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A Review of Sea Turtle Awareness Programmes in Malaysia

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ABSTRACT

Malaysia is blessed with important sea turtle nesting rookeries along its coasts. As the sea turtle population declines in the country, conservation efforts in the form of outreach are important to obtain support and civic engagement in this sector. To understand the sea turtle outreach efforts in Malaysia, the outreach programmes, programme types and strategies by Malaysian non-governmental organisations and government agencies are reviewed in this paper, by tracking their social media and websites between January 2023 and December 2024. The findings help conservation entities to identify respective outreach blind spots and take initiatives to improve wherever possible. Out of the 18 agencies analysed, 38.89% (7) conducted all four types of outreach programmes. Ecotourism and community outreach are the most commonly conducted programme types at 77.78% (14). Knowledge dissemination is employed by all organisations, while hands-on activities are used by 94.44% (17) organisations, and only 22.22% (4) of the organisations were found to employ knowledge application on top of the former two. This paper suggests that school and youth outreach programmes should be prioritised by more organisations, as pro-environmental attitudes are more easily shaped in younger participants. On top of that, all tracked organisations should continue in their efforts of employing multiple outreach strategies, ensuring the effectiveness of their programmes.

Keywords: Awareness, governmental agencies, Malaysia, non-governmental organisations, sea turtle

INTRODUCTION

Sea turtles inhabit the tropical and subtropical seas around the globe. There are two families of sea turtles: Cheloniidae, the hard-shelled family, comprises Green turtles (*Chelonia mydas*), Hawksbill turtles (*Eretmochelys imbricata*), Loggerhead turtles (*Caretta caretta*), Flatback turtles (*Natator depressa*), Olive Ridley turtles (*Lepidochelys olivacea*), and Kemp's Ridley turtles (*Lepidochelys kempii*); and Dermochelyidae, the leathery-shelled family, represented by Leatherback turtles (*Dermochelys coriacea*), the largest sea turtle species (Chan, 2006; Thomson *et al*., 2021). Out of the seven species, Malaysia is home for nesting and foraging to four: Green turtles, locally named "penyu agar/hijau"; Hawksbill turtles, "penyu karah/sisik"; Olive Ridleys or "penyu lipas"; and Leatherbacks or "penyu belimbing" (Zulkifli & Kamaludin, 2023). In addition to that, there have been sightings of Loggerheads in Malaysia, believed to have nested in Sarawak, and one reported to be stranded in ghost nets off the west coast of Peninsular Malaysia (Leh, 1985; Abdul Rahman *et al*., 2021). According to the International Union for Conservation of Nature and Natural Resources (IUCN) Red List, Green turtles are classified as endangered, Leatherbacks and Olive Ridleys as vulnerable, and Hawksbills as critically endangered on a global basis (IUCN-SSC Marine Turtle Specialist Group (MTSG), n.d.). On Malaysian beaches, Green turtles have the highest nesting number, reaching up to 15, 000 annual nests as recorded in Sabah Turtle Islands Park (Joseph *et al*., 2022), followed by Hawksbill turtles, with an annual average of 432 nests in Melaka, Malaysia (Salleh *et al*., 2018). Malaysia is one of the sea turtle nesting hotspots (Jolis *et al.*, 2015). As the total sea turtle population of all four species in Peninsular Malaysia declined from 2017 to 2021 (Fadli *et al.*, 2023), they have become legally protected and conserved by various government agencies and non-governmental organisations (NGO) within Malaysia, with the prominent examples of Department of Fisheries (DoF), Sarawak

Forestry Corporation (SFC), Sabah Wildlife Department (SWD), Perhentian Turtle Project (PTP), Reef Guardian, WWF-Malaysia, etc. In addition to conservation groundwork and research, each agency or organisation extends their focus to outreach programs to conjure collective efforts in sea turtle conservation.

Awareness programmes are one of the key approaches to educating the public on the plight of sea turtles and their conservation. The locals are indifferent towards the declining number of sea turtles as they lack knowledge of their importance to the marine ecosystem and the coastal communities, although turtle conservation awareness has been discovered to be higher among the younger generation than the older generation due to higher education levels and outreach efforts (Abd Mutalib *et al.*, 2013; Abdullah, & Halim, 2018). With the coastal migration of Green and Hawksbill sea turtles in Malaysia, particularly in Sabah and Sarawak as discovered by Pilcher *et al.* (2019), they are prone to fishery-based mortality such as shrimp fishing in nearshore Malaysian waters (Chan & Liew, 1996; Jaaman *et al.*, 2009; Project GloBAL, 2008). Outreach programs encouraging the widespread and consistent adoption of Turtle Excluder Devices (TEDs) among local fishermen are thus of utmost importance to ensure a decline in sea turtle bycatch mortalities (Tookes *et al*., 2023). Another example is turtle egg poaching and consumption, a practice deeply embedded in the local cultures, particularly in the older generations (Abd Mutalib *et al.*, 2013), calling for drastic measures to raise awareness and eradicate the illegal exploitations of sea turtles. Hassan *et al.* (2017) were able to inspire a decrease in the desire for turtle egg consumption through an awareness programme in Lundu, Sarawak, involving presentations and sea turtle interactive sessions. Other harmful behaviours of humans as described by Nahill (2021) may include disturbing in-water and nesting turtles, littering, obstructing nesting beaches and inconsiderate boating practices. Disturbance to sea turtles may include touching, blocking their paths or flashing white lights at nesting mothers; littering contributes to marine debris that may destroy marine habitats, cause entanglement and subsequently drowning events of sea turtles and other marine animals, and potentially fatal ingestion; coastal developments and the addition of man-made items (e.g., furniture or large debris) on nesting beaches can obstruct the paths of nesting mothers, cause light pollution and discourage nesting events; inconsiderate boating practices such as anchoring on coral reefs, speeding in nearshore waters and discharging fuels into the sea can damage the marine habitat and lead to boat strike events, in which sea turtles are struck, often to death, by the propellers of the boats. These anthropogenic pressures negatively impact the populations of sea turtles and other marine megafauna, that are key tourist attractions in the marine tourism industry (Read, 2008; Teh *et al*., 2018). It is therefore vital to raise awareness of the locals regarding the consequences of certain practices, increase their willingness to adopt alternative practices and advocate for more sustainable practices, developments and legislation.

From a historical aspect, turtle meat, tortoiseshells and eggs were widely consumed in Southeast Asia. For example, in Sarawak, Malaysia, the harvest of Green turtle eggs was a significant industry until the 1980s, and the extensive harvesting over the years led to the drastic decline of the nesting population (Chan, 2006). Hassan *et al.* (2022) reported an 82.6% decline in nesting turtles from the 1950s to the 2000s, reaching a plateau in the 2000s. Other research shows that the global abundance of certain species, namely Green and Olive Ridley turtles is increasing, but Leatherback turtles are decreasing (Mazaris *et al.*, 2017), highlighting the need for continuous conservation and protection. Although the trade of sea turtle products has been banned by the governments of Sabah and Sarawak under the Wildlife Conservation Enactment (1997) and Wildlife Protection Ordinance 1998 respectively (Jani *et al.*, 2020; Joseph *et al.*, 2022), and the trade of all turtle eggs have been banned in Terengganu under the Turtle Enactment 1951 (amendment 2021) (Yong, 2021), these illegal trades remained active in Malaysia, as they moved to underground markets (Gomez & Krishnasamy, 2019). For example, through the analysis of genetic samples, Pertiwi *et al.* (2020) found that 10% of the live and dead sea turtles illegally traded in Bali originated within Indonesia (Berau), and also outsourced from Malaysia (Terengganu and Sarawak). In other cases, there have been reports of poached green turtles (Joseph *et al*., 2019), and the harvest of hawksbill turtle shells in Semporna, Malaysia (Jeethvendra *et al.*, 2023). The reported

poaching of green and hawksbill turtles in the Coral Triangle suggests Malaysia is a potentially active trade source (World Wide Fund for Nature (WWF), 2015). With the conservation and exploitation of these creatures occurring at the same time, the efforts taken by conservationists can be said to be in vain. Successful public education on marine conservation has been demonstrated by local and international studies. For a local example, Ismail *et al.* (2021) discovered a 66.11% increase in excellent grades in sea turtle knowledge test scores after the conduction of Turtle Camp. Similarly, Virgili *et al*. (2024) proved that fishermen outreach is crucial in reducing sea turtle bycatch mortality, although the results of Thomas- Walters *et al*. (2020) showed that the decrease in sea turtle poaching was irrelevant to the awareness campaign conducted. Education and awareness must therefore be raised among the Malaysian communities to eradicate sea turtle exploitations and ensure sea turtle populations increase.

