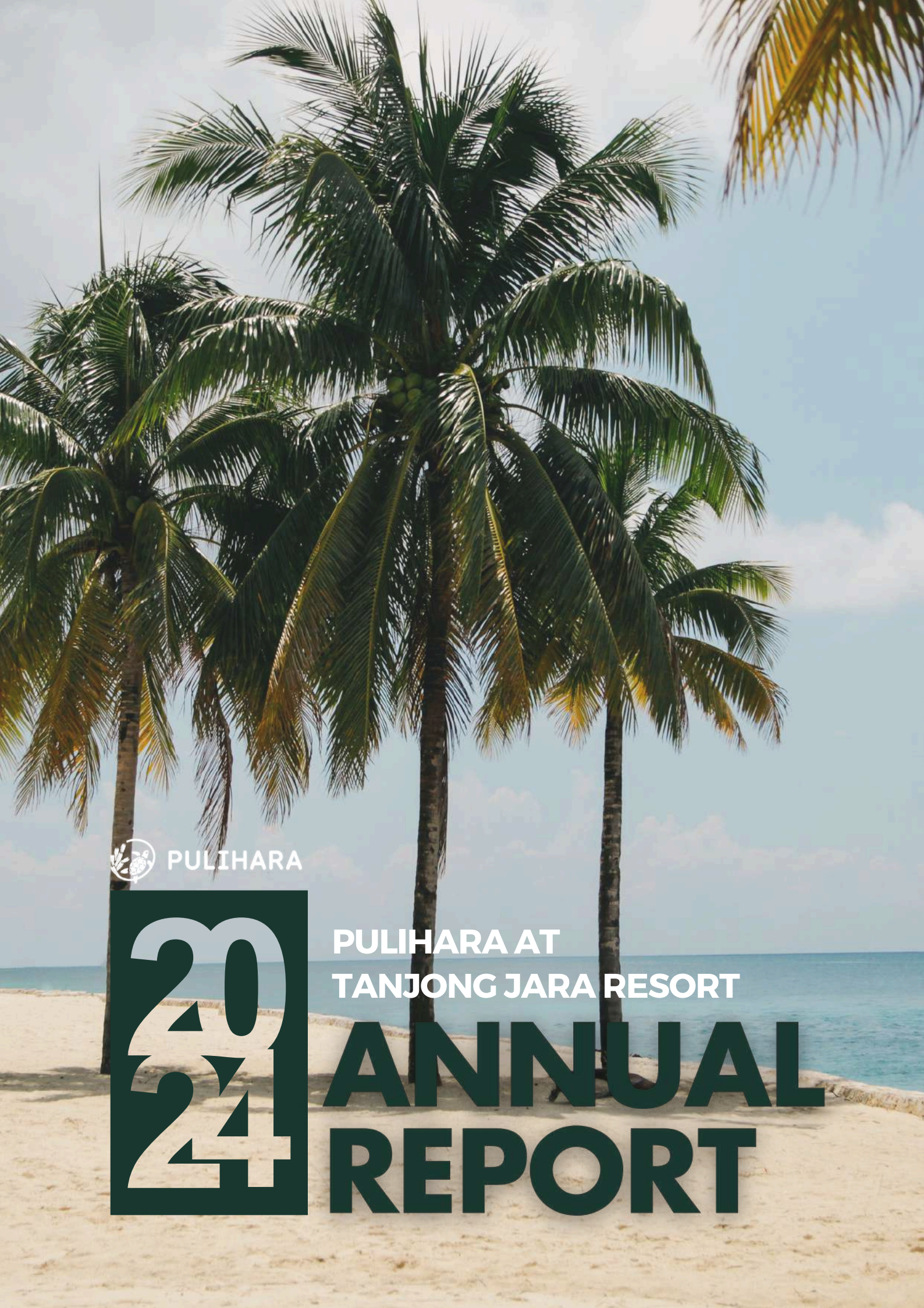

PULIHARA

2024 ANNUAL REPORT

PULIHARA AT TANJONG JARA RESORT

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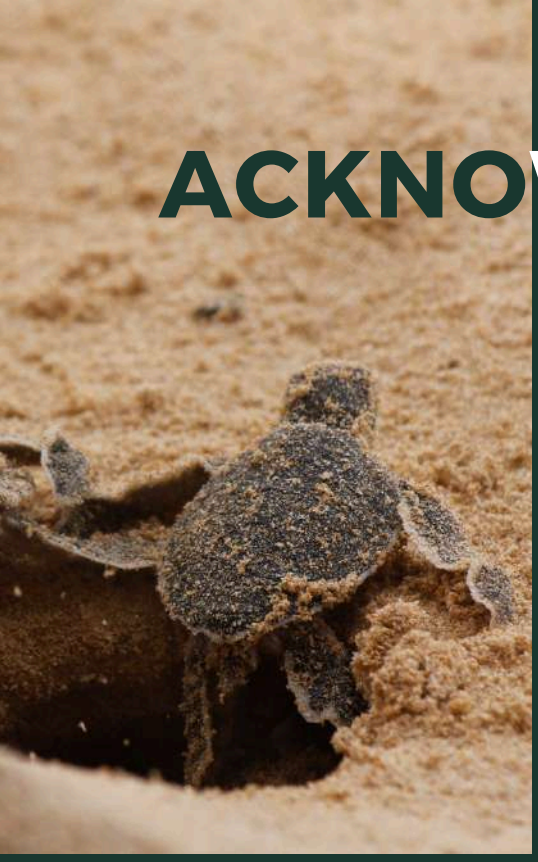


ACKNOWLEDGEMENT

As we close the first year of PULIHARA's journey, it is impossible not to feel a sense of pride, gratitude, and excitement for the journey ahead. This year marked a significant transition - from being the conservation arm of Lang Tengah Turtle Watch to stepping into our own identity as PULIHARA. It has been a year of growth, discovery, and reaffirming our commitment to protecting the ecosystems we hold dear.

The name PULIHARA, meaning "to conserve" or "to preserve" in Bahasa Malaysia, perfectly encapsulates our mission. Building on the strong foundation laid by Lang Tengah Turtle Watch, we have continued vital conservation and research work in collaboration with the Department of Fisheries (DoF) and Tanjong Jara Resort. We owe a heartfelt thank you to our dedicated rangers and licensed egg collectors, who tirelessly patrolled nesting beaches and relocated nests with care to our hatcheries.

