergence success rate, the average was 81.47% (SD \pm 20.69).

Comparison of total number of painted terrapin eggs hatched and the average hatching success rate is shown in Figure 7. Overall, painted terrapin nests relocated to our Tanjong Jara hatcheries this season reported an average hatching success rate of 76.28% (SD ± 27.63) which is the highest in comparison to previous years. Out of 87 nests, 25 nests recorded 100% hatching success rate. Meanwhile, for the emergence success rate, the average was 36.64% (SD ± 31.28).



Figure 6. Comparison of average hatching success of green sea turtles by year.



Figure 7. Comparison of average hatching success of painted terrapins by year.

HATCHLING RELEASES

Nest inspections are integral for us to assess the development stage of the nest and to know when a nest is likely to emerge. During these inspections, if we find hatchlings that appear ready to emerge later that evening, we will contact the reception staff – who will inform guests of a scheduled hatchling release to take place at 10 p.m.



Guests are invited to join us at our Visitors' Hut shortly before 10 p.m. to allow us to informally chat about the project and show a video outlining some of the work being done by the organisation. At 10 p.m., we then give a comprehensive briefing about the release to ensure that it is carried out in a manner that avoids causing unnecessary stress to the hatchlings.

The hatchling release is carried out about 300 m away from the resort, at a location which minimises light pollution, as white light can be confusing for the hatchlings. The guests are safely guided down the beach to the release site under red light to ensure minimal disturbance to potential nesting mothers.



In 2022 we were able to release:

16,369 Endangered green sea turtle hatchlings

&

1,072 Critically Endangered painted terrapin hatchlings

To date, LTTW at Tanjong Jara Resort has been able to release over 73,000 endangered turtle hatchlings back to the sea. The support received from Tanjong Jara Resort and YTL Hotels in 2022 has allowed us to continue to carry out our sea turtle conservation work. We hope to increase our capacity to save even more eggs in the coming years as we look to achieve our mission of saving endangered sea turtle populations on the East Coast of Malaysia.



GREEN SEA TURTLE POPULATION

Nesting Population



The facial scale patterns of nesting turtles were analysed manually by comparing the left and right facial photos with the existing LTTW Tanjong Jara photo-ID database. Newly identified individuals were then given a unique Turtle ID that will help us to recognise them in the future.

Turtle facial photos featured in this page are from two different landings on 5 June 2022 (left) and 27 June 2022 (right). Comparing the facial scales confirms that both sightings are of the same nesting turtle, TJG0031F (Rain).

Six individual females were identified using the photo-ID method in 2022 (Table 1). These individuals were considered new mothers in Tanjong Jara, as there were no records of prior nesting either in the photo-ID database or flipper tag record. There were no re-sightings of green turtles that were already in our database this season. To date, 30 individuals have been identified in Tanjong Jara's photo-ID database.

Table 1. Nesting information of six individual female green sea turtles.

Turtle ID	Turtle name	New/ Returning mother	No. of nests	Total eggs laid	Average clutch size (mean \pm SD)	Nesting site	Inter- nesting interval (days)
TJG0030F	Laangia	New	2	220	110 \pm 11	Tahu Tiga	10
TJG0031F	Rain	New	4	429	107 \pm 5.36	Tahu Tiga	10-11
TJG0032F	Stormy	New	1	110	NA	Rantau Abang C	NA
TJG0033F	Beatrice	New	1	103	NA	Kuala Abang	NA
TJG0034F	Nara	New	2	151	76 \pm 3.5	Tahu Tiga	NA
TJG0035F	Slipa	New	1	100	NA	Tahu Tiga	NA

Stranding

Only one case of turtle stranding was reported this season. A green sea turtle carcass was discovered by beach-goers at Tahu Tiga on 23rd July 2022 at 10 a.m., who then contacted us to investigate the situation. The carcass was inspected for the following:

- Signs of injuries on carapace and plastron
- Curved carapace length (CCL)
- Curved carapace width (CCW)
- Tags and/or previous tag marks
- Sex based on tail length
- Facial scale pattern for photo-ID

Upon inspection, the highly decomposed carcass had a brick tied to its front flippers and head. It is believed that such act was done in an attempt to get rid of the turtle, where the weight of the brick will cause the turtle to sink. A large slit could be seen on the middle part of the carapace, revealing its internal organs. The highly decomposed state of the carcass hampered the attempt to locate tag marks on its flippers and photo-ID process. The turtle measured 65 cm for CCL and 56 cm for CCW. The sex was unknown. A stranding encounter report form was filled up and submitted to the DoF.

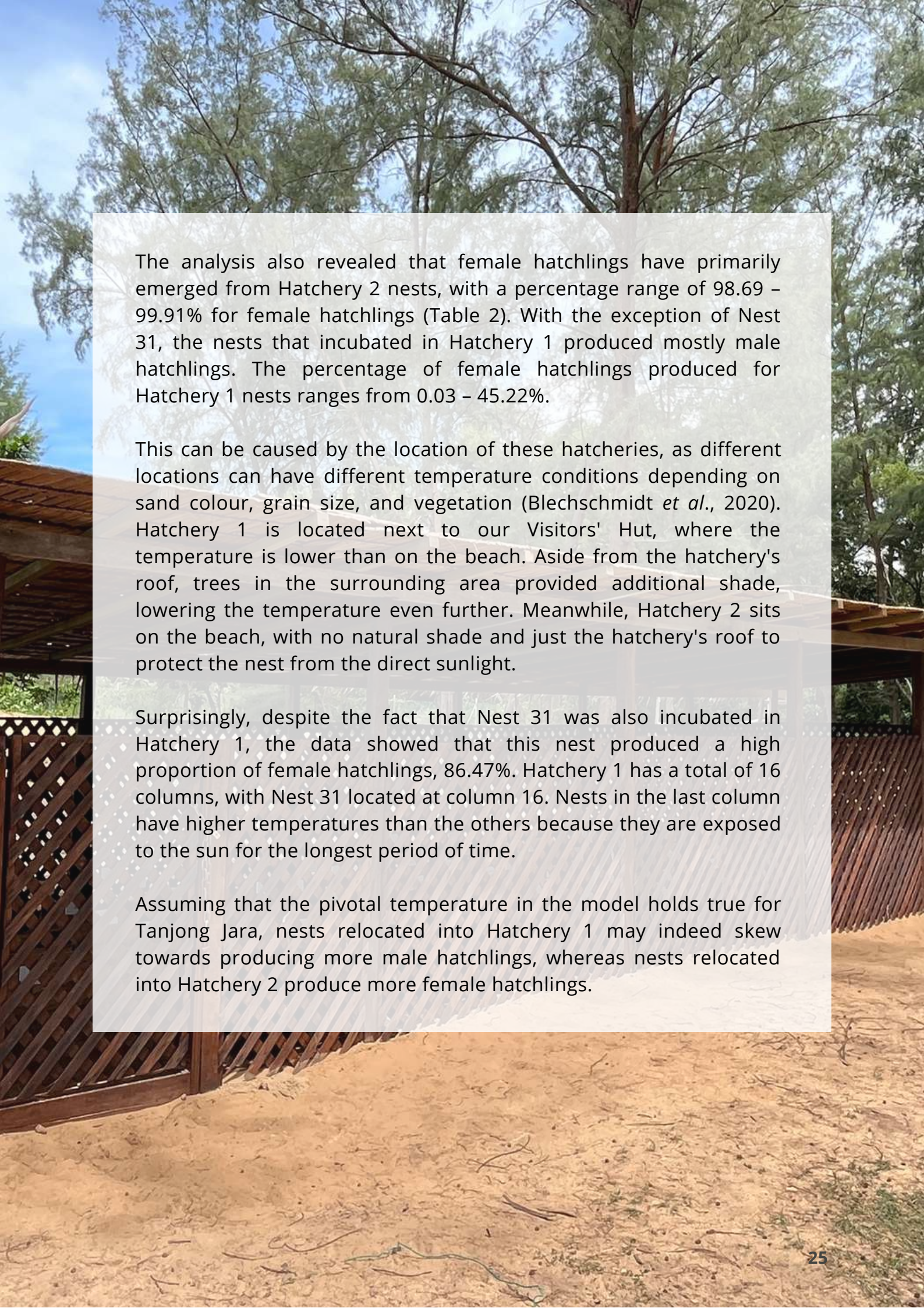


NEST TEMPERATURES AND SEX RATIOS

Throughout the season, we also deployed the HOBO MX TidbiT 400 temperature loggers in 24 green sea turtle nests to track respective nest temperatures during incubation, and used a logistical equation to estimate hatchling sex ratio in each nest (Table 2; see Booth & Freeman, 2006; Tolen *et al.*, 2021) with a proposed pivotal temperature of 29.1°C for the Malaysian green turtle population (Chan & Liew, 1995; Reboul *et al.*, 2021; van de Merwe *et al.*, 2005). Sea turtle embryos undergo temperature-dependent sex determination (TSD), with warmer incubation temperatures producing higher proportions of female hatchlings and cooler temperatures producing more males (Mrosovsky, 1994).

Table 2. Nest temperature and sex ratio of 24 nests in our hatcheries.

Nest	Days of incubation	Nest location	Average temperature during temperature-sensitive period (°C)	Percentage of female hatchlings (%)
3	57	Hatchery 1	28.99	43.31
4	59	Hatchery 1	28.78	20.35
8	63	Hatchery 1	28.76	18.11
11	61	Hatchery 1	28.87	28.45