Despite being an important nesting rookery for sea turtles, Malaysia has witnessed a decline in Green and Hawksbill nesting populations (Chan, 2013), raising concerns regarding their conservation status and underlining the necessity of effective outreach programmes to promote awareness and engage the public in sea turtles conservation efforts. For context, the Malaysian population is approximately 34.1 million, with a median age of 30 years old (Department of Statistics Malaysia, n.d.). Malaysian primary school children are aged between 7 – 12, while secondary school children are aged between 13 – 17 years. In addition, Malaysia comprises diversity in ethnicity, culture, beliefs and religion, hence there are opportunities and challenges in awareness programmes and the conservation of sea turtles.

To understand the conservation awareness of sea turtles in Malaysia, this literature review provides an overview of the outreach programmes in the country, the programme types and strategies. Types of outreach programmes included in this review are school or youth outreach programmes, ecotourism, citizen science projects, funding/adoption programmes and fishermen or community outreach programmes. The objectives of this paper are to assess the types of awareness programmes aimed at sea turtle conservation in Malaysia implemented by governmental and non-governmental organisations and identify the key strategies employed in these programmes.

MATERIALS AND METHODS

This study used digital platforms to gather information about awareness programmes on sea turtles in Malaysia. Due to time constraints, virtual or verbal interviews were not included. A total of 18 marine conservation NGOs and government agencies within Malaysia with available virtual updates of awareness programmes were scrutinised. These organisations were compiled from the existing knowledge of the authors or searched on Google with keywords i.e., "sea turtle conservation in Malaysia", and were filtered according to the availability of sea turtle awareness programme updates within the assessed period. Websites were accessed by searching the names of each organisation on Google. The same was done for social media pages that were accessed by searching the corresponding agency names on the platforms or from the information provided on the website. Through the website and social media (Instagram and Facebook) of each conservation entity, the types of outreach programmes conducted, and the strategies employed were tabulated. For each website, the search for annual reports, volunteer and other outreach programmes was done by exploring the website navigation menu, usually displayed on a bar in the website header. Social media and blog posts of outreach activities conducted by each party were tracked from January 2023 until December 2024, and annual reports for the year 2023, if available by the date of analysis (18 December 2024), were examined.

Undated activities such as weekly talks or on-site facilities such as turtle information centres are presumed to be ongoing and thus included in the analysis. For organisations with more than one conservation focus (e.g., Corals, terrestrial wildlife, plants etc.), only outreach programmes designed to raise awareness about sea turtles or related to sea turtles (i.e., waste collection with the purpose of sea turtle conservation) were included in this review. Inactive organisations with inconsistent conduction of programmes and posts of outreach dated older than January 2023 were excluded from this review to omit inconsistent and outdated outreach efforts from this analysis.

The programmes conducted by each agency were then categorised into four main types of awareness programmes, namely school or youth outreach programmes, ecotourism, community outreach and citizen science or funding programmes, to visualise the corresponding outreach efforts. School or youth outreach encompasses all programmes aimed at youngsters below 18 years of age; ecotourism includes all sea-turtle-related tourism and volunteerism; community outreach involves fishermen and all members of the local community; and citizen science programmes refer to all projects involving the general public (citizen scientists), while funding programmes refer to adoption programmes and partnerships.

Citizen science and funding programmes are grouped together in this study as both involve the help of the public. The strategies employed by each agency were classified as "knowledge dissemination", "hands-on activities", or "knowledge application" according to the study by Ahmad-Kamil *et al.* (2024). Knowledge dissemination includes all forms of talks, video presentations, forums, seminars, and workshops; while hands-on activities refer to camps, volunteer activities, waste collection such as beach or underwater clean-ups, citizen science, Do-It-Yourself (DIY) or art activities, ecotourism and other practical activities; quizzes, art and DIY contests, including online posters and video competitions, are categorised as knowledge application.

RESULTS & DISCUSSION

In this study, there are 18 organisations involved in sea turtle conservation awareness (Table 1). Three out of 18 sampled organisations are federal and state parties, while the rest are NGOs. Given that governmental agencies such as DoF operate across a wider range in Malaysia (in this case Pahang, Melaka, Negeri Sembilan, Terengganu and Penang), while NGOs such as JTP, SEATRU and PTP concentrate on specific areas or islands with turtle conservation needs, it is no wonder that NGOs outnumber governmental agencies. In most cases, NGOs collaborate with governmental agencies for a comprehensive and inclusive approach to address challenges in conservation and outreach (Chaurasiya *et al.*, 2023). For example, WWF-Malaysia collaborated with the Department of Fisheries Melaka to conserve Hawksbill turtles in Melaka (See & Latip, 2023), or in the case of other marine conservation work, the collaboration between DoF and Reef Check Malaysia to conserve and restore the marine ecosystem (Reef Check Malaysia, 2023).

Table 1. A list of NGOs and Government Agencies sampled in this review. There are considerably more NGOs than government agencies

	NGOs	Government
List of organisations	World Wide Fund for Nature Malaysia (WWF-Malaysia)	Sarawak Forestry Corporation (SFC)
	Marine Research Foundation Asia (MRF)	Sabah Wildlife Department (SWD)
	Kudat Turtle Conservation Society (KTCS)	Department of Fisheries Malaysia (DoFM)
	Juara Turtle Project (JTP)	
	Marine Conservation and Research Organisation Malaysia (PULIHARA)	
	Sea Turtle Research Unit (SEATRU)	
	Perhentian Turtle Project (PTP)	
	MY Ocean Hope	
	Tengah Island Conservation (TIC)	
	Bubbles Turtle Conservation (BTC)	
	Tropical Research and Conservation Centre (TRACC)	
	Reef Guardian	
	Kapas Turtles	
	Turtle Conservation Society of Malaysia (TCS)	
	Scuba Junkie SEAS	
Total	15	3

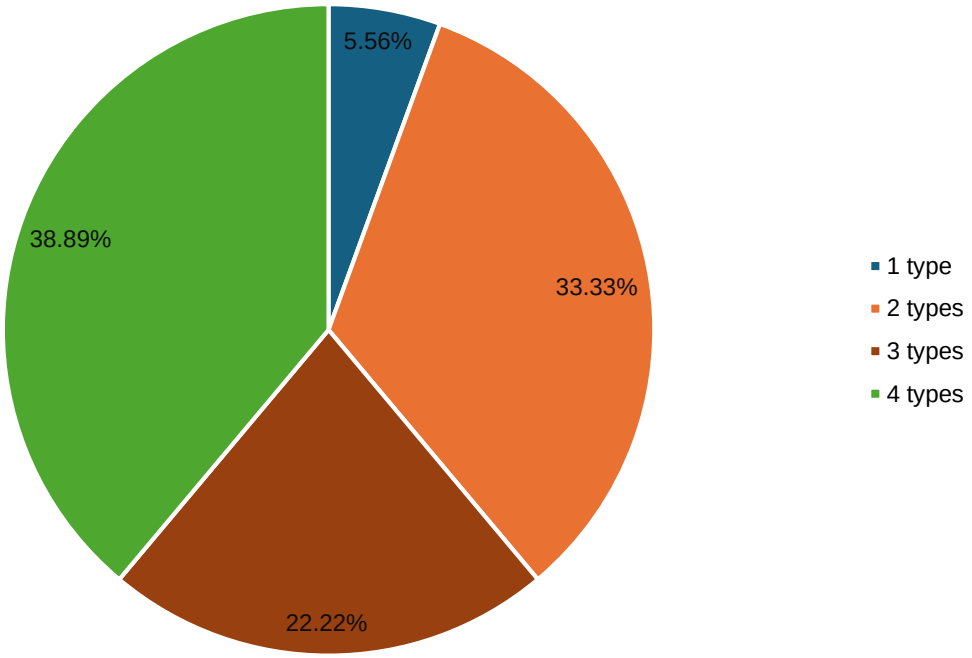

Figure 1. Pie chart of the percentage of organisations conducting one to four types of awareness programme(s). The majority conducted two to three types of awareness programmes