The support we have received from - funders, collaborators, donors, and adopters who fuel our work - has been nothing short of inspiring. From corporate entities such as YTL, Yayasan Sime Darby, and Yayasan Kossan, to educational institutions such as Taipei European School and St. Joseph International Institution, their contributions - whether financial, in-kind, or through fundraising, have amplified our conservation efforts. We are also deeply grateful to our collaborators, including Universiti Malaysia Terengganu's Sea Turtle Research Unit (SEATRU), International Sea Turtle Society, Turtle Survival Alliance, and TeamRakyat, among others, whose expertise and shared vision enriched our research conservation and outreach activities. Special thanks go to adopters of our programmes, whose support directly enabled us to increase our impact on awareness and conservation.

This year's achievements would not have been possible without the tireless dedication of our staff members and interns - Isandra Shazlynn Shamsul Azmil, Audrey Symplicius, Fadhilah Ruhaya, Fadhlil Hakimi, Alia Fatihah, Anna Wilson, Aimee Ly, Nusrat Adawiyyah, Lee Zhen Yang, Amira Ah Yee Sima, Amir Aizat, Amin Hamzah, Amira Hasanah and Puteri Nuraida Syuhada.

We also would like to express our heartfelt thanks to our Chief Executive Officer, Rahayu Zulkifli, for her exceptional leadership and ongoing support. Our gratitude extends to our Operations Coordinator, Mary Lowe, for her steadfast assistance from KL office, and to the staff members and interns from other project sites who occassionally extended their help when needed.

2024 has not been without its challenges. Transitioning into a standalone entity came with its share of learning curves, but it also brought opportunities to innovate, adapt, and grow. As we reflect on this milestone year, we are excited about what's to come. There is so much more to do, but with the groundwork we have laid and the people by our side, we are ready to take on the challenges ahead. Thank you for being part of this journey with us.

Here's to protecting what matters, now and always.

The Earth, which we all have in common, is our deepest bond, and our behavior toward it cannot help but be an earnest of our consideration for each other and for our descendants. To corrupt or destroy the natural environment is an act of violence not only against the earth but also against those who are dependent on it, including ourselves.

WENDELL BERRY
THE LONG-LEGGED HOUSE

OUR TEAM

RAHAYU ZULKIFLI

Chief Executive Officer

MARY LOWE

Operations Coordinator

ISANDRA SHAZLYNN

Project Manager

AUDREY SYMPLICIUS

Asst. Project Manager

CONSERVATION INTERNS

FADHLIL HAKIMI

Universiti Putra Malaysia

FADHILAH RUHAYA

Universiti Putra Malaysia

ALIA FATIHAH

Universiti Putra Malaysia

AIMEE LY

University of Essex

ANNA WILSON

University of Leeds

LEE ZHEN YANG

Universiti Malaysia Sarawak

AMIRA AH YEE SIMA

Federation University Victoria

NUSRAT ADAWIYYAH

Universiti Malaysia Sarawak

	Internship Period	Nationality	Current/Past Study	Notes
Fadhlil Hakimi	March-September	Malaysian	BSc (Hons) Biology, Universiti Putra Malaysia	Previous experience studying disease development of human oral bacteria (*P. Gingivalis)* in Javanese Medaka (*Oryzias javanicus*) model
Fadhilah Ruhaya	March-August	Malaysian	BSc (Hons) Biology, Universiti Putra Malaysia	Previous experience studying the diversity and ecosystem of macroinvertebrate in Klang Strait
Alia Fatihah	March-August	Malaysian	BSc (Hons) Biology, Universiti Putra Malaysia	Previous experience studying the variability in abundance, community structure, and growth of coastal fishes in Klang Strait
Aimee Ly	March-May	British	BSc in Marine Biology, University of Essex	Previous experience as marine conservation intern at Seal Rescue Ireland
Anna Wilson	March-May	British	BSc (Hons) in Zoology, University of Leeds	Previous experience conducting in-water monitoring of sea turtles in Costa Rica and studying coral vital rates in Mozambique
Lee Zhen Yang	July-September	Malaysian	BSc (Hons) in Aquatic Resource Science and Management, University Malaysia Sarawak	Currently studying the substrate preferance of bio-fouling bivalves wild spat in Santubong
Amira Ah Yee Sima	August-October	Australian	Bachelor of Veterinary and Wildlife Science, Federation University Victoria, Australia	Previous internship experience at Universiti Malaysia Terengganu and the Malaysian Primatological Society-Terengganu
Nusrat Adawiyyah	August-October	Malaysian	BSc (Hons) in Aquatic Resource Science and Management, Universiti Malaysia Sarawak	Previous experience in studying about the morphological and phylogenetic analysis of mud crabs from Belawai Mangroves, Sarawak

PULIHARA

CONSERVATION IMPACT AND RESEARCH

MILESTONES, FINDINGS AND PROGRESS

NESTING BEACH MONITORING

This year brought a quieter nesting season than anticipated, with fewer sea turtles and painted terrapins coming ashore to nest throughout Terengganu. Changing weather patterns and shifting coastal conditions likely played a role in this decline. While natural fluctuations like these are to be expected, they serve as stark reminder of the challenges we face in safeguarding the survival of these critically endangered species. Each nesting season underscores the importance of refining our conservation strategies to adapt to an ever-changing environment.

At PULIHARA, we continuously strive to improve our conservation practices for the benefit of the species we save. Studies show that turtle eggs are most viable when incubated within two hours of being laid to optimise hatching success and reduce embryonic mortality. Handling must also be kept at minimum to protect the developing embryos. To align with these findings, we have adjusted how we manage nests. Instead of relocating nests from distant beaches such as Kerteh and Kijal to our hatchery in Tanjong Jara, they are now transferred to hatcheries closer to their nesting sites; the Department of Fisheries' hatchery in Ma'Daerah or PULIHARA's hatchery in Chakar Hutan. We now focus exclusively on nests from nearby beaches - **Tahu Tiga, Kuala Abang, and Kuala Dungun** - ensuring the eggs receive the best possible care.

These changes explain the differences in the number of nests and eggs saved, as well as the frequency of Hatchling Releases at Tanjong Jara since our collaboration with YTL began in 2016. Despite the setback, we managed to save nests from the aforementioned beaches. Every hatchling released from these beaches is a small but significant step towards ensuring the survival of the green sea turtles and the painted terrapins.

