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Marine resource recovery in Southern Thailand during COVID-19 and policy recommendations

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ARTICLE INFO
Keywords: Marine resource recovery COVID-19 Sustainable tourism management Marine resource sustainability Thailand

ABSTRACT
COVID-19 and subsequent government health containment measures have slowed down economic activities worldwide, particularly tourism. With the number of foreign tourists entering Thailand during 2020 and 2021 greatly diminished, the number of tourists at marine and coastal attractions in Southern Thailand has declined as well. This study found evidence of a relationship between the decline of the number of tourists and marine resource recovery. This recovery appears in the form of cleaner beaches, clearer seawater and increased sighting of marine animals. Between 2020 and 2021, official reports found increased sighting of dugongs, dolphins, blacktip reef sharks, whale sharks, leopard sharks, sea turtles, green turtles, hawksbill turtles, and false killer whales at marine national parks in Southern Thailand. The study also found that, prior to the COVID-19 outbreak, the number of tourists at Patong Beach and Maya Bay exceeded their tourism carrying capacities. Finally, this study proposes eight policy measures related to tourism management for marine resource sustainability: conservation and recreation zoning, enforcing marine park closure, redesigning marine park entrance fee systems, ensuring adequate recreational facilities, stricter enforcement of the law, promoting alternative tourism sites, encouraging more inclusivity and participation in decision making processes, and enhancing public awareness.

1. Introduction

With a total of 2614 kilometers of shoreline and 936 islands, Thailand is rich in marine resources and tourist destinations [26]. The more well-known marine destinations in Southern Thailand include the James Bond Island, Koh Samui Island, Patong Beach, Phi Phi Island, and Maya Bay. Each year, marine resources in Southern Thailand attract more than 50 million tourists. Although tourism generates significant income for the Thai economy, it also exerts pressure on marine resources and the environment.

In Thailand, tourism affects marine resources and the environment in several ways, such as, coral damage, collecting coral for souvenirs, solid waste generation, wastewater discharge, seagrass damage, beach littering, visual pollution and marine littering [26,29,39]. Moreover, tourism-related urbanization at coastal areas in the Eastern region of Thailand also imposes negative impacts on climate change resilience of the community, such as, impact on water scarcity through intensive use [27]. Maya Bay, where the Hollywood movie ‘The Beach’ starring Leonardo DiCaprio filmed one of its scenes, hosted more than one million visitors in 2017. As a result, the beach at Maya Bay was severely disrupted. The deterioration at Maya Bay included tourist overcrowding, conflicts between boat docking and swimming, coral destruction from snorkeling and use of illegal suntan lotion, fish capturing for photographs, fish feeding, fishing, seawater deterioration, and insufficient restroom and garbage disposal facilities. These events eventually led the Thai marine park authority to close Maya Bay from visitation in July 2018 [9].

The COVID-19 outbreak that began in early 2020 affected the global community far more than the Subprime Mortgage Crisis or the Asian Economic Crisis. With a sharp reduction in both international and domestic travels, lockdowns, and working from home, COVID-19 significantly affected the wellbeing of societies around the world.

In the fishing industry, COVID-19 resulted in a decrease in fishery demand and had negative impacts on the seafood industry in many countries, such as, small-scale fisheries in Mexico [20], salmon production in Chile [33], fisheries in the European Union [19], the aquatic food system, aquaculture industry, and small-scale fisheries in Bangladesh [14,17,36], the aquatic food value chain in Asia and Africa [3], and the livelihoods and food security in the Republic of Vanuatu [35]. The impact of COVID-19 on marine pollution, particularly the
disposal of sanitary masks, still remains unclear. Estimates show an increase in sanitary masks that may end up in the oceans [7], but other studies find no evidence of COVID-19 related products leaking into marine environment [28].