Government departments must work on more aspects of conservation than NGOs, encompassing but not limited to policy development, law enforcement and regulation and sustainability management all while taking into account the economic and social aspects of local communities, while NGOs focus more on conservation operations, advocacy for better policies, lobbying supports and raising awareness (Young & Dhanda, 2013; Carver & Sullivan, 2017; Chaurasiya *et al.*, 2023). With the collaborative goal of NGOs and government departments in wildlife conservation and protection, their efforts should be applauded regardless of their level of efforts.

Out of these organisations tracked, seven (38.89%) have an all-round focus in terms of the outreach programme types namely School/Youth Outreach, Ecotourism, Community Outreach and Citizen Science /Funding Programmes (Figure 1), whereas six (33.33%) agencies focused on two outreach programme types. A minority of four (22.22%) and one (5.56%) focused on three types and one type of outreach programmes respectively. Although the percentage of conservation entities conducting all four types of sea turtle outreach programmes is low, this is understandable as some organisations may be facing limited funding and manpower to conduct different types of programmes. For example, Poti *et al.* (2021) mentioned the discontinuation of SEATRU's outreach programme at Redang Primary School in 2014 due to a lack of funding. This could also be explained by the wide conservation scope of several organisations. For example, MRF Asia has various ongoing projects encompassing marine debris, sharks and rays etc.; TRACC Borneo focuses on coral restoration and WWF-Malaysia conserves terrestrial wildlife, forests, freshwater and marine ecosystems and others. Another plausible explanation may be the funders' goals prioritising other aspects of turtle conservation over awareness programmes, as most of the resources may be channelled towards conservation groundwork such as hatchery management or research instead of awareness programme conduction (Gruby *et al.*, 2023). Therefore, limited outreach programme implementation could be explained by funding and manpower constraints, a wide range of conservation focuses or the funders' priorities.

School Outreach Program

Figure 2 shows the number of organisations that conduct each type of outreach program. Ecotourism and community outreach were conducted by 77.78% of organisations, followed by citizen science/funding programmes (72.22%). School or youth outreach is the least conducted program type (66.67%). Despite this finding, school or youth outreach programmes serve as one of the most important channels to instil conservation and pro-environmental awareness in local communities and therefore should be prioritised by all organisations in their outreach plans. Boyd (2019) noted that environmental education and interventions during childhood can alter the lifelong beliefs and attitudes of youths and that children tend to share knowledge with their families, aiding in the spread of pro-environmental awareness (As the environment and its inhabitants are interlinked, sea turtle outreach can be classified under environmental education or intervention and pro-environmental behaviours refer to involvement in sea turtle conservation work in this review). This is supported by other studies stating that younger participants acquire new pro-environmental behaviours more easily than adults (Zelezny, 1999), are more responsive towards pro-environmental interventions (Liefländer & Bogner, 2014), and retain their childhood experiences until adulthood (Chawla, 2020). For example, Abd Mutalib *et al.* (2013) found that participants below 20 years of age obtained the highest score in the sea turtle survey in Setiu, Terengganu, whereas those aged between 50-59 obtained the lowest score, as some of them admitted that turtle egg consumption is a part of their cultural norms.

Meanwhile, Poti *et al*. (2021) reported a cease in sea turtle egg consumption in eight out of ten individuals who participated in sea turtle awareness programmes at Redang Primary School as children. The significance of environmental education in schools is emphasised as past research has indicated that environmental literacy (referring to knowledge, awareness, behaviour, attitude and involvement in environmental issues: Jannah *et al.*, 2013) possessed by local youths is moderate to low (Erdogan *et al.*, 2009). Although newer research found an increase in environmental awareness behaviours among the youths due to environmental education programs and the role of social media in raising environmental-related awareness, their level of participation in environmental-related issues remains low (Abdul Rahman, 2020; Nasir *et al.*, 2020; Norkhaidi *et al.*, 2021). With children being the future decision-makers of Malaysia, it is therefore of utmost importance to cultivate their awareness of sea turtle conservation since young to help them cope with these increasingly pressing conservation matters in the future.

Several past studies have shown that female students show a higher level of environmental awareness and responsibility than male students (Tikka *et al.*, 2000; Jannah *et al.*, 2013; Li *et al.*, 2022), while some studies like Larson *et al.* (2019) reported the opposite as males spend more outdoor times. Nevertheless, organisations targeting school outreach programmes should integrate outdoor or fieldwork experiences to provide more fun learning experiences and increase the engagement of both genders, effectively adding positive impacts to the long-term memories of students and improving their pro-environmental behaviours (Mann *et al.*, 2022). This is supported by Kuo *et al.* (2018) who discovered learning in nature increases classroom engagement significantly as compared to classroom learning.

In addition to that, Ives *et al.* (2018) suggest that establishing bonds with nature can instigate significant societal shifts towards greater respect and care for the environment, and childhood is a stage of opportunity to nurture these bonds. For a local example, Ismail *et al.* (2021) reported an increase in knowledge, positive perception and behaviour towards turtles through the implementation of Turtle Camp, involving school-based and outdoor programmes, in primary schools in Kemaman, Terengganu. Therefore, the implementation of outdoor programmes is favoured whenever possible, to allow youths to build positive connections with nature, and shape their conservation attitudes.

Ecotourism

A total of 14 (77.78%) agencies are involved in ecotourism. Ecotourism can increase conservation awareness among tourists of various ages and nationalities. It should involve education regarding the wildlife sighted, coupled with controlled and responsible interaction with wildlife such as turtle watching and hatchling

releases conducted by PULIHARA, DoF, BTC and so forth (Table 2). In addition to raising awareness, the revenue generated from sea turtle-related tourism can be channelled to fund relevant research and conservation programmes (Tisdell & Wilson, 2000). For example, the paid 3-day-2-night sea turtle volunteer programme by SFC and the marine park fees imposed by the Department of Marine Parks on the tourists are channelled towards the management of marine parks, and the protection and conservation of the marine environment (Ismail *et al.*, 2020). Ecotourism that includes environmental education and turtle sightings can cause a positive and significant increase in the desire and intentions of tourists to help sea turtles, demonstrating the importance of learning and wildlife interaction in the cultivation of pro-conservation sentiments and actions (Tisdell & Wilson, 2005). This is proven by Mendes *et al.* (2019), reporting that 89.1% of sampled tourists showed awareness and sensitivity regarding the conservation of sea turtles. However, the effectiveness of ecotourism in raising conservation awareness is greatly linked to the sustainability and responsibility of tourism operators, local industries and governments, as in some cases, these values are ignored for higher economic returns (Mihalic, 2016). For example, the development of touristy regions in terms of transportation, accommodation, agriculture etc. by the government and local industries, and the footprints of mass tourism (e.g., littering and noise pollution) may bring negative impacts to local biodiversities that are often overlooked to rake in economic benefits of tourism (Sahahiri *et al.*, 2023; Zhu *et al.*, 2023).