Figure 1. Comparison of green sea turtle and painted terrapin eggs and nests saved from 2016 to 2024

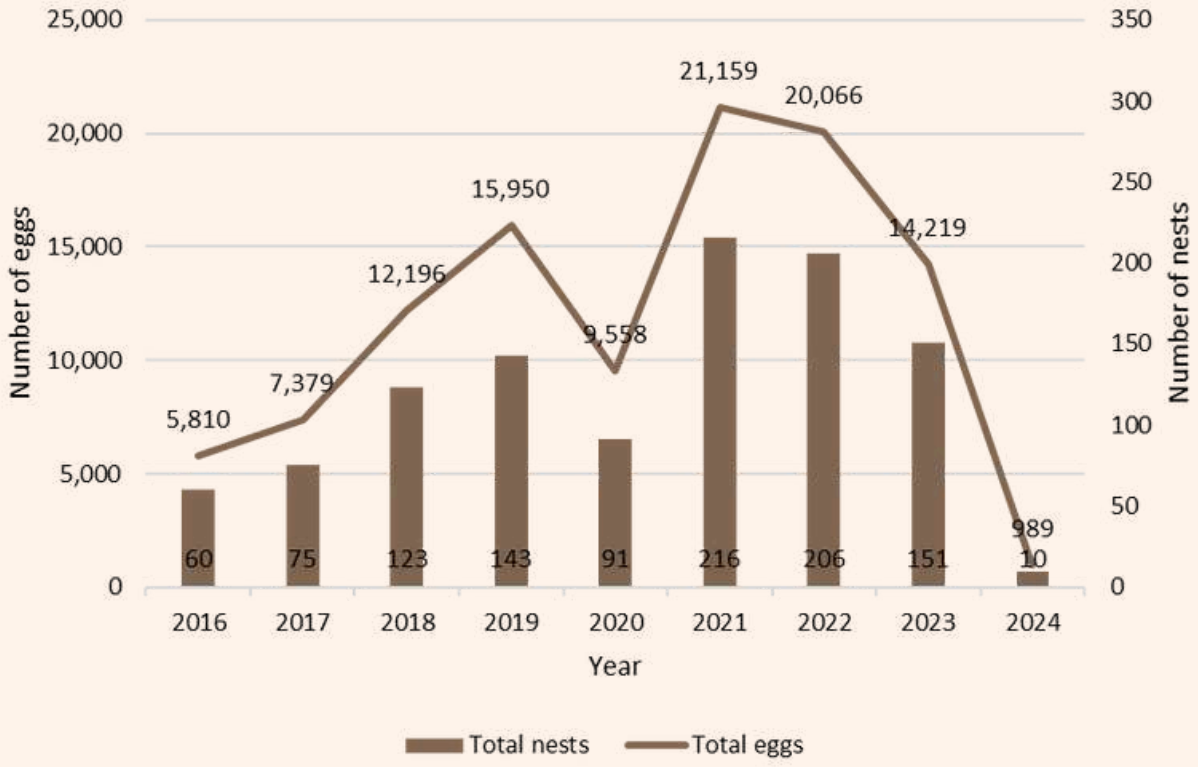


Figure 2. Comparison of green sea turtle eggs and nests saved from 2016 to 2024

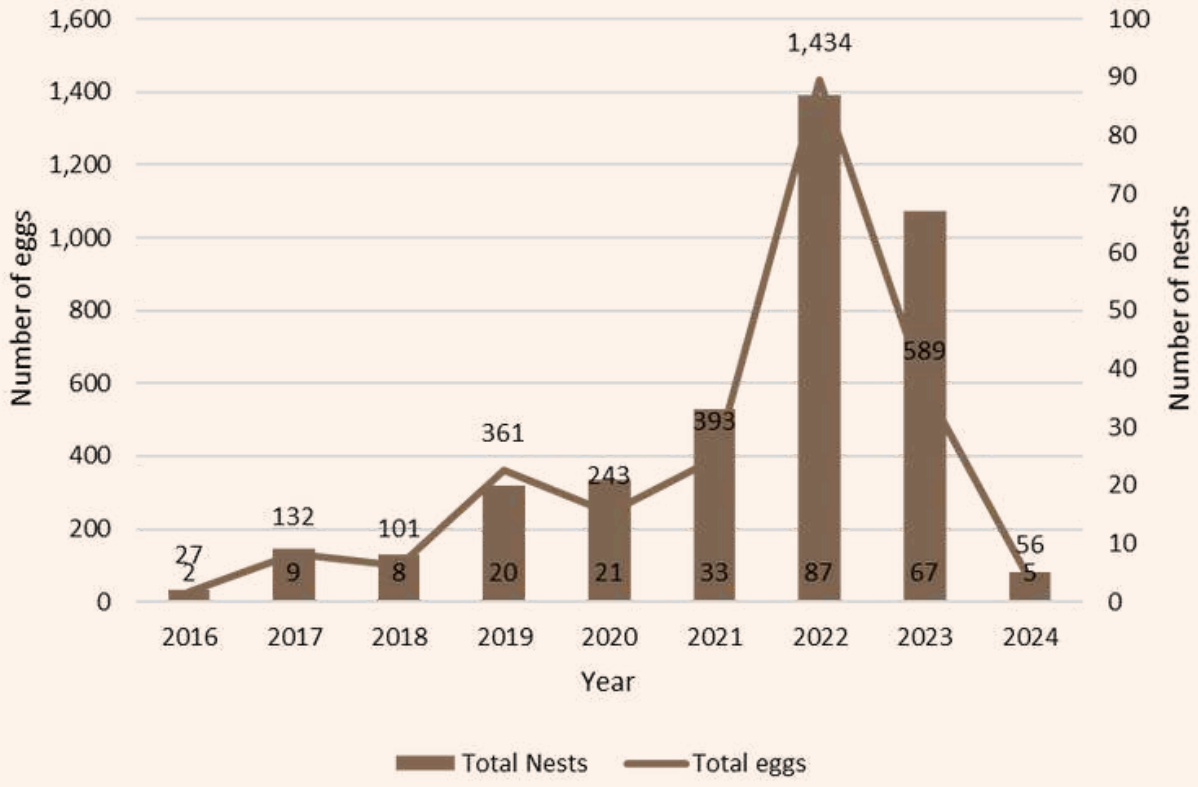


Figure 3. Comparison of painted terrapin eggs and nests saved from 2016 to 2024

1,045

TOTAL EGGS SAVED

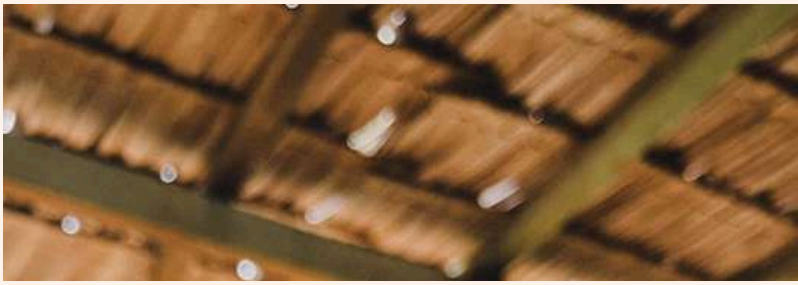
764

TOTAL HATCHLINGS RELEASED

15

TOTAL NESTS SAVED

HATCHING AND EMERGENCE SUCCESS RATES



Every season, we conducted a meticulous evaluation of hatching and emergence success rates of each nest relocated into our hatchery. This assessment involved detailed data collection at the hatchery, including counts of eggshells, unhatched eggs, depredated eggs, live hatchlings and dead hatchlings.