Despite all these negative global impacts, some countries took the opportunity of decreased tourism and fishing demands to rehabilitate their oceans. For example, the United Kingdom, experiencing the negative impacts of COVID-19 in the commercial fishery industry, saw the opportunity to rehabilitate the fishery stocks by realigning fishery policies for future sustainability [18]. Higgins-Desbiolles [16] also suggests that the COVID-19 global shutdown should provide an opportunity to rethink and reset tourism towards a better pathway for the future. This pandemic may be an opportunity for Thailand as well. In Thailand, right after the COVID-19 outbreak and the large reduction in tourism, Thai media began reporting increases in marine animal sighting in several parts of the Southern Thai oceans (Fig. 1). Linking the decline of tourist visitation to the increased marine animal sighting is important as it provides evidence that tourism is a threat to marine animals. Thus, if more concrete evidence can be collected to support this negative linkage between tourism activities and the wellbeing of marine animals, it will enable the Thai marine park authority to propose a stronger argument in favor of tighter regulations over tourism activities as a means for sustainable marine resource management.

Previous pandemic events, such as, SAR or Cov-2 virus, demonstrated that decrease in human activities in marine ecosystems tends to have positive impacts on marine resource recovery. Coll [8] and Kemp et al. [18] illustrate that when the oceans are not disrupted, marine ecosystems can improve, with more frequent wildlife sightings such as baleen whales, dugongs, manatees, toothed whales, orcas, and dolphins, as they appear in unexpected areas. These increases in marine animal sighting may be due to reductions in accidental deaths, collision with boats, underwater noise and marine traffic, and fishing effort [8]. Hall [11] also recognizes that excessive growth in tourism can lead to deterioration at tourist destinations. This observation supports the argument of overtourism and a need for degrowth in tourism activities.

With this rationale, this study asks three research questions. First, is there evidence linking the level of tourism and sighting of marine animals before and during the COVID-19 pandemic? Second, do tourism activities at the study sites exceed their tourism carrying capacities? Third, what are the policy measures that will gear marine tourism and marine resource management towards sustainability?

The contribution of this study is to provide strong evidence for Thailand to recognize the cost of overutilization of marine resources and the need to tailor marine tourism policy measures to recognize the natural ecological limit. An important message this study aims to communicate to governments all around the world is that ‘COVID-19 provides an opportunity for marine policy adjustment leading to a healthier marine resource today and sustainable tourism tomorrow’ [8].

Five marine recreational sites in Southern Thailand were selected for this study: Patong Beach in Phuket province, Maya Bay, Koh Rok Island, Koh Hong Island in Krabi province, and Koh Libong Island in Trung province. These study sites were chosen because their marine/natural resource endowments are tourist attractions.

2. Methodology

The study contains three components: first, linking the trends of tourism activities with marine animal sighting before and during the COVID-19 pandemic; second, calculating the tourism carrying capacities and compare them with the actual number of tourists; and third, proposing policy recommendations for sustainable marine resource tourism. Although several definitions of resource recovery can be used, this study measures resource recovery based on increases in marine animal sighting compared to historical levels [21]. Because of the short timespan between the start of the COVID-19 pandemic and this study, a healthier ocean will not appear in the form of increased marine animal population. Many megafauna species identified in this study take many years to recover from low population abundance (Lotze, [21]). Rather, the decrease tourism traffic, marine disturbances, accidental deaths, collision with boats, underwater noise, or fishing effort may have led to increased sightings due to change in animal behavior and distribution [8]. These increased sightings are still an encouraging sign of recovery. When marine animals return to the surface and their original habitat ranges, this opens up increased opportunities for breeding, foraging, and creating safe spaces for juveniles.