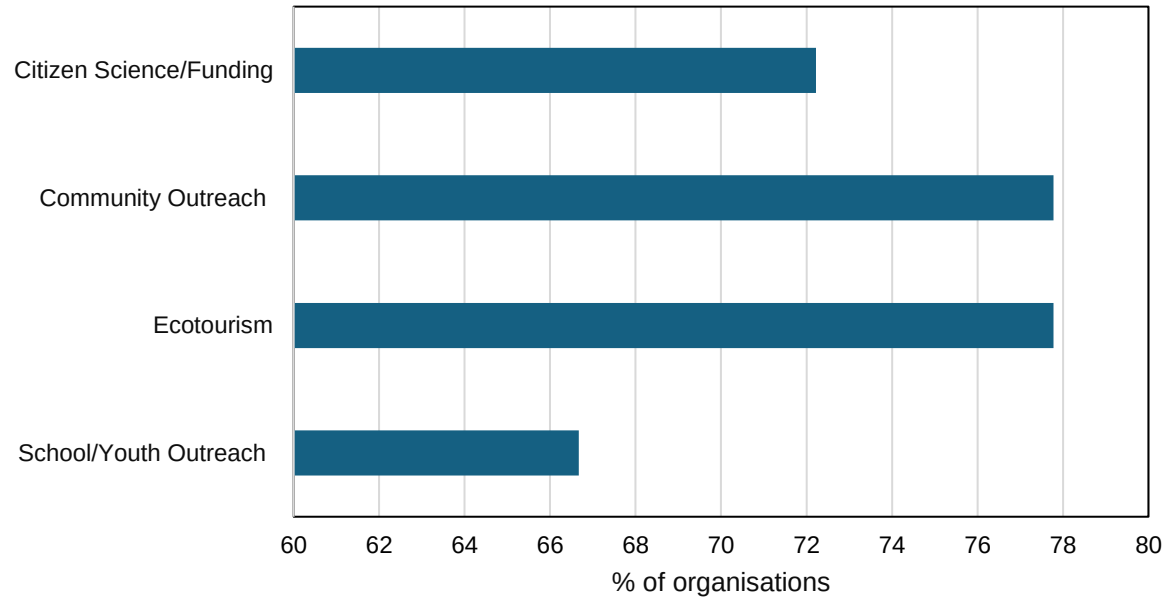

Figure 2. A bar chart of the percentage of organisations conducting each type of awareness programme. Community outreach and ecotourism are conducted by the same percentage of organisations

According to the Global Sustainable Tourism Council, private and governmental operators have the social responsibility to minimise environmental impacts while maximising environmental benefits (Marin-Pantelescu *et al.*, 2019). Given that most sea turtle conservation centres reviewed in this article (Table 2) operate in marine tourism hotspots on islands or along the coasts, outreach efforts extended towards the stakeholders, private or governmental tourism operators, are extremely crucial. Moreover, due to their strategic locations in the heart of tourism, ecotourism can be easily carried out by opening their conservation centres for tourist visits. The staff at these centres should be able to offer a clear overview of sea turtle species, ecology (natural habitat), biology (anatomy, behaviour, and reproduction), conservation measures and challenges faced (Dimopoulos *et al.*, 2009). This is in line with the programme structure proposed by Koeswiryono and Chandra (2021), stating that each tour should include (1) an explanation of displays of the protected turtle species, which in the case of Malaysia, are Green, Hawksbill, Leatherback, and Olive Ridley turtles, to impart knowledge on the distinguishing features of each species; (2) a tour of the hatchery, the hatchlings tank, and the adult turtle's exhibition pool, or (3)

in the case of most Malaysian conservation centres that lack the skills and fundings for rehabilitation, specimens of hatchling carcasses, turtle taxidermy and turtle carapace, coupled with explanations regarding the biology, care, threats and conservation measures. With the awareness raised, tourists and stakeholders can be more mindful of their footprints during their travels and sustainable tourism can be more easily attained with their cooperation.

Another aspect of ecotourism gradually gaining popularity in the sea turtle conservation sector over the years is the volunteer programme or volunteerism. Volunteering with conservation organisations allows tourists to work with the organisations for a short period. This is a clear example of a win-win situation, whereby volunteers get to experience sea turtle encounters and increase their skill sets, and conservation workers obtain practical help and funding while spreading awareness. Volunteerism may include a wide range of programme types. It can be as simple as a beach or underwater clean-up open for public participation on a touristy beach, or a programme that lasts for a short period (from days to weeks or months) and covers various types of activities, which, on top of conservation work, may include non-conservation-related miscellaneous work encompassing maintenance, gardening and mural or sign-making (Nahill, 2021).

With the knowledge and wildlife interaction experiences acquired during the volunteering period, tourists are more alert to anthropogenic impacts on sea turtles, may be more inclined towards eco-conscious choices and are properly equipped to educate their peers. Not to mention that volunteerism may bring greater profits to the local community businesses in sectors such as food, accommodation and other shopping places (McGehee & Andereck, 2009; Zahra & McGehee, 2013). Despite all the benefits it brings, some organisations reviewed in this paper may be unable to achieve its implementation due to various issues. One of the prominent issues may be insufficient funding, as this programme may require a significant monetary sum to construct appropriate accommodation facilities (for organisations in remote places) and employ adequate manpower (i.e. volunteer coordinators) to market and manage the programme and its participants (Liu, 2020).

Community Outreach

Similar to ecotourism, 14 (77.78%) out of 18 agencies in this study implemented community outreach programmes. This programme type is emphasised by most conservation entities as the coastal communities live interdependently with the marine ecosystem, and sea turtle egg poaching and consumption remain a common practice in many parts of Malaysia. The local communities should learn the importance of sea turtles as a keystone species in the marine ecosystem, which can then affect their livelihoods. With the shift of the era, conservation awareness and legal boundaries have largely reduced these unhealthy practices, though it is far from being completely eradicated.

To attract the attention of various age groups and mindsets that make up a community, community outreach requires creativity such as beautification projects in strategic locations (i.e. the beautifully decorated Turtle Alley with turtle-related information by Turtle Conservation Society) and practicality in terms of economy and social benefits. It is only natural for the communities reliant on sea turtles for consumptive uses in the past to shift to non-consumptive uses such as ecotourism and tourism businesses as discussed in the previous section (Wilson & Tisdell, 2003; Abdullah, & Halim, 2018; Brander *et al*., 2024), as they realise the economic benefits of live sea turtles to local businesses and the increase in job opportunities in the tourism and conservation sectors.

For instance, WWF reported that sea turtle-related tourism is estimated to generate money approximately three times the economy obtained from the trade of sea turtle products (eggs, tortoiseshells and meat) while increasing local jobs, funding monitoring programmes and reducing consumptive uses of sea turtles, and this should be part of the information imparted to the communities during outreach programmes to allow the locals to understand that sea turtles provide more benefits when alive than dead (Troëng & Drew, 2009). Therefore, engaging with the local communities and assisting their shift to non-consumptive income alternatives, for instance, the Kampung Mesra Penyu

Initiative by WWF-Malaysia and Mabul Community Market by Scuba Junkie Seas (Table 2), are crucial in promoting such transitions.

Turtle excluder devices or TEDs play a vital role in sea turtle conservation by mitigating fatal interactions between sea turtles and trawl fishing gear. TEDs are designed to fit within the neck of a trawl net, through which shrimp can freely pass through the bars to the back of the net, while larger animals such as turtles can escape through a flap in the mesh, reducing bycatch and drowning events (NOAA, 2021). Therefore, educating the fishermen on sustainable fishing with TEDs is an imperative step towards sea turtle conservation. Sankar and Raju (2003) documented the implementation of awareness camps in coastal districts to educate and promote sea turtle conservation, featuring demonstrations on TED fabrication, function, and assembly, successfully reducing the use of ray nets and cultivating fishermen's cooperation to protect sea turtle eggs during nesting seasons.