Observations of abnormalities, such as developmental issues, were also recorded alongside evidence of egg predation by various predators, including crabs, ants, termites, monitor lizards, and maggots, as well as fungal infections. The hatching success rate was calculated by determining the percentage of empty eggshells found during Post-Emergence Inspections (PEI) relative to the total number of eggs laid.

This season, green sea turtle nests relocated to our Tanjong Jara hatchery achieved an average hatching success rate of 79.96% (with a standard deviation of ±29.22, based on 9 nests). Simultaneously, the emergence success rate, which reflects the percentage of hatchlings successfully leaving the nest, averaged 78.01% (with a standard deviation of ±30.4).

As for the painted terrapins, the average hatching success rate plummeted to a value of 34.63% (with a standard deviation of ±34.03, based on 5 nests) and the emergence success rate stood at 31.55% (with a standard deviation of ±29.67). Such a low rate can be attributed to several factors, including a significant proportion of undeveloped eggs. Environmental conditions such as inconsistent temperatures, flooding, or insufficient oxygen levels within the nest may impede embryo development. Additionally, issues like poor fertilisation, fungal infections, or bacterial contamination could play a role in the high proportion of undeveloped eggs.

SEA TURTLE PHOTO-IDENTIFICATION

This innovative, non - invasive method involve capturing high-resolution images of the unique patterns on the turtles' faces, much like a fingerprint for humans. These natural markings are permanent and unique for each turtle, allowing us to recognise individual females returning to nest and build a more comprehensive understanding of our local population. It also allows for collaboration with other conservation organisations, as shared photo databases can help track turtles across different regions, revealing their migratory paths and nesting behaviours.

Using photo-ID, we successfully identified several new nesting individuals this year. These newcomers not only add to our growing database but also highlight the significance of our beaches as one of the nesting sites for sea turtles. As of the current reporting period, the Tanjong Jara photo-ID database comprises a total of 44 sea turtle individuals.

Understanding which turtles are returning and identifying new individuals provide invaluable data about nesting patterns, site fidelity, and population health - which can guide future conservation strategies.

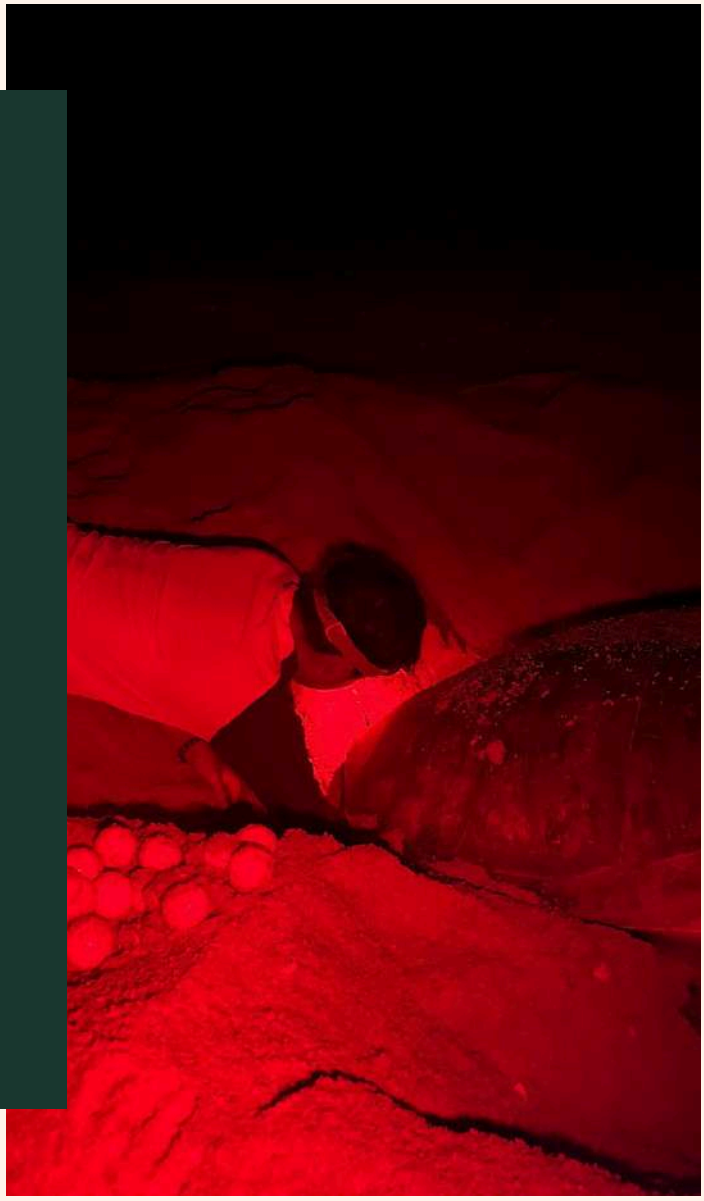
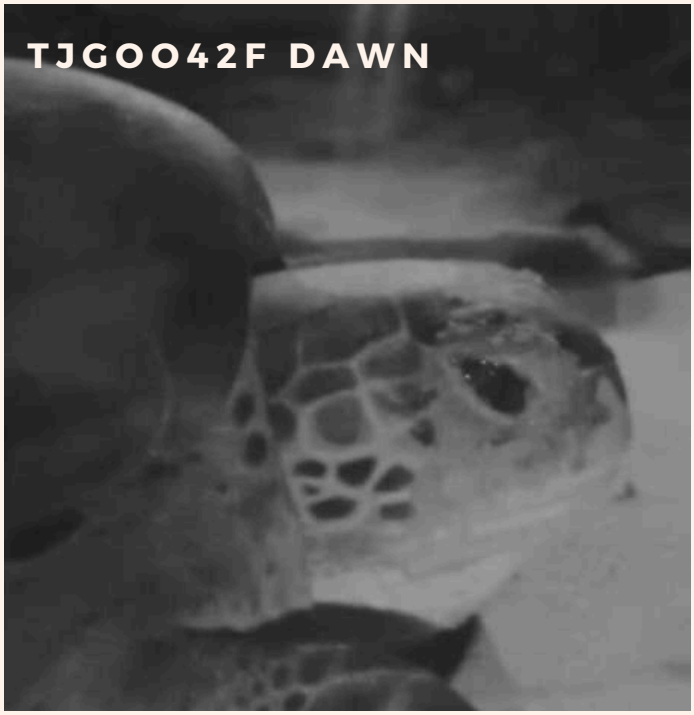
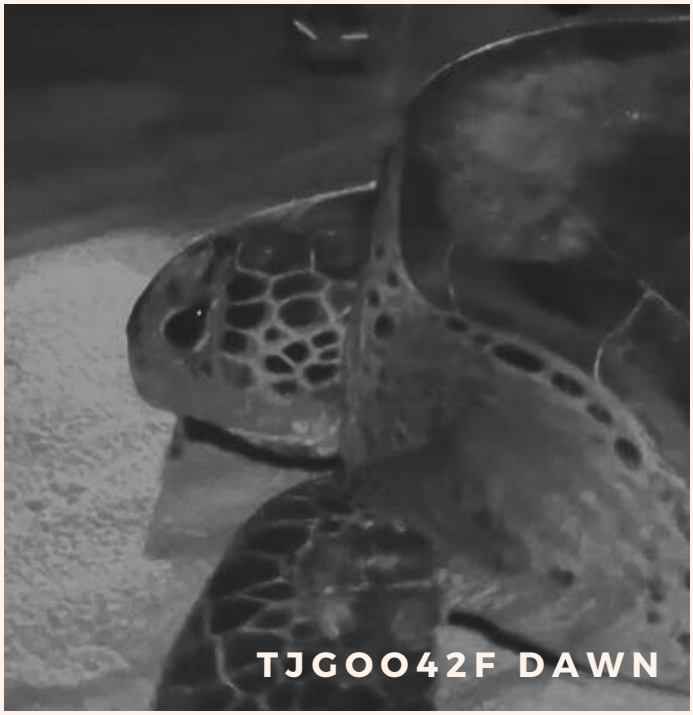
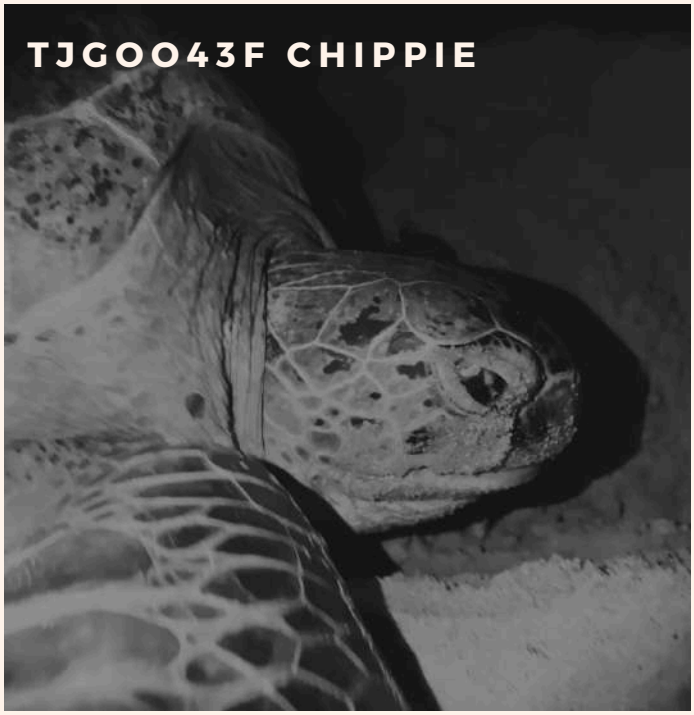