16	60	Hatchery 1	28.44	3.99
18	64	Hatchery 1	28.44	4.01
24	62	Hatchery 1	28.60	8.98
31	58	Hatchery 1	29.40	86.47
32	65	Hatchery 1	28.50	5.50
38	68	Hatchery 1	27.76	0.12
43	68	Hatchery 1	27.98	0.37
47	61	Hatchery 1	29.01	45.22
48	62	Hatchery 1	28.96	39.59
51	65	Hatchery 1	27.94	0.29
114	52	Hatchery 2	29.87	98.69
160	NA	Hatchery 2	29.97	99.23
184	50	Hatchery 2	30.10	99.63
252	58	Hatchery 2	30.34	99.89
259	55	Hatchery 2	30.38	99.91
268	52	Hatchery 2	30.05	99.51
272	60	Hatchery 1	28.68	12.92
282	68	Hatchery 1	27.51	0.03
289	NA	Hatchery 1	27.63	0.06



The analysis also revealed that female hatchlings have primarily emerged from Hatchery 2 nests, with a percentage range of 98.69 – 99.91% for female hatchlings (Table 2). With the exception of Nest 31, the nests that incubated in Hatchery 1 produced mostly male hatchlings. The percentage of female hatchlings produced for Hatchery 1 nests ranges from 0.03 – 45.22%.

This can be caused by the location of these hatcheries, as different locations can have different temperature conditions depending on sand colour, grain size, and vegetation (Blechs Schmidt *et al.*, 2020). Hatchery 1 is located next to our Visitors' Hut, where the temperature is lower than on the beach. Aside from the hatchery's roof, trees in the surrounding area provided additional shade, lowering the temperature even further. Meanwhile, Hatchery 2 sits on the beach, with no natural shade and just the hatchery's roof to protect the nest from the direct sunlight.

Surprisingly, despite the fact that Nest 31 was also incubated in Hatchery 1, the data showed that this nest produced a high proportion of female hatchlings, 86.47%. Hatchery 1 has a total of 16 columns, with Nest 31 located at column 16. Nests in the last column have higher temperatures than the others because they are exposed to the sun for the longest period of time.