Fig. 1. Media reports of increased marine animal sighting in Southern Thailand.
(A) As many as 30 false killer whales were sighted at Koh Lanta National Park, Krabi province; source: [37]. (B) A drone survey reported 10 Indo-pacific humpback dolphins near islands in Krabi province; source: [23]. (C) A leatherback turtle nest found at beaches in Phuket and Phang Nga province; source: [2]. (B) An aerial survey reported 10 Indo-pacific humpback dolphins near islands in Krabi province; source: [23]. (D) A drone survey reported 4 dugongs near Hat Chao Mai National Park in Trung province; source: [31].
For the first component, trends of tourism activities and marine animal sightings during the study period are shown. Pearson correlations are also calculated to show if there exist correlations between the number of tourists and marine animal sightings. At Patong Beach, where records on marine animal sightings do not exist because it is located outside national park boundary, trends of tourism activities against seawater quality were used instead.

On recreation carrying capacities, there has been increasing scrutiny on using numerical carrying capacity as a tool for managing recreational resources. McCool and Lime [25] are critical of the use of a numerical carrying capacity, as it may not reflect the appropriate balance between social and biophysical conditions of recreation nor will it reflect the optimum trade-off between the social benefits of the use level and the cost in terms of environmental impact. While such remark has its validity when addressing a specific recreation site, using numerical carrying capacity as a tool to gain an overview assessment of recreation activities is still useful. Calculating numerical carrying capacities based on available secondary data is beneficial in providing cost effective information as to where detailed attention should be directed. Once recreational sites that are heavily visited can be identified, the more detailed analysis of tourism behavior vs. the biophysical impacts can be carried out. In this study, the calculation of carrying capacity serves as a tool to identify recreation sites that need a further looking into.

This study adopts two measures of the tourism carrying capacity calculations: Physical Carrying Capacity (PCC) and Real Carrying Capacity (RCC) as indicated in Eqs. (1) and (2) [22,40].

\[
PCC = (A/a) \times R_f \tag{1}
\]

Where \(PCC\) = Physical Carrying Capacity (the number of visitors per day).

\(A\) = recreational area at study sites (square meters)

\(a_i\) = recreational area recommended for a visitor (square meter per visitor)

\(R_f\) = rotation factor (the number of rounds of visitation each site can accommodate per day calculated by operating hours per day/average visitation hours per visitor). \(R_f\) takes the value of 1 for whole day recreation.

Real Carrying Capacity (RCC) measures PCC and also takes into consideration the number of days that can reduce visitation at the recreational site – the correction factors. The study considers two limiting magnitudes that give rise to correction factors \((C_f_i)\) that reduce recreational visitation: the number of rainy days per year and the number of thunder days per year. The total magnitude is the number of days in a year, 365 days.

\[
RCC = PCC \times C_f_1 \times \ldots \times C_f_n \tag{2}
\]

Where \(RCC\) = Real Carrying Capacity (the number of visitors per day).

\(C_f_i\) = correction factors \(i\)

\(L_m_i\) = limiting magnitude of factor \(i\)

\(T_m_i\) = total magnitude of factor \(i\)

PCC shows the maximum number of tourists recommended while RCC takes a close examination of the actual maximum number of tourists recommended by deducting days that recreational sites are out of service due to factors such as raining and thunders. Given all the five study sites are located in Southern Thailand that tend to receive higher precipitation than other parts of the country, RCC will be a more preferred measure of carrying capacity.

On policy recommendations, the study uses in-depth interviews with various stakeholders in marine resource management and marine tourism. Six groups of stakeholders are included in the in-depth interviews: municipalities, national park offices, marine and coastal resource offices, tour companies, local villages, and volunteer groups. The in-depth interviews cover discussion on the suitability of policy measures and implementation. The suitability of policy measure and implementation is assessed in four separate areas: legal feasibility, site suitability, local acceptance, and business acceptance. After the in-depth interview each policy measure is evaluated for each area separately whether such policy measure is (1) feasible/suitable/acceptable, (2) feasible/suitable/acceptable but needs further improvement, or (3) infeasible/unsuitable/unacceptable.

