

A REVIEW

Effectiveness of Marine Parks as a Fisheries Management Tool: Status and Issues

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Abstract: A marine park is an area of the sea zoned two nautical miles from the shore at lowest low tide, except for Kapas Island in Terengganu, Kuraman Island, Rusukan Besar and Rusukan Kecil Islands in Labuan which are zoned one nautical mile each from the shore at lowest low tide. To date, waters of 42 islands in Malaysia have been gazetted as marine parks. Marine parks have garnered much attention among researchers and marine advocacy groups as a tool for protecting marine habitats, preserving unique marine ecosystems and fishery management. There is a strong scientific consensus that they increase biodiversity, contribute towards increased abundance of fish, guard against the shortcomings of other management tools and protect against the risk of fishery collapse. In addition to the claims of increased productivity, experiences at some of the marine parks around the region have shown that protected spots recover very quickly and experience a rapid increase in fish numbers in the first year or two after disturbances. While marine parks may offer promise for the conservation and management of marine fisheries and their habitats, much is unknown about what benefit has been derived from existing marine parks for the conservation and management of marine fish and their habitats (other than in small, localised areas) in Malaysia. For example, some of our marine parks have been in existence for more than 20 years, yet little data exists regarding their overall performance on fisheries conservation. As such, this paper provides an overview of the current status and issues facing Malaysian marine parks in conserving and sustaining fisheries.

Keywords: marine park, conservation, management tool, fisheries.

Abstrak: Taman laut adalah kawasan perairan yang dizonkan sejauh dua batu nautika dari tikas air surut terendah, kecuali Pulau Kapas di Terengganu, Pulau Kuraman, Pulau Rusukan Besar dan Pulau Rusukan Kecil di Labuan yang dizonkan sejauh satu batu nautika dari tikas air surut terendah. Taman laut ditubuhkan untuk melindungi dan memulihara pelbagai habitat dan hidupan marin akuatik. Hari ini, perairan di 42 pulau-pulau di Malaysia telah digazetkan sebagai taman-taman Laut. Ianya telah menerima perhatian yang khusus daripada pelbagai pihak tentang perlunya memelihara ekosistem dan habitat marin demi membantu meningkatkan sumber perikanan negara. Terdapat kajian yang membuktikan kawasan taman laut dapat memberikan perlindungan kepada flora dan fauna akuatik, serta memelihara dan menguruskan tempat pembiakan semula jadi dan habitat hidupan akuatik, membenarkan pertumbuhan semula hidupan akuatik di mana kepupusan telah berlaku, menggalakkan kajian dan penyelidikan saintifik, mengekalkan dan mempertingkatkan sistem dan daya pengeluaran persekitaran yang masih terpelihara, serta menyelaraskan aktiviti rekreasi dan lain-lain aktiviti bagi mengelakkan kemusnahan persekitaran yang kekal. Walau bagaimanapun, kebanyakan laporan ini adalah daripada negara-negara lain. Tidak banyak laporan mengenai keberkesanan taman-taman laut di Malaysia. Oleh itu, kertas kerja ini akan memberikan tumpuan kepada status dan cabaran yang dihadapi dalam mencapai objektif penubuhan taman-taman laut di Malaysia dalam meningkatkan sumber perikanan negara.

Introduction

The general decline in marine resources worldwide has triggered a demand for a change in the way ocean resources are managed. Ecosystem-based management approaches have emerged using marine protected areas (MPAs) as the main tool. Marine protected areas are an important component of the ecosystem-based approach to conserving marine resources and can be implemented in a great range of economic and social conditions. It also provides a legal and institutional framework to deal with the complex problems that exist in coastal zones towards sustainable development (Jorge and Bruce, 2010). One of the other terms used in similar context is 'marine park'. The term 'marine park' is basically used to describe an area of sea sometimes protected for recreational use, but more often set aside to preserve a specific habitat and ensure the ecosystem is sustained for the organisms that exist there. Some literature also uses the term 'marine reserves' which simply mean "no-fishing" in the marine environment or areas that are permanently closed to fishing activities.