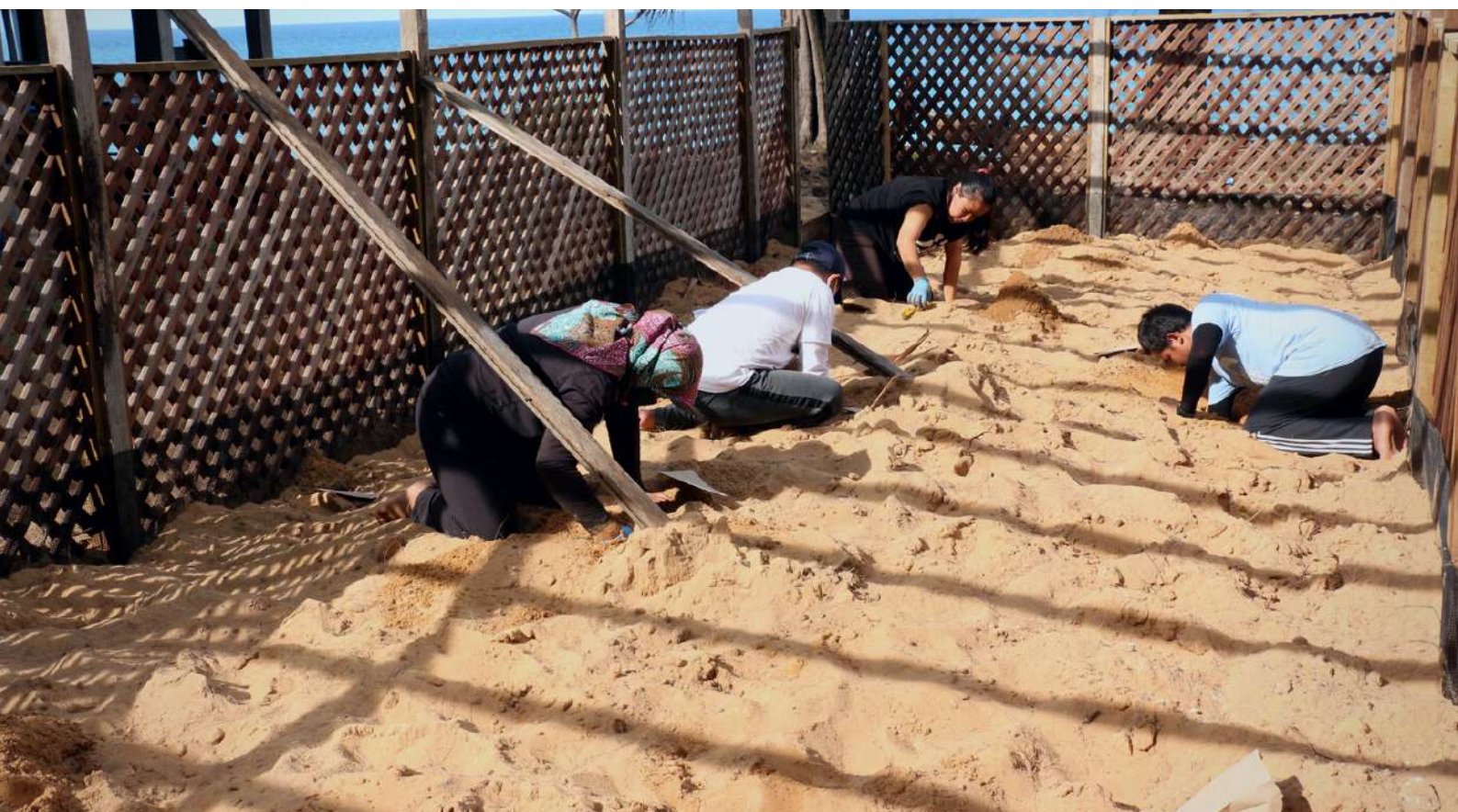
Assuming that the pivotal temperature in the model holds true for Tanjung Jara, nests relocated into Hatchery 1 may indeed skew towards producing more male hatchlings, whereas nests relocated into Hatchery 2 produce more female hatchlings.