3. Study sites and data collection

The study adopted a five-year timeframe between 2017 and 2021 to cover activities both pre and during the COVID-19 pandemic. Establishing an appropriate geographical unit of analysis is essential as the volume of tourists need to be mapped against marine animal sightings and recreational areas. The marine animal sighting data is collected by the national park authority. The national park authority patrols the ocean to observe its condition every other day (around 14 days per month) by speed boat and inflatable boats. Each patrol involves five to seven officers who collect data, such as, Global Positioning System (GPS) location, marine animal sighting, or marine animal threats and deaths. The coastal resource authority, on the other hand, flies small aircraft using line transect method for a duration of 5–6 days. The line transect flights are carried out once a year only.

In linking the trends of tourism activities with marine animal sightings, the study adopts an island as the unit of analysis. Table 1 shows all the five marine study sites: Patong Beach, Maya Bay, Koh Rok Island, Koh Hong Island and Koh Libong Island. Patong Beach and Maya Bay are not islands per se, but they are included because of their policy relevance. The locations of these five study sites are shown in Fig. 1.

| Beach                  | Island        | National Park            | Province |
|------------------------|---------------|--------------------------|----------|
| Patong Beach           | on mainland   | outside national park    | Phuket   |
| Maya Beach             | Maya Bay      | Hat Noppharat Thara-Mu Ko Phi-Phi National Park | Krabi |
| Koh Rok Island         |               | Mu Koh Lanta National Park | Krabi |
| Koh Hong Island        | Island        | Than Bok Khorani National Park | Krabi |
| Koh Libong Island      | Island        | outside national park    | Trang    |

1 Marine Water Quality Index (MWQI) measures water quality based on a weighted score of eight parameters: 1) dissolved oxygen, 2) coliform bacteria, 3) phosphate-phosphorus, 4) nitrate-nitrogen, 5) ammonia-nitrogen, 6) pH, 7) suspended solid, and 8) temperature. The weighted scores are then ranked in five categories: very good (90–100), good (80–89), fair (50–79), poor (25–49), and very poor (0–24).
the data on the number of tourists and marine animal sightings were obtained from the marine and coastal resource office (Fig. 2).

On tourism carrying capacities, the study adopted a beach as the unit of analysis as tourism carrying capacities are specific to each recreational area. The recreational areas (A) are measured in square meters at each study site and the rotation factors \( (R) \) were obtained from national park offices. The Ministry of Tourism and Sports provided the values for the suitable recreational area per visitor \( (a_u) \). The number of rainy days per year \( (L_m_1) \) and the number of thunder days per year \( (L_m_2) \) were from the Thai Meteorological Department offices in the area. The total magnitude factor is 365 days per year.

On policy recommendation, the study interviewed a total of 28 offices and groups of people as indicated in Table 2. During the in-depth interviews, officers, staff, and respondents were asked to discuss the suitability and feasibility of policy measures that will help balance tourism and marine resource sustainability. The policy measures discussed during the in-depth interviews are listed in Table 4 and the respondents were also given opportunities to suggest other measures they felt suitable. The in-depth interviews at Phuket province took place during December 16–17, 2020, Krabi province during March 8–11, 2021 and Trung province during March 15–18, 2021.

4. Results

4.1. Marine resource recovery

Patong Beach, a very popular tourist destination in Southern Thailand, is located on the mainland of Phuket province. Each year, Patong Beach hosts around five million visitors, but after the implementation of COVID-19 measures, the number of tourists drastically declined but started to return again towards the end of 2020 when the situation eased (see Fig. 3). Being a public beach on the Phuket mainland, Patong Beach is under the jurisdiction of Patong Municipality. As reports on the marine animal sighting at Patong Beach were unavailable, the study mapped the number of tourists against seawater quality. Prior to COVID-19, the seawater quality, measured as MQWI at Patong Beach from station 1–3, showed mixed results, but during COVID-19, the seawater quality improved at all three stations (see Fig. 3). The level of Biochemical Oxygen Demand (BOD) also improved significantly from

![Fig. 2. Map indicating the locations of the five study sites.](image_url)
Fig. 3. Number of tourists and seawater quality at Patong Beach, Phuket province. Note: BOD = Biological Oxygen Demand. It is a measure of water quality.