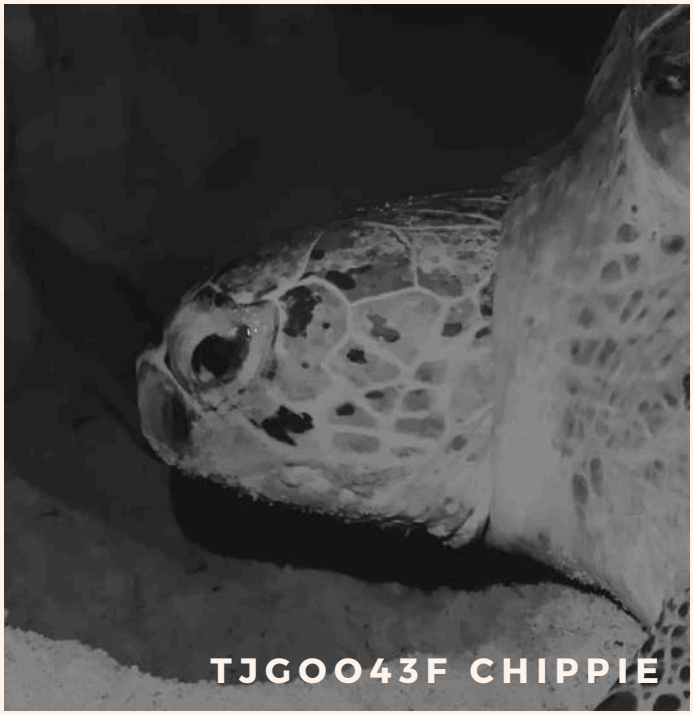
Table 1. Nesting information of three individual female green turtles

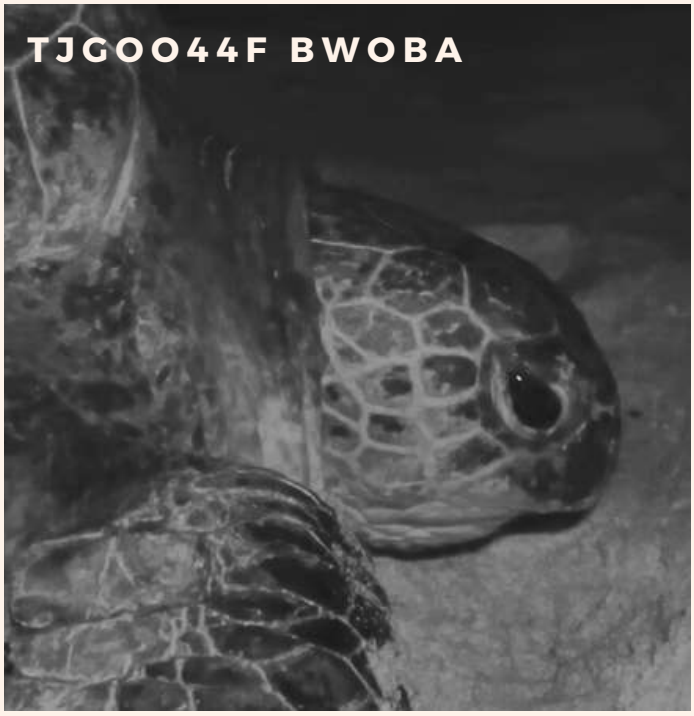
Turtle ID	Turtle Name	New/ Returning mother	No. of nests	Total eggs laid	Average clutch size (mean ±SD)	Nesting site	Inter-nesting interval (days)
TJG0042F	Dawn	New	1	55	NA	Tahu Tiga	NA
TJG0043F	Chippie	New	1	118	NA	Tahu Tiga	NA
TJG0044F	Bwoba	New	2	214	107 ± 8.49	Tahu Tiga	12