FUNGAL DIVERSITY

The goal of our fungi studies, which we started last year in partnership with Dr. Siti Nordahliawate Mohamed Sidique from Universiti Malaysia Terengganu (UMT), was to identify the fungal species present in the hatchery and the prevalence of fungal infection in the nests. This was done in order to mitigate the threat of fungal infection and increase hatching success.

Fungi exists naturally in the environment. In the sandy soil of the coastal ecosystem, decomposition of organic matter, nutrient cycling and degradation of hydrocarbon is aided by the critical role played by microfungi. The microfungi can be a saprophyte, mutualist, or pathogen on marine flora and fauna (Zakaria *et al.*, 2011). In the recent years, fungal infection has made its way to become one of the factors threatening sea turtles, especially at nesting sites (Mohd Sidique *et al.*, 2017, Sarmiento-Ramirez *et al.*, 2010;). The nesting sites includes both in-situ (natural) and ex-situ (relocated) nest in hatcheries (Abd Mutalib & Fadzly, 2015).

Fungal species complexes like *Fusarium* spp. are thought to have started to grow to epidemic proportions in turtle nests around the world over the past decades propelled by human disturbance in terrestrial and marine systems. These fungi can grow on floating particles of plant tissues, silt, and plastic in the ocean, which are carried by wind and currents to the beaches where turtles lay their eggs (Gleason *et al.*, 2020).



To keep fungal infection to a minimum, we assess the soil in the hatchery for fungal presence and conduct anti-fungal treatments regularly. Prior to relocating eggs into the hatchery, the soil in the hatchery is treated with turmeric concentrate daily. Upon relocation, the nest chamber is treated with neem concentrate. These herbal plants have anti-fungal properties and are commonly used to curb infestations of plant pathogens.

Nest inspection showed that on average the fungal infection rate was 10.8% in green sea turtle nests (n=204) and 11.5% in painted terrapin nests (n=87). Several nests had a healthy 0% fungal infection rate, while the worst nest had 100% of its eggs infected by fungus. The rate of fungal infection in both green sea turtle and painted terrapin nests this season is lower in comparison to the rate calculated last season, which may be due to the regular anti-fungal treatments.



Aspergillus and *Fusarium* fungi are commonly found in soil and vegetation and, as such, are prevalent around the areas of our hatchery. To further understand the species and prevalence of the infection, we collected sand samples from every nest after the hatchlings had emerged. The lab analysis for these samples is currently being conducted in the UMT lab. The information gained from this study will enable UMT to develop a treatment that can reduce the prevalence of fungi in sea turtle nests.

COMMUNITY AND TOURIST ENGAGEMENT



THE VISITORS' HUT AT TANJONG JARA RESORT



The Hut has always been a great place for us to conduct our education and outreach activities. Due to wear and tear and extreme weather conditions over the years, our long-standing Visitors' Hut fell into disrepair in 2020. The construction of the brand-new Visitors' Hut was completed in March 2021, funded by a generous supporter of LTTW. The added size and functionality of the new Visitors' Hut give Tanjong Jara Resort's guests another space within the resort that welcomes them with open arms.

The Visitors' Hut was constructed using traditional Terengganu methods with the use of screws and nails almost non-existent. The Hut mainly consists of salvaged cengal wood, thus making it a sustainable structure that is also imbued with an authentic feel. The latter falls very much in line with the resort's traditional Malay architectural aesthetic. With the quality of craftsmanship and material used, we hope that our Visitors' Hut will continue to be a mainstay in Tanjong Jara Resort's rich history.