Fig. 4. Marine resource recovery and the number of tourists at the four national park study sites. (A) Maya Bay, Krabi province (B) Koh Rok Island, Krabi province (C) Koh Hong Island, Krabi province, and (D) Koh Libong Island, Trung province. Patong Beach is not presented here as animal sighting data is not available, therefore water quality has been used to indicate resource recovery (see Fig. 3).
around 120 mg/l before COVID-19 to only 7.9 mg/l in December 2020. This indicates that tourism has a strong negative impact on seawater quality and most likely the health of marine resources as well.

Maya Bay is also popular among tourists as it was used in one of the scenes in the movie ‘The Beach’ starring Leonardo DiCaprio. Fig. 4(A) shows the number of tourists at Maya Bay reached as high as 1.2 million in 2017. With the continued deterioration in beach quality, the national park authority decided to close Maya Bay in July 2018 [9]. However, despite the close down of Maya Bay, a number of tourists (shown as the dotted line) still wished to cruise by and catch a glimpse of Maya Bay at a distance. With a decline in the number of tourists in 2020, the authority recorded as many as 132 blacktip reef sharks and a small number of leopard sharks, hawksbill turtles, and green turtles around Maya Bay. The Pearson correlation coefficients (r) between the number of tourists and marine animal sightings are negative, as expected. The p-values of Pearson correlations coefficients are also given in Fig. 4(A).

In 2020, the number of tourists at Koh Rok Island declined by about a half compared to the previous years (see Fig. 4B). At Koh Rok Island and Koh Hong Island, the number of tourists began to decline since 2019 even before COVID-19 incidence that took place in the early quarter of 2020. As a result, 18 false killer whales, 2 whale sharks and 2 hawksbill turtles were sighted in 2020 when their sightings were not reported in the previous years. In 2020, Koh Hong Island experienced the similar decline of the number of tourists and reported sighting of 296 blacktip reef sharks when only 60 were sighted in 2019 and none were sighted during 2017–2018 (see Fig. 4C). The Pearson correlation coefficients between the number of tourists and marine animal sighting are negative, as expected. Lastly, following the decline in the number of tourists at Koh Libong Island in 2020, the number of dugongs sighting rose from 186 in 2019–221 in 2020 (see Fig. 4D). However, sighting of other marine animals, such as, whale shark, dolphin and sea turtle at Koh Libong Island fluctuated during the study period.

The negative correlations between the number of tourists and marine animal sighting are confirmed by their p-value statistics (at 90% significant level) at Koh Rok Island (B) for false killer whale, whale shark and hawksbill turtle, Koh Hong Island (C) for blacktip reef shark, and Libong Island (D) for dugongs and whale sharks. The correlations between the number of tourists and other marine animals are still negative, although not supported by p-value statistics.

### 4.2. Carrying capacity

Table 3 shows the calculations of tourism carrying capacities measured as PCC and RCC at all five study sites. Based on the suggested recreational standard of the Ministry of Tourism and Sports, Table 3 shows that Patong Beach is able to host 7500 tourists per day and 2952 tourists per day when taking into consideration rain and thunder. At Maya Beach, their tourism carrying capacities are 1040 tourists per day and 436 tourists per day when taking into consideration rain and thunder. Fig. 5 shows the actual number of tourists at Patong Beach exceeded their carrying capacities for all months even during the low tourist seasons. Only during COVID-19 did the number of tourists at Patong Beach fall within the carrying capacities. At Maya Beach, the number of tourists were more than triple the carrying capacity before it was closed down in 2018 (see Fig. 6). As for Koh Rok Island, Koh Hong Island, and Koh Libong Island, the numbers of tourists did not exceed their carrying capacities both before and during COVID-19.