Nevertheless, only one organisation (MRF Asia) reviewed in this paper explicitly reported conducting an ongoing TED outreach project, which can be due to the challenges posed in persuading fishermen regarding the benefits of TEDs, as the lack of visible socio-economic benefits of TEDs towards fishermen may fuel their reluctance in adopting TEDs. As explained by Jenkins (2023), the proper, widespread and consistent use of TEDs may be harder to achieve, possibly due to its perceived complexity and incompatibility with the fishermen's needs. Despite these challenges, consistent outreach efforts in the form of workshops and continuous striving for TED structural improvements to minimise fishermen's inconvenience should be sustained for greater TED adoption and application success.

Table 2. Summary of names, websites, programmes conducted and the respective programme types and strategies employed by each conservation entity. The description of the programmes conducted (if provided) is included. Organisations were excluded if they lacked virtual updates of sea turtle-related awareness programmes in 2023 and 2024. The majority of organisations conduct more than one programme type and employ multiple strategies except for Sabah Wildlife Department (SWD)

Agency/ NGOs	Website	Turtle Awareness Programme	Summary of Programme Types	Summary of Strategies Employed
1. World Wide Fund for Nature Malaysia (WWF-Malaysia)	https://www.wwf.org.my/our_work/marine/protecting_endangered_marine_species/	• Turtle Camp for youths in Terengganu, Malaysia • Kampung Mesra Penyu Initiative at Kampung Padang Kemunting, Melaka to ensure a balance between improved community life quality and sea turtle conservation • Sea turtle mural in Tun Mustapha Park, Sabah • Protect Nature, Protect Our Future online fundraising programme for the conservation of Malayan tigers, Orangutans and sea turtles, with tax exemption receipts and gifts in return.	School/youth outreach, community outreach and funding programmes	Knowledge disseminati on and hands-on activities.
2. Marine Research Foundation Asia (MRF Asia)	https://www.mrf-asia.org/project/malaysia-turtle-excluder-devices-project-2007-present/	• Educational and practical workshops, including the use of short documentary videos to educate local fishermen and encourage the use of Turtle Excluder Devices (TEDs). This programme is expanded from Sabah to Peninsular Malaysia. • Educational booth at Turtle Islands Heritage Protected Areas (TIHPA) Conference 2023 • Sponsorships and partnerships with various other organisations, corporates, stakeholders and government departments. • Underwater clean-up with volunteers and other departments funded by KePKAS	Community outreach and funding programmes.	Knowledge disseminati on and hands-on activities.
3. Kudat Turtle Conservation Society (KTCS)	https://www.ktcsborneo.org/environmental-education-1	• Awareness talks in schools and villages, exhibitions. • Beach clean-ups with the Bavang Jamal Community • Rehabilitated turtle releases by Wildlife Rescue Unit Sabah • Sustainable Livelihood Project- includes capacity building, facilities improvement, business marketing etc. – to boost incomes of Kudat communities in support of their marine conservation efforts • Volunteer Programme • Citizen science – monitoring programme/ turtle egg protection programme - involving the local communities to provide training and skill enhancement. • Industrial training for students and staff of stakeholders	School outreach, community outreach, ecotourism and citizen science.	Knowledge disseminati on and hands-on activities.

*indicates Malaysian governmental agencies

Table 2. (continued)

Agency/ NGOs	Website	Turtle Awareness Programme	Summary of Programme Types	Summary of Strategies Employed
4. Juara Turtle Project (JTP)	https://www.juaraturtleproject.com/projects/environmental-program/	• Organise weekly visits to Juara Primary School in Kampung Juara of Tioman Island, Pahang to educate on different monthly topics and conduct activities ranging from presentations to games or outdoor activities such as snorkelling or beach clean-up. Bilingual and monthly rotation of topics and varying weekly activities keep the attention of the same audience group. • The volunteer programme allows tourists to be involved in turtle conservation work throughout the nesting season, increasing their knowledge and awareness. (Fees: RM1000-1500 per week) • Recycling Programme involving stakeholders and local communities • Juara Plastic Free Initiative – promoting sustainable alternatives to plastic among stakeholders (e.g., Use of metal straws instead of plastic straws)	School outreach, ecotourism, and community outreach.	Knowledge dissemination and hands-on activities.
5. Marine Conservation and Research Organisation Malaysia (PULIHARA), formerly known as Lang Tengah Turtle Watch (LTTW)	https://pulihara malaysia.org /what-we-do/	• Free educational talks for guests and school children coupled with specimen exhibition. • Volunteer Programme involving talks and hands-on conservation work (Fees starting at RM850 per week for locals and USD450 for foreigners) • School outreach programmes • Turtle Kids Club for children below 12 • Encourage the public to send in photos of sea turtles for Photo-ID • Turtle Adoption and Nest Adoption Programmes • Kelas Penyu aimed at children and locals at Pantai Chakar Hutan • Beach clean-ups with resort guests, school children and locals. • Turtle watching, hatchery visits, nest inspection and hatchling releases with the public • Informative talks provided at the Visitors' Hut at Tanjong Jara Resort, Dungun, Terengganu • Collaborated with Majlis Perbandaran Kemaman (MPK) to organise a beach clean-up at Pantai Chakar Hutan. • CSR Programmes • Educational booth at KDI Open Day • Partnership with Team Rakyat for only merchandise sales	Ecotourism, school outreach, community outreach and citizen science/funding programme.	Knowledge dissemination and hands-on activities.
6. Sea Turtle Research Unit (Seatru)	https://seatru.umt.edu.my/	• Allow day trips to the site for educational talks, site visits, nest checks and excavations. • Turtle Camps for school children comprise storytelling, games, group activities, quizzes, and on-site training in conservation work. • The TurtleTok contest encourages the public to produce videos related to sea turtles on social media to reach a wider audience. • 5D4N Volunteer Programme from RM680 • Sembang Ke Laut Podcast Project • Advertisement Board Partnership with businesses ranging from RM1000 (basic package) to RM 2000 (premium package).	Ecotourism, school outreach, community outreach and funding programme.	Knowledge dissemination and application, and hands-on activities
7. Perhentian Turtle Project (PTP) by Fuze Ecoteer	https://www.perhentianturtleproject.org/citizen-science	• Volunteer programme involving turtle conservation works (RM900 per week for locals) • Penyu Warrior Initiative – a citizen science encouraging the public to take photos of sea turtles and send them to the organisation for individual identification, complete with a set of guidelines • Turtle adoption programme and wish list – to fund necessary equipment for research and conservation work • Beach clean-ups • Collaboration with Mojo More Furniture – 10% of the proceeds from selling eco-friendly bookstands go to PTP.	Ecotourism, citizen science/funding programmes.	Knowledge dissemination and hands-on activities.
8. Sarawak Forestry Corporation (SFC)*	https://sarawakforestry.com /sea-turtle-conservation-program/	• 3D2N Volunteer Program at Pulau Talang-Talang (Fees: RM1000 for foreigners and RM450 for locals) • Adoption Programme - RM 100/year per nest or RM 200/year per turtle.	Ecotourism and funding programme.	Knowledge dissemination and hands-on activities.