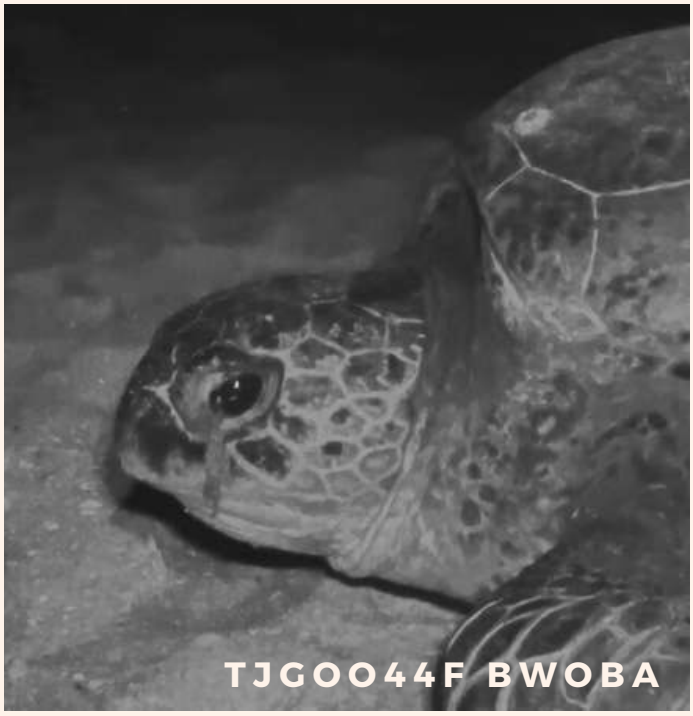












Photos taken under red light and edited to black and white

HATCHLING SEX RATIO

Understanding the Role of Temperature in Sea Turtle Conservation

TEMPERATURE-DEPENDENT SEX DETERMINATION

Unlike most species, the sex of sea turtles is determined by the incubation temperature of their nests – a phenomenon known as temperature-dependent sex determination. Cooler sand temperatures, below 29.5˚C, typically produce male hatchlings, while warmer sand yields females. The pivotal temperature, which is the threshold where an equal number of male and female hatchlings are produced, is approximately between 29.1˚C and 29.5˚C for green turtles. However, global warming and habitat changes threaten this delicate balance, potentially skewing sex ratios dramatically toward females and raising concerns about long-term population sustainability.

METHODOLOGY

Our field teams employ HOBO MX TidBit 400 temperature loggers in randomly selected nests relocated to our hatchery. These advanced devices provide continuous, real-time data throughout the 45-70 day incubation period, revealing how seasonal temperature fluctuations influence hatchling outcomes.

Using this data, we applied a logistical equation to estimate the hatchling sex ratios for each nest. This calculation is based on the pivotal temperature of 29.1˚C identified for the Malaysian green turtle population.

FINDINGS AND LIMITATIONS

The low nesting season this year resulted in a smaller sample size of nests being studied at the hatchery, limiting the breadth of data available for analysis.

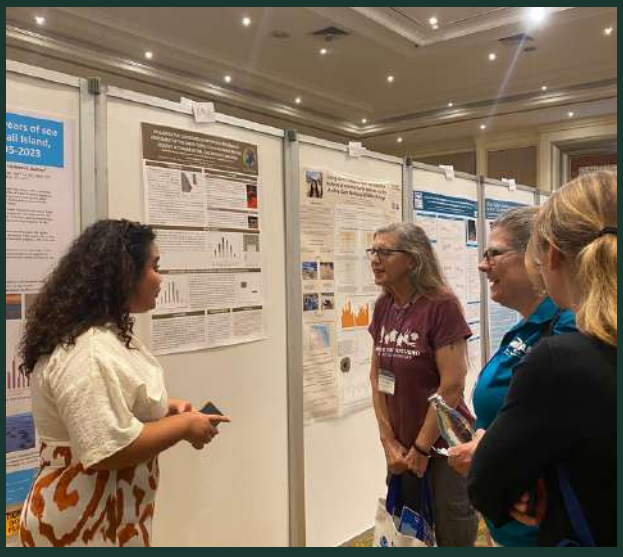
Despite this, preliminary findings indicate that, assuming pivotal temperature holds true for Tanjong Jara, the two nests analysed this season skewed towards producing more female hatchlings. This observation contrasts with our 2023 analysis, where Hatchery 1 predominantly produced female hatchlings, while Hatchery 2 skewed towards male hatchlings.

Our research work continues...

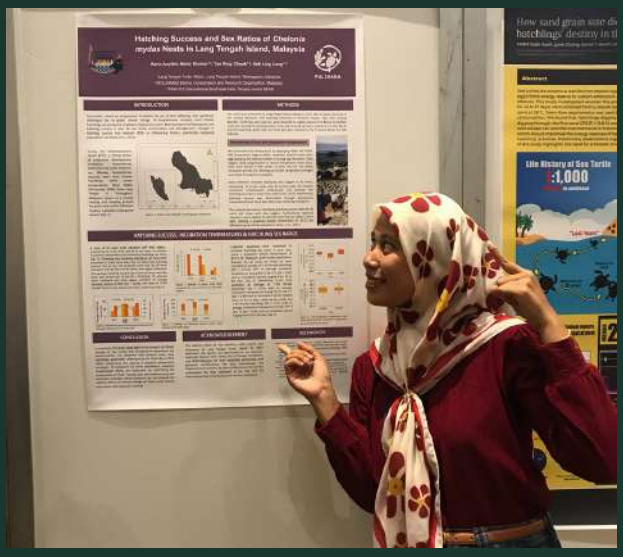
THE 42ND INTERNATIONAL SEA TURTLE SYMPOSIUM

In March 2024, the PULIHARA team had the privilege of participating in the 42nd International Sea Turtle Symposium (ISTS) in Pattaya, Thailand. This annual gathering is a cornerstone event for sea turtle researchers, biologists, and educators worldwide - offering a platform to enhance knowledge, explore innovative practices, and strengthen collaborative networks.