BEACH CLEAN-UPS



Students of all ages across three schools, namely SMKA Kuala Abang, SMK Tengku Intan Zaharah, and the International School of Kuala Lumpur, were involved in beach clean-ups this year. Aside from that, we teamed up with two corporate organisations, Neal's Yard Remedies and Hapag-Lloyd, to clean the beach next to Tanjong Jara Resort during their visit to our hatcheries.

As COVID-19 restrictions eased in Malaysia, it has been relieving for us as we start to pick up on community engagement activities that had been halted for two years due to the pandemic. By organising a number of beach clean-up events, we were given the opportunity to re-engage with the local community, schools, and even corporate companies.



In conjunction with World Ocean Day, a large-scale beach clean-up event was held, with **100 volunteers** removing trash along the 1-km coastline of Teluk Bidara beach. The event was the product of collaboration between several like-minded organisations, including the Turtle Conservation Society of Malaysia, ADA Biotech, ZUS Coffee, Geng Plastik Ija, Tanjong Jara Resort, and Precious Plastic Malaysia. A whopping total of **664.1 kg** of trash was removed within an hour of the event.

Beach clean-up efforts are paramount in ensuring a good habitat for all marine species that use the area, including sea turtles. Our efforts, especially if continued in collaboration with the resort, will help to create a cleaner beach for guests to enjoy and result in better guest satisfaction ratings. A grand total of **1,459.3 kg** of waste was removed from beaches around Tanjong Jara Resort, of which **727.3 kg was recycled**. All beach clean-ups this season utilises the d2w biodegradable trash bags, which were generously sponsored by Miracle Spectrum Sdn. Bhd.



SCHOOL PROGRAMMES



Our in-person educational school outreach programmes in Dungun resumed after a two-year hiatus. The primary goal of these programmes was to raise awareness about the importance of protecting sea turtle populations and the environment among the younger generations.

On three separate occasions, students from two local schools and one international school were invited for educational tours of LTTW's conservation efforts at Tanjong Jara Resort. Interactive talks which highlighted the way marine pollution threatens sea turtles, hatchery tours, as well as in-depth information on their life cycle were presented by our team members.



A total of **167 students** from the schools listed below attended these school programmes:

- SMKA Kuala Abang
- SMK Tengku Intan Zaharah
- The International School of Kuala Lumpur

Building on that, we continued with virtual turtle and marine conservation awareness sessions with schools, universities, and the general public outside of Dungun. This broadens our target audience while also stepping up our efforts to raise awareness about sea turtles and marine conservation.

CORPORATE SOCIAL RESPONSIBILITY



As our conservation efforts ramped up, we opened our doors to corporations interested in collaborating with us as part of their CSR initiatives. This season, we hosted a group from Hapag-Lloyd Malaysia for a two-day programme in which participants learned about the ups and downs of a sea turtle's life through action-packed team-building games. Furthermore, Hapag-Lloyd **adopted two green sea turtle nests** and removed **25.9 kg** of trash from Tahu Tiga beach.



CONCLUSION



2022 has been a transitional year for LTTW as the COVID-19 pandemic neared its end. Conservation efforts across all our project sites shifted into a higher gear following the lift of travel bans and the relaxation of COVID-19 SOPs. This season saw us saving a grand total 21,500 turtle eggs from 293 nest, another record-breaking figure achieved since the Tanjong Jara project commenced in 2016. A combined figure of 17,441 green sea turtle and painted terrapin hatchlings were released back to the sea, with hatching success rate of 82.66% and 76.28% respectively. Our community engagement activities moved up a notch, enabling us to welcome students and corporate groups to the project site to learn more about the conservation work we carry out at Tanjong Jara. With such high traffic, beach clean-ups benefitted the most as a total of 1,459.3 kg of waste was removed from beaches around Tanjong Jara Resort, of which 727.3 kg was recyclables.

With the amended Terengganu Turtles Enactment 1951 now in effect, there is a lot of room for improvements in the terms of egg buyback. Since sale of turtle eggs are now completely banned, we can certainly do more in ensuring these precious eggs do not end up in the black market. Finally, stable and well-managed finances were essential to achieving the project objectives, and we hope to be able to keep this up for future seasons.