*indicates Malaysian governmental agencies

Table 2. (continued)

Agency/ NGOs	Website	Turtle Awareness Programme	Summary of Programme Types	Summary of Strategies Employed
9. Department of Fisheries (DoF) *	https://marinepark.dof.gov.my/en/locations/tcic/	• Free ongoing exhibition of live sea turtles, specimens, photos and information boards in the Turtle Conservation and Information Center (TCIC) or Fish Ornamental Centre to educate the public. These centres are open in various locations such as Pantai Kerachut (Penang), Segari (Pahang), Port Dickson (Negeri Sembilan), Padang Kemunting (Melaka), Cherating (Pahang), Ma'Daerah (Terengganu) and Rantau Abang (Terengganu). • Regular organisation of beach clean-up programmes and hatchling releases that are open for public participation • Turtle specimens on display at Laman Agrofood Perikanan • Hatchling release programme • Sea Turtle Conservation Awareness Programme Kelantan 2024 at Kampung Kuala Rekang, Kandis, Kelantan	Community outreach and ecotourism.	Knowledge dissemination and hands-on activities
10. MY Ocean Hope	https://oceanhope.umt.edu.my/	• School tour • Beach clean-up • Workshop & seminars • Drawing contest	School outreach and community outreach.	Knowledge dissemination and application, and hands-on activities.
11. Tengah Island Conservation (TIC)	https://www.tengahislandconservation.org/community	• School outreach programmes that include lessons and activities related to sea turtle conservation. • Volunteer programme – hatchery maintenance, nest checks and excavations, nesting surveys, beach clean-ups and outreach programmes • Beach and underwater clean-ups • Fundraising campaigns that can be started by the public, sponsorships and donations from the public.	School outreach, community outreach, ecotourism and funding programmes.	Knowledge dissemination and hands-on activities.
12. Bubbles Turtle Conservation (BTC)	https://www.bubblesturtleconservation.com/	• On-site turtle talks in various languages to guests and school presentations • Hatchling releases and turtle watching with resort guests • Sea Turtle Conservation Experiential programme – patrols, hatchery maintenance, turtle talks, beach cleaning (RM1500 per pax per week) • Sponsorship programme for general sponsors, corporate sponsors, Sponsor-A-Nest etc. • Partnership with NEArt – joining NEArt membership with RM50 helps support BTC conservation works.	School outreach, ecotourism and funding programmes.	Knowledge dissemination and hands-on activities.
13. Tropical Research and Conservation Centre (TRACC)	https://tracc.org/life-at-tracc	• Volunteer programme with fees starting from EUR 1,300 – turtle photo ID, patrol and hatchling release (although they mainly focus on coral work) • Marine conservation seminars • Hatchling releases	Ecotourism and community outreach.	Knowledge dissemination and hands-on activities.
14. Reef Guardian	https://www.reefguardian.com.my/programmes/marine-conservation/sea-turtle-conservation	• Turtle-watching includes nesting mothers and hatchling release which are open to the Sugud Island Marine Conservation Areas (SIMCA) guests in Sabah. Briefings and Q&As will be conducted during these activities. • Organises school outreach programmes by inviting selected students to SIMCA to learn about marine conservation and providing training to Marine Science Undergraduate students. • Project AWARE – beach and underwater clean-ups involving tourists, government agencies and NGOs. • Infographics, posters, books, brochures and other exhibits are readily displayed at the office, together with the provision of video presentations and educational talks by staff. • Turtle adoption at RM200 per nest • Marine conservation talks at expeditions such as MIDE • Programme packages for educational field trips and visitation are open to students and the public.	School outreach, community outreach, ecotourism and citizen science/funding programmes.	Knowledge dissemination and hands-on activities.

*indicates Malaysian governmental agencies

Table 2. (continued)

Agency/ NGOs	Website	Turtle Awareness Programme	Summary of Programme Types	Summary of Strategies Employed
15. Kapas Turtles	https://kapasturtles.com/wp/	• Sign-making workshops, upcycling workshops, sharing sessions about Marine Protected Areas, video challenge • Karnival Kapas 2023 • On-site Sea Turtle Talks on every Saturday • Beach clean-ups – participants will be rewarded with snorkelling sessions, snacks and drinks • Volunteer programme - RM700 per person per week, for Malaysians. GBP 230 / EUR 260 per person per week for International volunteers (minimum period is 2 weeks) • #BringOurTurtlesBack Campaign – Sand sculpture contest 2023 to raise awareness and funds for sea turtle conservation in Terengganu, Malaysia. • Sea turtle nest adoption programme – each nest can be adopted with a minimum donation of RM400 • CSR and education programmes	Ecotourism and community outreach, funding programme.	Knowledge dissemination and application, and hands-on activities.
16. Turtle Conservation Society of Malaysia (TCS)	https://www.turtleconservationsociety.org.my/outreach/	• Turtles and firefly discovery trip- to share knowledge on sea turtles terrapins and fireflies. • Nature Discovery Trip – The 2D1N programme includes a Turtle and firefly discovery trip, a beach clean-up and trash analysis. 3D2N adds in a river cruise and mangrove planting session. • Turtle Alley – a themed lane decorated with turtle art on the walls and floor in Chinatown, Kuala Terengganu, Malaysia, complete with turtle-related stories and information. • Turtle Camp – educating teachers and students about turtles in schools. • Biodiversity talks – open to public participation to share knowledge about turtles and terrapins such as the pocket talk by Dr Pelf Nyok of TCS at Conservation Carnival NCTF 1.0 • Booth set-ups at events such as Dive Resort Travel Expo and Year End Bazaar • Distributed "Turtles of Malaysia" colouring books to children in rural Terengganu for free • Partnerships e.g. with Melvita and Watsons Malaysia, in which certain purchases will donate RM1 to TCS, or Royong, in which purchases give the consumers a chance to win a 3D2N stay at Shangri-La Rasa Sayang, Penang. • Awareness workshops involving soap and lotion-making, and turtle-related knowledge sharing. • CSR programmes with Bank Negara Malaysia, Ocean Network Express etc. • "18 Turtles – 18 Facts" Quiz Mania and trivia quizzes on Instagram	School outreach, community outreach, ecotourism, and citizen science/funding programmes.	Knowledge dissemination and application, and hands-on activities.
17. Sabah Wildlife Department (SWD) *	https://wildlife.sabah.gov.my/index.php	• Tour Programme of World Sea Turtle Day 2024 at six schools in Semporna in collaboration with WWF-Malaysia to raise awareness of the importance of protecting and conserving sea turtles and their habitats. • A meeting to initiate the Malaysia CITES Youth Network to include the younger generation in awareness campaigns focusing on turtle egg consumption.	School and youth outreach	Knowledge dissemination
18. Scuba Junkie SEAS	https://www.scubajunkieseas.org/	• Citizen science to help with Turtle ID database – photo submission from guests • Adopt A Turtle initiative – adopt a hatchling with RM100 • Volunteer programme starting at RM2,310 per week • Beach clean-ups • Sponsor a clean-up initiative • School outreach programmes • Conservation awareness talks for resort guests. • Work with the Mabul Community to develop the Mabul Community Market as an alternative to marine life exploitation. • Presentations and workshops available for the participation of local community • Partnership with Tee Mill Store to sell merchandise	School outreach, community outreach, ecotourism, funding programme	Knowledge dissemination, hands-on activities

*indicates Malaysian governmental agencies

Citizen Science/ Funding Programmes

A total of 13 (72.22%) conservation entities conducted citizen science projects or funding programmes. These programmes are similar in terms that both involve the general citizens in conservation and they can usually be performed without time or location constraints. Citizen science is a valuable tool for scientists to obtain information for research and conservation purposes while fostering civic involvement and raising awareness via explanations and practical involvement. Similarly, funding programmes provide explanations of the importance of sea turtle conservation and the uses of the raised funds to draw adopters and partners, simultaneously educating the potential funders. Citizen science projects are a cost-effective way of obtaining data from a wider geographical range, and over extended chronologies to increase the validity of the ongoing research while raising public awareness, and increasing scientific skill sets among citizen scientists (Lucrezi *et al.*, 2018).