The symposium not only allowed us to showcase our work but also provided an opportunity to engage with global experts, receive valuable feedback, and explore new strategies to enhance our conservation efforts. It was a rewarding experience to see our research resonate with others in the field and to learn from the diverse insights shared by fellow participants. At the symposium, our team presented two research posters;



Collaborative Conservation Initiatives: Preliminary Assessment of the Green Turtle (*Chelonia mydas*) Nesting Ecology in Chakar Hutan, Terengganu, Malaysia
Presented by Isandra Shazlynn



Ten Years of Sea Turtle Conservation Project in Pulau Lang Tengah, Terengganu, Malaysia
Presented by Azrin Asyikin

TURTLE STRANDING

Responding to stranded turtles

REPORTS AND INSPECTION DETAILS

This season, two turtle stranding cases were reported, both by guest from Tanjong Jara Resort. Each case provided an opportunity to gather valuable data about the turtles. Both carcasses were inspected for:

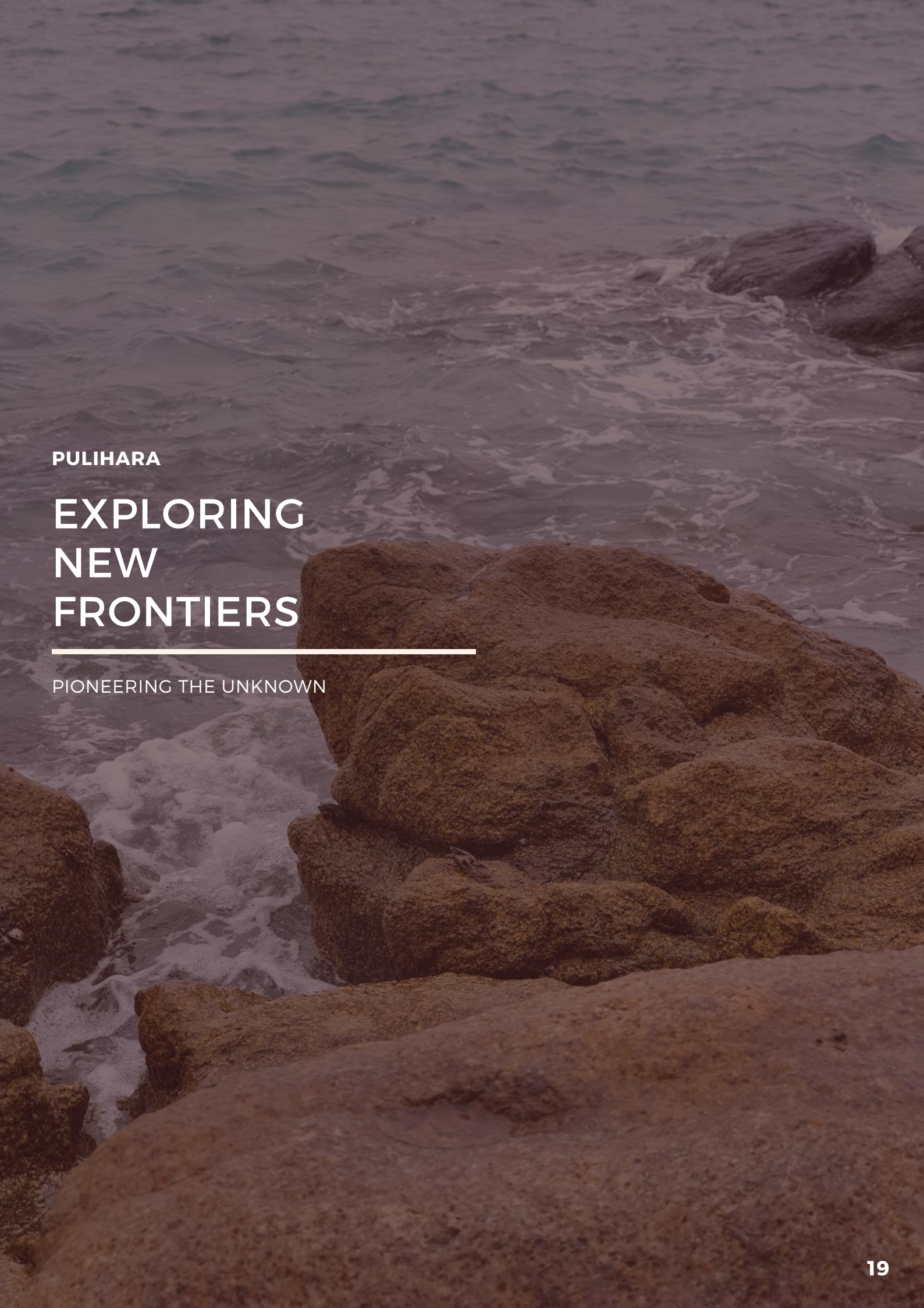
- Signs of injuries on the carapace and plastron
- Curved carapace length (CCL) and width (CCW)
- Presence of tags or previous tag marks
- Sex determination based on tail length
- Facial scale patterns for photo identification

CASE 1 AND CASE 2

The first incident was reported on March 13, 2024 and involved a severely decomposed female turtle. Despite its condition, we were able to measure its CCL at 76.8 cm and CCW at 70.6 cm. **Eight days after the first report**, a moderately decomposed male green sea turtle was discovered. Alarmingly, a brick was tied to its front flippers, suggesting a deliberate act to sink the animal. This turtle was measured at 74.9 cm in CCL and 64.4 cm in CCW.

ACTIONS TAKEN AND MOVING FORWARD

A stranding encounter report form was completed for both cases and submitted to the Department of Fisheries (DoF). These incidents highlight the critical need for raising awareness and implementing proactive measures to protect sea turtles from both natural threats and human-induced harm.



PULIHARA

EXPLORING NEW FRONTIERS

PIONEERING THE UNKNOWN

PAINTED TERRAPIN PILOT STUDY

In 2025, PULIHARA at Tanjong Jara will embark on an exciting journey with a pilot study focusing on the critically endangered *Batagur borneoensis* or painted terrapin. Known for their striking appearance and unique nesting behaviours, these freshwater turtles are among Southeast Asia's most threatened species. Their survival hinges not only on the protection of nesting beaches but also on safeguarding the habitats they rely on throughout their life cycle.

Funded by the Turtle Conservation Fund and in collaboration with the Turtle Survival Alliance, the study will focus on assessing and mapping where these elusive turtles can still be found in Dungun. Through field excursions in selected rivers, the team aim to gather essential data on their movements and key habitats. With painted terrapin populations dwindling due to habitat loss and human disturbances, understanding their distribution and habitat use is crucial for their long-term survival.

While this study primarily focuses on assessing their current distribution, PULIHARA is also exploring the possibility of conducting satellite tracking studies in the future. Such advancement, with the injection of additional funding, would allow us to gather even more detailed data on the movements and behaviours - offering deeper insights into how best to protect them.