At Koh Rok Island, the average tourist visitation per day before COVID-19 was 243 which is well below the RCC of 7794 visitors per day and during COVID-19 the average number of tourists dropped to around 85 visitors per day. At Koh Hong Island, the average tourist visitation per day before COVID-19 was 348 which is still below the RCC of 584 visitors per day and during COVID-19 the average number of tourists dropped to around 161 visitors per day. And, at Koh Libong Island, the average tourist visitation per day before COVID-19 was 561 which is still below the RCC of 1731 visitors per day and during COVID-19 the average number of tourists dropped to around 235 visitors per day.

### 4.3. Policy measures and implementation

The study undertook in-depth interviews with 28 agencies at the study sites. The in-depth interviews enabled the local staff, entrepreneurs, and local people to share their views on marine tourism policy measures in four areas: legal feasibility, site suitability, local acceptance, and business acceptance. The color-code in Table 4 represents the views of the majority of the respondents at all the five study sites. The opinion of the respondents from all the study sites tends to conform to the same direction, hence allowing the study to assign a color-code to each aspect of each policy measure. However, the respondents reported that implementation of each policy measure at each study site may vary depending on the local circumstances.

All agencies interviewed agreed that tourism should be geared towards marine resource sustainability. However, there is a need for a well-designed policy measure and implementation that balances the need for income generation today against marine resource sustainability tomorrow. Table 4 shows the results of the in-depth interview.

Tourism licensing is essential as it requires tour businesses to observe the code of conduct. However, violations are sometime observed, and a more effective enforcement of the code of conduct is needed. Zoning is seen as an essential element of marine resource management, but enforcing a maximum allowable number of tourists can only be implemented at marine national parks where laws are already in place and controlling tourist arrival on the islands is practical. However, imposing the maximum allowable number of visitors at public recreational sites, such as public beaches, remains a problem partly because there are no laws that prohibit tourists from entering public beaches, and preventing people from entering public beaches is also physically difficult. Similarly, while closing recreational sites for a given period is a suitable measure for island recreation, such measure cannot be implemented on public beaches outside national park jurisdiction.

There is skepticism with regards to imposing parking fees for public use of the beach areas.
recreational sites as an indirect measure to control the number of tourists at public beaches. Site accessibility and lack of local acceptance makes this measure impractical. This is because it is known among the Thai people that the Thai law declares beaches to be public property and openly accessible. It was also agreed that more efforts are needed on strict law enforcement, raising public awareness, and providing rewards and incentives for environmentally friendly practices. A study at Koh Tao Island, Trad province, also found similar results. The authority and local residents at Koh Tao also view recreational zoning, limiting the number of tourists, creating public awareness, and regulation enforcement as key policy measures for marine resource sustainability [39].

5. Policy recommendations

Preparing a set of policy prescriptions is key in marine resource management and sustainable tourism. Gearing tourism towards sustainability and becoming environmentally friendly is interdisciplinary in nature, encompassing of economic, social, cultural, political and environmental considerations. While combining views of different disciplines can be conflicting and involves trade-offs between objectives, a well-designed policy prescription where disciplines are well integrated and complement one another can actually enhance policy efficacy. Bramwell et al. [5] describes the evolution of sustainable tourism studies and shows that sustainable tourism general involves issues, such as, altering human behavior or attitude, social and production systems, transition from the old path to new path creation, governance system, interconnection between human and natural systems, and ethical and political considerations. In connection with COVID-19, several studies argue that tourism of pre-COVID-19 era may be characterized as over-tourism and suggest for ways to rethink tourism leading to degrowth in tourism trend. (Higgins-Desbiolles [16], [32,34]).