Participation in these projects may be primarily directed at marine sports hobbyists such as divers and marine tourism operators as they may have access to valuable sea turtle-related information and photos (Martin *et al.*, 2016; Lucrezi *et al.*, 2018). Citizen scientists can contribute by adhering to structured protocols, sending in opportunistic data, or participating in crowdsourcing initiatives (Becken *et al.*, 2019). One example of a popular citizen science project is the photo-identification (photo-ID) project to understand the spatiotemporal distribution of sea turtles, which is implemented by several agencies in this review. This project, as described by various studies such as Long and Azmi (2017) and Hoh *et al.* (2022), is to encourage the public to send photos of sea turtles with a clear view of facial or flipper scutes for identification of individual turtles to relevant agencies, complete with metadata including the sighting location, the sighting date, the sighting time, and the camera model. From this process, the public learns about the individual uniqueness of sea turtle scutes (sea turtle biology), the importance of photo-ID (sea turtle research), and scientific processes and outcomes, thus increasing their knowledge and awareness regarding sea turtles. Protocols or guidelines provided through this project may allow the public to learn to behave appropriately around wildlife, ensuring that disturbances to sea turtles are minimised. However, citizen science projects may have limitations that may discourage some of the organisations from implementing them. The accuracy of the data collected by citizen scientists and volunteers is highly dependent on the completion and quality of the data. For example, the metadata of the photos, particularly the location, date and time of sighting, may be missing or the quality of the photos may be too blurred for individual identification (Long & Azmi, 2017). Another aspect to be considered is the increase in the size of the database, requiring longer processing time and manpower, even with the help of software due to possible inconsistencies in the photo quality (Long, 2016; Calmanovici *et al.*, 2018). On top of that, there is a chance that only those who are presently concerned about sea turtles and the environment are more inclined to participate in these programmes. Therefore, rewards and encouragements to the participants such as the opportunities to name newly identified turtles presently done by PULIHARA and the other NGOs should be provided to accentuate their sense of involvement and promote participation.

Outreach Education Framework

From Figure 3, 13 (72.22%) organisations employed two types of programme strategies (knowledge dissemination and hands-on activities), while 4 (22.22%) organisations used all three types of strategies. One (5.56%) organisation used only one programme strategy. As shown in Figure 4, all organisations employ knowledge dissemination as their outreach strategy, 94.44% (4) organisations employ hands-on activities, while only 22.22% (4) employ knowledge application on top of the other two strategies. From these findings, it can be deduced that 94.44% of organisations employ knowledge dissemination and hands-on activities as their outreach strategies, while only 22.22% include knowledge application. Only one organisation employed a single strategy (knowledge dissemination).

Effective environmental management and long-term conservation can be achieved by cultivating collective responsibilities through the main educational strategies known as “knowledge dissemination”, followed by “hands-on education” and “knowledge application” (Ahmad-Kamil *et al.*, 2024). Figure

5 describes the flow of implementing an effective environmental education programme, by integrating the General Teaching Model in Figure 6 (Hungerford *et al.*, 1988) into the outreach programme framework (Ahmad-Kamil *et al.*, 2024). The lessons to be disseminated in the awareness programmes are important factors determining the efficacy of the programmes and are therefore the core of outreach programmes conducted by all the organisations reviewed.

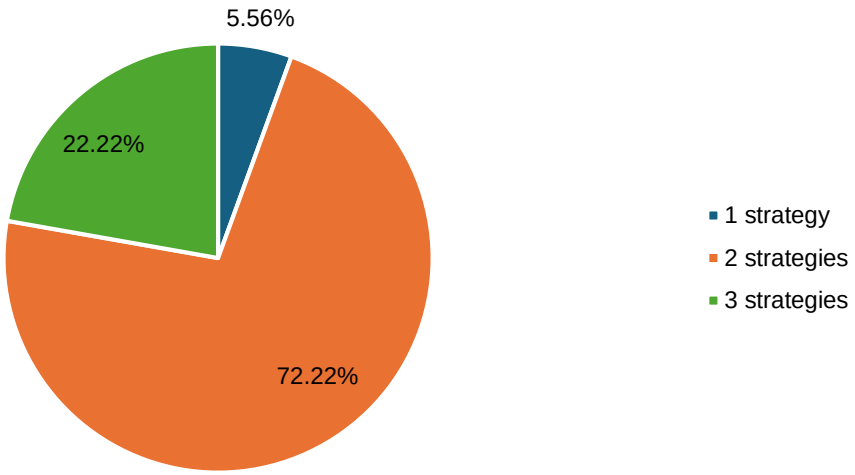

Figure 3. Pie chart showing the percentage of organisations adopting one, two or three strategies. 72.22% of organisations used 2 types of programme strategies in their outreach efforts

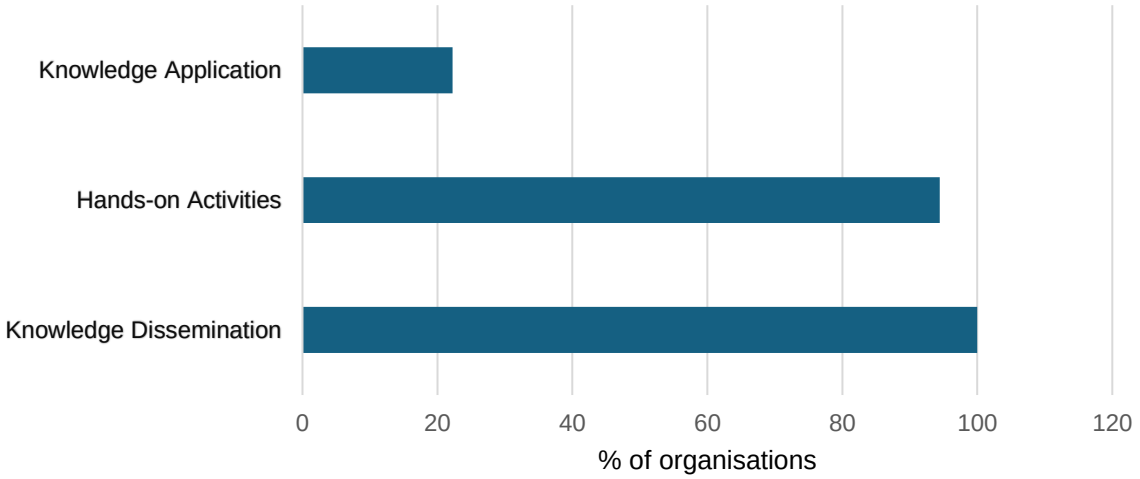

Figure 4. Bar chart of the percentage of organisations employing each programme strategy. Knowledge dissemination is employed by all organisations

This should include variables to construct positive behaviour toward the topic of interest, namely entry-level, ownership, and empowerment, which in the case of sea turtle awareness programmes, translate to basic sea turtle biology (specifically the morphological, reproductive, behavioural and nutritional characteristics and life cycle), threats and conservation measures, and the belief that personal action can make a difference to sea turtles along with a verbal commitment to sea turtle conservation, respectively (Dimopoulos *et al.*, 2009; Jiménez Acosta *et al.*, 2024). Poti *et al.* (2021) demonstrated the importance of long-term outreach efforts and debunking myths regarding the medicinal properties of sea turtle eggs, as it was discovered that most participants of the long-term awareness programme by SEATRU at Redang Primary School stopped sea turtle egg consumption due

to the knowledge obtained from the programme. Therefore, the lessons to be disseminated should be carefully planned out to ensure the conveyance of crucial information to reduce negative pressures on the sea turtle population.

Active learning activities in the form of hands-on activities and/or knowledge application after knowledge dissemination can aid in strengthening and broadening the knowledge and awareness of participants. For example, Frame *et al.* (2021) observed that a significant increase in wildlife conservation knowledge can be attributed to active-learning activities such as group problem-solving, games, group discussions, distinguishing unique flipper patterns between sea turtle species, beach clean-ups, and observing hatchlings emergence. Positive experience in hands-on activities can greatly pique the interests of students (Holstermann *et al.*, 2010). With the majority of organisations in this review employing hands-on activities, this may imply the greater convenience and usefulness of conducting hands-on activities such as waste collection on readily accessible beaches and volunteering activities to deal with manpower shortage than knowledge application. Schwichow *et al.* (2016) reported that both hands-on activities and knowledge dissemination are equally effective in increasing the scientific knowledge of school children, although they seem to do better in the aspects (hands-on or pen-and-paper) they were trained in.