REFERENCES

Abd Mutalib, A. H., & Fadzly, N. (2015). Assessing hatchery management as a conservation tool for sea turtles: A case study in Setiu, Terengganu. *Ocean and Coastal Management* 113, 47–53.

<https://doi.org/10.1016/j.ocecoaman.2015.05.010>

Blechs Schmidt, J., Wittmann, M. J., Blüml, C. (2020). Climate change and green sea turtle sex ratio—Preventing possible extinction. *Genes*, 11(5), Article 588.

<https://doi.org/10.3390/genes11050588>

Booth, D. T., & Freeman, C. (2006). Sand and nest temperatures and an estimate of hatchling sex ratio from the Heron Island green turtle (*Chelonia mydas*) rookery, Southern Great Barrier Reef. *Coral Reefs*, 25(4), 629–633.

<https://doi.org/10.1007/s00338-006-0135-4>

Chan, E. H., & Liew, H. C. (1995). Incubation temperatures and sex ratios in the Malaysian leatherback turtle *Dermochelys coriacea*. *Biological Conservation*, 74(3), 169–174. [https://doi.org/10.1016/0006-3207\(95\)00027-2](https://doi.org/10.1016/0006-3207(95)00027-2)

Gleason, F. H., Allerstorfer, M., & Lilje, O. (2020). Newly emerging diseases of marine turtles, especially sea turtle egg fusariosis (SEFT), caused by species in the *Fusarium solani* complex (FSSC). *Mycology*, 11(3), 184–194.

<https://doi.org/10.1080/21501203.2019.1710303>

Mohd Sidique, S. N., Azuddin, N. F., & Joseph, J. (2017). First report of *Fusarium* species at nesting sites of endangered sea turtles in Terengganu and Melaka, Malaysia. *Malaysian Applied Biology*, 46(3), 195–205.

<http://journalarticle.ukm.my/12375>

Mrosovsky, N. (1994). Sex ratios of sea turtles. *Journal of Experimental Zoology*, 270(1), 16–27. <https://doi.org/10.1002/jez.1402700104>

Reboul, I., Booth, D. T., & Rusli, M. U. (2021). Artificial and natural shade: implications for green turtle (*Chelonia mydas*) rookery management. *Ocean and Coastal Management*, 204, Article 105521.

<https://doi.org/10.1016/j.ocecoaman.2021.105521>

Sarmiento-Ramírez, J. M., Abella, E., Martín, M. P., Tellería, M. T., López-Jurado, L. F., Marco, A., & Diéguez-Uribeondo, J. (2010). *Fusarium solani* is responsible for mass mortalities in nests of loggerhead sea turtle, *Caretta*, in Boavista, Cape Verde. *FEMS Microbiology Letters*, 312(2), 192–200. <https://doi.org/10.1111/j.1574-6968.2010.02116.x>

Tolen, N., Rusli, M. U., & Booth, D. T. (2021). Relocation green turtle (*Chelonia mydas*) eggs to open beach areas produces high female-biased hatchlings. *Herpetological Conservation and Biology*, 16(3), 639–651. http://www.herpconbio.org/Volume_16/Issue_3/Tolen_etal_2021.pdf

van de Merwe, J., Ibrahim, K., & Whittier, J. (2005). Effects of hatchery shading and nest depth on the development and quality of *Chelonia mydas* hatchlings: implications for hatchery management in Peninsular Malaysia. *Australian Journal of Zoology*, 53(3), 205–211. <https://doi.org/10.1071/ZO03052>

Zakaria, L., Yee, T. L., Zakaria, M., & Salleh, B. (2011). Diversity of microfungi in sandy beach soil of Teluk Aling, Pulau Pinang. *Tropical Life Sciences Research*, 22(1), 71–80. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3819092/>