Marine resource recovery during the COVID-19 pandemic at five study sites in Southern Thailand shows a strong link between the number of tourists and frequency of marine animal sightings. This information, coupled with the fact that the number of tourists at Patong Beach and Maya Bay also exceeded their carrying capacities, are crucial in supporting further investigations at these two study sites as to how tourism can be better managed leading to sustainability. Drawing the
observed healthier ocean following the decline in the number of tourists led the study to propose ways to ease the tourism pressure on marine resources [4]. For successful implementation, policy measures also need to conform to the local conditions, namely, legal feasibility, site suitability, local acceptance, and business acceptance [21]. Therefore, this study finds that successful marine resource policy measures need to be indigenous and may need to vary with time and space. An experience drawn from Easter Island, Chile, shows that even the traditional Rapanui fishing management also needed to be modified to meet new challenges facing their fishery sector today [1].

Based on the findings of this study and the in-depth interviews, this study hereby proposes eight policy recommendations that aim to ease the tourism pressure on marine ecology and promote sustainability in tourism and marine resource management.

### 5.1. Conservation and recreation zoning

Establishing zones where recreation is separated from conservation is essential for minimizing negative externalities from tourism activities and conservation as well as maintaining a well-balanced marine resource utilization. Zoning should be designated for fishery, aquaculture, beach recreation, scuba diving and snorkeling, vessel routes, vessel docking, park conservation areas, coral and seagrass conservation, and nesting and nursery areas. Zoning is currently practiced in some coastal areas in Thailand, such as, swimming vs motorized sport areas, or sea-grass conservation areas, thus, expanding and enforcing the use of zoning as a tool for marine resource conservation is promising.
5.2. Enforcing marine park closure

Evidence from increased marine animal sighting during COVID-19 supports the view that giving marine parks a break from tourism will lead to healthier marine ecosystems. Marine park closure is already practiced in Thailand, but such measure can be extended without significant impacts on tourism. Marine parks can be closed for a period of months or years. If marine park closure is well planned in advance and the schedule is known to the public in advance, tour businesses can redesign their tour package programs to divert tourism to other marine parks that are in operation. Tourists can also make arrangements in advance and be minimally affected.

5.3. Advancing the marine park entrance fee systems

Most national parks in Thailand adopt some form of an entrance fee system. Marine national parks currently charge an entrance fee higher than that of inland national parks. This entrance fee system is useful in communicating congestion information to the tourists as well as incentivize tourists to visit the destinations during less congested time. Entrance fee differentiation can be established between weekend vs. weekday visitation, high season vs. low season, or between fragile vs. conventional marine sites. Entrance fee differentiation will help even out tourism traffic throughout the year and lessen the pressure on marine resources. The increase in revenue collected will also help strengthen marine park monitoring and management. Grilli et al. [10] conducts a willingness-to-pay study to advocate for using payment for ecosystem service for sustainable tourism projects and found that charging an entrance fee is feasible. It is also important to take into consideration the impact of marine park entrance fee systems on the low-income visitors and the local community. In these cases, entrance fee exemption or discounted entrance fee can be established for local citizens, children, the elderly, and other groups as deemed appropriate by the park authorities. Entrance fee exemption or discounts can be used during some public holidays, such as, labor day or national day.

5.4. Ensuring adequate recreational facilities

To lessen the adverse impacts of tourism on marine ecology, authorities should provide adequate recreational facilities for tourists. Such facilities include, for instance, clear boundary marking, warning and instruction signs, restrooms, garbage disposal, closed-circuit camera systems, global position system for vessels, or weather warning systems. Many tourists want to be involved in conservation efforts, but the authorities must provide adequate facilities that enable them to do so.

5.5. Strict enforcement of the law

Despite the best conservation efforts, violations of laws and regulations are inevitable. Frequent reports of violations include, for instance, fishing activities within marine national park areas and discarded plastic water bottles found in the ocean. With modern technology such as closed-circuit camera systems, law enforcement can be carried out more effectively and at a much lower cost. The use of closed-circuit camera systems will also store evidence that facilitates further litigation.