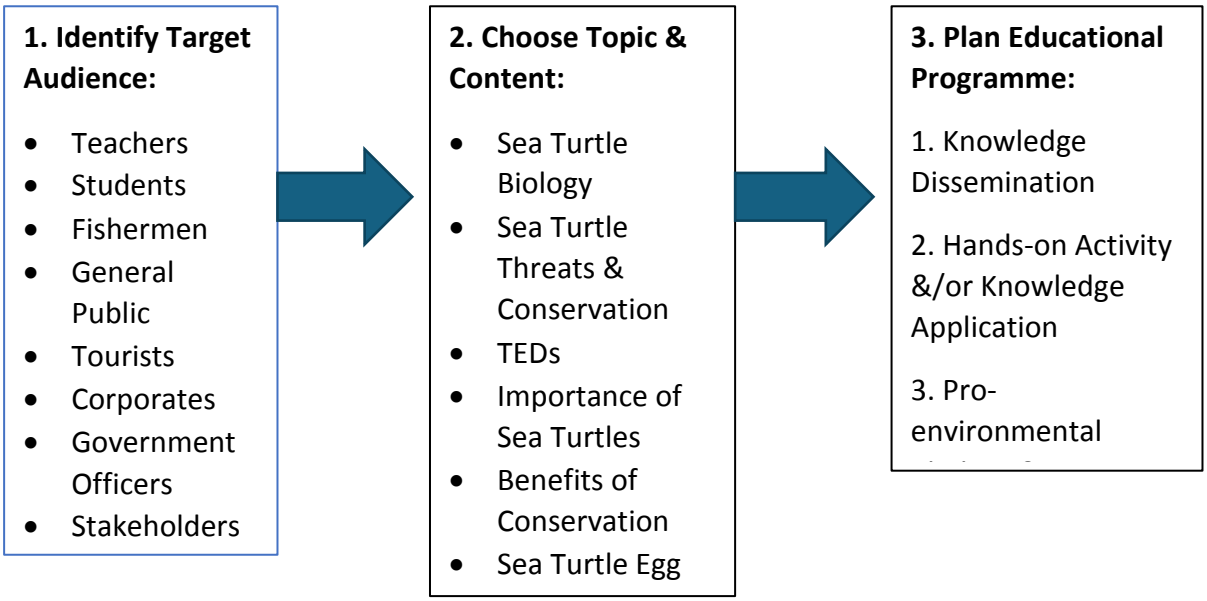

Figure 5. The framework for environmental education programmes, adapted from Ahmad-Kamil *et al.* (2024) and Gratwicke *et al.* (2016)

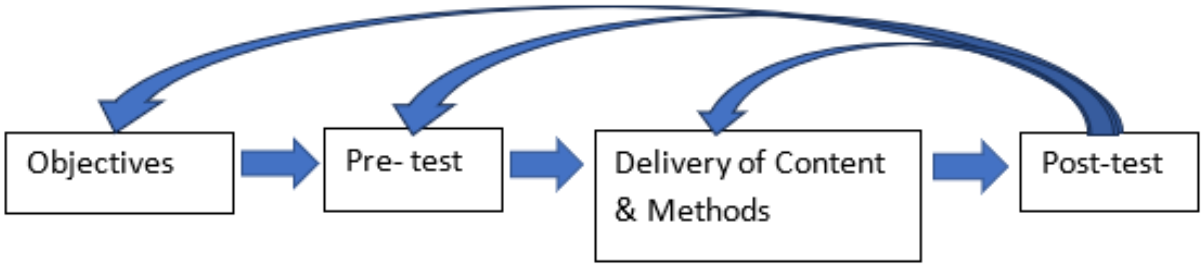

Figure 6. The General Teaching Model, adapted from Hungerford *et al.* (1988)

As sea turtle conservation encompasses both aspects, employing both strategies can maximise the effectiveness of awareness raising. As for knowledge application, Ta (2024) suggested that

low-effort contests offering various prizes can be effective in promoting conservation as evidenced by the success of the residential energy conservation contest in Vietnam. The launch of a sea turtle conservation campaign in Central Africa focusing on (1) knowledge dissemination in the form of public service announcements, awareness texts, posters, lectures etc. and (2) knowledge application in cooking contests to promote alternative food sources to sea turtles was effective in reducing turtle eggs consumption (Thomas- Walters *et al*., 2020). These studies by Schwichow *et al*. (2016) and Thomas- Walters *et al*. (2020) show that the employment of either hands-on activities or knowledge application on top of knowledge dissemination can contribute to awareness raising. Therefore, the strategy employment of the majority of the organisations in this study is adequate and should be maintained.

Recommendations

Broadening the scope of awareness programme types and consistency is crucial to altering the mindsets of local communities to protect Malaysia's sea turtle populations. To overcome the monetary and manpower challenges possibly faced by many organisations, this paper provides a few recommendations. Generating income by offering paid services such as guided tours, workshops and educational programmes is a great way to start. Transparency in terms of annual reports and updates can help to build trust with funding donors and stakeholders, paving the way for long-term funding. On the same note, using simple tools such as pre-and-post surveys to track and demonstrate the outcomes of each programme can help to secure funding from donors. Awareness can be raised with limited resources as well. An example would be expanding virtual efforts by conducting webinars or online sea turtle contests that can reach a broader audience with minimal costs in terms of logistics and manpower. Training volunteers, students or other community members in sea turtle knowledge and empowering them to conduct independent awareness programmes is another possible initiative. This has the potential to multiply the efforts of an organisation in the long term without the need for continuous output. To overcome the issue of the lack of trained personnel, establishing skill-based volunteering to attract professionals such as educators, content creators and graphic designers is a great way to fill in vacancies for programme hosts, programme development, event planning and so forth. By combining these approaches, organisations can overcome their challenges and sustainably extend their outreach efforts to foster greater impacts.

Limitations & Future Research

The following limitations in this study may be addressed in future research. Due to the time constraints of the authors, the scope and accuracy of this review may be limited as the documentation of outreach efforts is highly dependent on the transparency and activeness of each organisation in updating its annual reports, websites and social media. Some organisations such as WWF-Malaysia with more manpower and followers update their digital platforms more actively than others. Few organisations update their organisation activities via annual reports on time, while others fail to produce annual reports probably due to their lack of manpower and time. Other organisations may be inactive on digital platforms altogether and thus were not sampled. In addition, some social media posts of biodiversity programmes were excluded from this analysis due to the vague descriptions that may or may not include sea turtle-related activities. These issues may lead to biases in the dataset and limit the scope of this review. In future analyses, sufficient time should be allocated for a thorough analysis of the activities of each organisation to account for delays in virtual updates, and direct engagement with each organisation to minimise biases and gaps in the data collection. Moreover, in-depth analyses of the strategies employed in each programme conducted by the organisations and their impacts will be beneficial. In this study, limited literature on knowledge application in conservation awareness can be found and therefore would be a good topic to delve into as well.

CONCLUSION

As a sea turtle nesting hotspot, Malaysia is experiencing a decline in Green and Hawksbill nesting populations, highlighting the urgent need for effective awareness programmes to promote sea turtle conservation and civic engagement. The evidence presented in this paper indicates that school and youth outreach programmes must be prioritised by more sea turtle

conservation entities, as these initiatives are of utmost importance for shaping conservation attitudes in younger generations. Moreover, the majority of organisations were found to employ multiple outreach strategies, enhancing the effectiveness of their programmes. Efforts to secure sufficient funding and manpower or maximise the use of limited resources must be emphasised to enable organisations to further broaden their outreach focuses, raise more extensive awareness and counter sea turtle population declines. Future studies should include an analysis of the specific strategies adopted in each awareness programme conducted by each organisation and their effectiveness. Conducting virtual or verbal interviews with the personnel(s) from each organisation can refine these findings. These insights will help determine the most effective framework for sea turtle outreach programmes in Malaysia, and reduce anthropogenic pressures on sea turtle populations.

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