THE INTERNATIONAL SEA TURTLE AMBASSADOR PROGRAMME

In an exciting step forward for conservation education, PULIHARA, in partnership with Florida based Inwater Research Group (IRG), is proud to bring the International Sea Turtle Ambassador (I.S.T.A.) Programme to Malaysia - the first of its kind in the country. Funded by the International Sea Turtle Society Innovation Grant, this initiative combines hands-on learning, cutting-edge resources, and global collaboration to inspire a new generation of marine conservation advocated.

The I.S.T.A. Programme will help unite youth, educators, and conservationists from diverse backgrounds to deepen their understanding of sea turtle ecology and the challenges these creatures face. Scheduled to launch in mid-2025, the programme will offer immersive field experiences and engaging educational workshops led by PULIHARA, using an innovative educational toolkit developed by IRG. Participants will be equipped to share their newfound knowledge within their schools, communities, and networks, inspiring others to join the conservation movement. From organising local beach cleanups to leading awareness campaigns, this programme will nurture future leaders ready to drive meaningful change.

As we prepare to launch this transformative initiative, we eagerly anticipate its ripple effects, fostering a brighter future for sea turtles and the ecosystems they call home.

PULIHARA

THE VISITORS' HUT

WELCOMING NATURE ENTHUSIASTS

Nestled amidst the serene beauty of Tanjong Jara Resort, the Visitors' Hut has remained an essential focal point of PULIHARA's conservation efforts. Open from March to October, it offers guests a unique opportunity to deepen their understanding of marine life and actively contribute to the protection of the critically endangered green sea turtles and painted terrapins.

The Visitors' Hut is not merely a place to learn - it is a space to engage. Guests are welcomed with informative talks that delve into the life cycles of sea turtles, the threats they face, and the intricate balance of marine ecosystems. These sessions are designed to spark curiosity and foster a deeper appreciation for conservative efforts. To further support these initiatives, the Hut features a range of merchandise, from tote bags to turtle-themed accessories, with proceeds channeled directly into ongoing projects.

The Visitors' Hut is also the launchpad for a host of interactive experiences that bring guests closer to the heart of a conservation work. From Nest Inspections to Hatchling Releases, every activity offers a tangible connection to the preservation of these magnificent animals. For younger visitors, the weekly Turtle Kids Club introduces conservation through play. With turtle-themed games and activities, it sparks a sense of wonder and responsibility for wildlife among the next generation. The hut also serves as the coordination hub for each beach clean-ups, bringing together resort guests, local schools, and community members in a collective effort to keep the nesting sites safe.

This year, the Visitors' Hut proudly welcomed 2,058 visitors from all walks of life, each participating in the various sessions it offers. Among the season's highlights was the Mini Sea Turtle Carnival, held in conjunction with World Sea Turtle Day. This eco-conscious carnival featured games and activities crafted from recyclable materials - over 80% which were collected during clean -ups.

TURTLE
EDUCATIONAL TALK

NEST INSPECTIONS

HATCHLING RELEASE

MINI CARNIVAL
WORLD SEA TURTLE DAY

194.1

KG OF TRASH REMOVED

132.9

KG OF RECYCLABLE TRASH REMOVED

PULIHARA

ADOPTION PROGRAMMES

SUPPORTING CONSERVATION EFFORTS

PULIHARA's **Nest Adoption** and **Turtle Adoption Programme** continue to bring together a dedicated community of supporters who share our passion for conservation. By adopting a nest or a turtle, these individuals and organisations play an important role in protecting vulnerable nests and ensuring the survival of future generations of sea turtles. These contributions directly empower our on-ground team to continue the essential work of monitoring and protecting the target species. In 2024, 40 nests were adopted.

With fewer nests recorded at Tanjong Jara this year, our Nest Adoption Programme expanded to include our sister project in Chakar Hutan. This expansion ensures adopters' contributions continue to have a tangible impact, extending support to multiple nesting sites. We are profoundly grateful to all of our adopters for their generosity and trust in our mission.

SPECIAL THANKS

NEST ADOPTION PROGRAMME

Virginie Charrier
Matt Pace
Nigel Cross
Quincy Siew
The Kautt Family
Linda Lim
Quan Hwai Teng
Belle Lam Mei Sum
Kevin and Tracy Plowman
Taipei European School
Wendy Soon
Yayasan Kossan
TechnipFMC
Natalie Teng, Guek Yee Hui and Ng Phaik Ho
Chong Wan Qiu
Naya, Frida and Kris
Tom Haitsma
Yeo Yam How
Tan Lai Choon
Yeo Yueyi Yvette
Chin
Chan Juat Lin
Timothy Yu
Helen Doyle
Cindy Ng
Ayra Lim Sivarajah
St. Joseph's International Institution Malaysia

TURTLE ADOPTION PROGRAMME

Yap Yei Ling
Jason Ng Eu Ming
St. Joseph's International Institution Malaysia
Zoe Low Kye Wen
Rozitah Mohd Hashim
Milepost 1 - Tunku Putra Help International School
InterNations Kuala Lumpur Changemakers Group
Edelweiss Ooi Chia Mae
Yayasan Kossan
Tee Hui Yi

PULIHARA

LOOKING AHEAD

EMBRACING FUTURE POSSIBILITIES

PREPARING FOR WHAT'S NEXT

As we look to the future, PULIHARA at Tanjong Jara is committed to enhancing and refining our current conservation activities to provide an even more engaging and impactful experience for guests and supporters. Central to these efforts is the continued development of the Visitors' Hut, which has long served as the hub of our outreach and educational initiatives. Plans are already underway to introduce new display materials that will offer guests valuable insights into the intricate world of sea turtles and conservation through a visually captivating space.

In 2025, we are excited to invite patrons of the resort to participate in the Hatchling Release and Turtle Watching Programmes at our sister project site in Chakar Hutan. These activities promise unforgettable experiences, allowing participants to witness the beauty of nature firsthand while supporting critical conservation efforts. This year, we were delighted to welcome a handful of resort guests to these programmes in a trial run, and their enthusiasm has encouraged us to expand opportunities for future visitors. Whether it's observing nesting turtles under the stars or joining the heartwarming journey of hatchlings making their way to the sea, these experiences are designed to foster a stronger connection to the cause.




WORLD SEA TURTLE DAY!

THE BAN
FAMILY


ST. JOSEPH'S
INTERNATIONAL
INSTITUTION
MALAYSIA


WORLD SEA TURTLE DAY!



PAUL LIM,
BELLE LAM &
BREANNE LIM

DAY!





THANK YOU

TO OUR FUNDERS, COLLABORATORS, SPONSORS, ADOPTERS, VOLUNTEERS, INTERNS, AND SUPPORTERS.

Your support has been the heart of our progress, enabling us to achieve meaningful milestones in marine conservation and community engagement. From protecting nests to inspiring next generation, none of it would have been possible without you.

COLLABORATORS AND SPONSORS