5.6. Promoting alternative tourism sites

To ease the tourism pressure on marine resources, there is a need for the government, together with the private sector, to invest in substitute recreational sites as a means to diversify tourism activities. These additional tourism sites may include, for instance, marine animal hatchery center, coral and seagrass rehabilitation center, mangrove or coastal walking route, local cultural heritage center, water park, local markets, or cuisine and street walk. Engaging the local communities in providing sustainable tourism services has been recognized as an effective and beneficial. Such local community-centered tourism or local food tourism is recognized to be an important part of sustainable tourism. Cakar, Uzut [6] In Fiji, it is found that the tourists place high value for community-based tourism management practices [38].

5.7. Encouraging more inclusivity and participation in decision making processes

Currently, the Thai authority manages marine resources and tourism via committees comprising of representatives of agencies. However, many local enterprises, food vendors, entertainment personnel, and taxi drivers who are at the forefront of tourism are often left out of policy discussion. Including the local stakeholders in policy discussions and decision making will not only help gather useful information, but is prerequisite for successful and effective policy implementation [12,21]. More importantly inclusivity and participatory are crucial as it provides a sense of local ownership and good governance in marine resource and tourism management. Collaboration between regional and local government, and local stakeholders including capacity building programs will strengthen coastal resource governance [27]. Community-driven tourism projects that are well managed can benefit the local community as well as promoting sustainable livelihood. Matiku et al. [24].

5.8. Enhancing public awareness

The need to instill public awareness on marine resource conservation and a sense of public ownership is fundamental in conservation. Although much effort has been invested, the government, local communities, and civil society must continue shaping the general public’s mindset into one where sustainable use of resources is key in maintaining long term wellbeing. Altering people’s attitude and behavior through education will always be a key component in achieving sustainability [5,12,13].

6. Conclusion

The event of COVID-19 enabled this study to establish a link between tourism and marine animal sightings. With a drastic decline in the number of tourists at marine parks, there are official reports of increase marine animal sightings at many marine national parks in Southern Thailand. This linkage provides a support for exercising policy measures that are designed to lessen the tourism pressure on marine national parks and provide marine ecology adequate resting periods. This line of policy measures, whilst seeming to impose some negative impacts on tourism now, will result in a healthier marine ecosystem and a brighter tourism prospect in the future [8]. On carrying capacity, the study finds the number of tourists at Patong Beach and Maya Beach has exceeded their carrying capacities. This information calls for a more thorough examination leading to preparation of appropriate measures at these two sites.

This study recommends eight policy measures that are designed to balance tourism and marine resource conservation, as follows: conservation and recreation zoning, enforcing marine park closure, advancing marine park entrance fee systems, ensuring adequate recreational facilities, stricter enforcement of the law, promoting alternative tourism sites, encouraging more inclusivity and participation in decision making processes, and enhancing public awareness.

COVID-19 provides marine parks a resting period and enables marine animals to return to cleaner oceans with less disturbances. After COVID-19 when health containment measures subside, marine tourism should not return to its previous pattern or what may be referred to as path dependence, but assume a new path, or path creation, where tourism is better designed to coexist with healthy marine ecology and return Southern Thailand, once again, to the land of the long blue sea.
Declaration of interest

None.

Acknowledgements

The author would like to thank the following agencies who provided secondary data and opportunities for in-depth interview: the Ministry of Tourism and Sports (DOT), the Department of Marine and Coastal Resources (DMC), the Department of National Park, Wildlife and Plant Conservation (DNPC), Thai Meteorological Department (TMD) and Patong Municipality. The author appreciates the help of Associate Professor Somporn Isvilanonda of the Knowledge Network Institution of Thailand (KNIT) who helped coordinate research funding from the Thailand Research Fund (TRF), Thailand — research grant ID number 571/2563. Last but not least, the author would like to thank the research staff of Thailand Development Research Institute (TDRI) who assisted with the data collection and in-depth interview: Kanjana Yasen, Thipawan Keawmesri, Prinloyat Laengchaoen, Promphat Bhumiwat and Patree Wiwitoonchart.

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