A marine park in Malaysia is defined as a protected area of the sea zoned two nautical miles from the shore at lowest low tide (except for Kapas Island in Terengganu; Kuraman Island, Rusukan Besar and Rusukan Kecil Islands in Labuan which are zoned one nautical mile from the shore at lowest low tide) designated and managed to achieve specific conservation objectives. To date, the waters of 42 islands have been gazetted as marine parks under the federal jurisdiction. Some of the major functions of marine parks in Malaysia are as listed below:

- a. Accord special protection to aquatic fauna and flora, to preserve and manage the natural breeding grounds and habitat of aquatic life, with particular regard to rare and endangered species.
- b. Allow natural regeneration where depletion has occurred.
- c. Promote scientific study and research.
- d. Preserve and enhance the undamaged system and productivity of the environment.
- e. Regulate recreational and other activities in order to avoid irreversible damage to the environment.

The goal of this paper is therefore to review the effectiveness, status, as well as to discuss some of the major issues facing the marine parks in Malaysia as a fisheries management tool. This is mainly because much is unknown about what benefits have been derived from existing marine parks for the conservation and management of marine fish and their habitats. This subject has not been given much emphasis compared to some of the other benefits of marine parks, including the maintenance of biodiversity, ecosystem structure and enhanced tourism, which have been reviewed on many other occasions.

Methodology

This paper is prepared based on analysis of existing literatures on the management of marine parks and from the collection of information on marine parks in Malaysia from key government agencies. Experiences from published work on international practices and success stories on the subject matter are also shared in this paper. The analysis is basically divided into few parts in this paper. The first part includes the experience elsewhere on marine protected areas as successful fisheries management tool. The second part highlights the nature, issues and challenges faced in Malaysia by taking the example of marine parks under the jurisdiction of the Federal government. The third part provides some recommendations to improve the situation and address the challenges faced on fisheries management in the country using marine parks as one of the important management tools.

Establishment of marine parks in Malaysia

Though parks and reserves were established as early as in 1925, they confined only to mainland areas (Jasmi, 1996). Only in 1983, water areas around Redang Island, Terengganu were gazetted as Fisheries Protected Area for the conservation of the natural habitats surrounding the island. Later in 1985, water areas of surrounding 21 islands in Terengganu (including Redang), Kedah, Pahang, and Johor were also gazetted under the Fisheries Act 1963. This act was then replaced by the Fisheries Act 1985 with the objective to cater for the rapid expansion of the fishing industry as well as for the management and protection of marine habitats and other marine resources. Under this act, a special provision for the establishment of marine park has been made under Part IX on Marine Parks and Marine Reserve (*Section 41 45*) (Najib *et al.*, 2002). Following this, water areas of two nautical miles surrounding 38 islands in Kedah, Terengganu, Pahang, Johor and Labuan were gazetted as marine parks in 1994; before adding two more islands in Terengganu to the list in 1998.

In 2004, the Marine Park Section was shifted from the Fisheries Department to a new management under the Ministry of Natural Resources and Environment (NRE). Effective from July 2007, Marine Park Section officially became the Department of Marine Park Malaysia. In addition, two more islands in Terengganu were then gazetted in year 2007, making a total of 42 marine parks islands under the Federal management. Table 1 summarises the history of the marine parks establishment in Malaysia, and Table 2 shows the number of islands as well as its area gazetted as marine parks.

Table 1: History of the establishment of marine parks in Malaysia

| Year | Steps to improve the management of marine parks in Malaysia |
|------|--|
| 1983 | <ul style="list-style-type: none"> Realising marine fisheries resources was decreasing and recognising the importance of coral reefs areas as critical habitat zone, the Fisheries (Prohibited Area) Regulations was enacted under the Fisheries Act 1963. |
| 1985 | <ul style="list-style-type: none"> Redang Island declared as Fisheries Prohibited Area. Waters stretching 3 km from shore and surroundings 22 islands in Kedah, Terengganu, Pahang, and Johor were declared as Fisheries Prohibited Area. Fisheries Act 1985 enacted to replace the Fisheries Act 1963. |
| 1989 | <ul style="list-style-type: none"> Marine Parks Malaysia Order 1989 established, resulting in the gazettment of Payar Island as marine park. |
| 1993 | <ul style="list-style-type: none"> Fisheries Act 1985 revised to include provisions for gazetting potential areas as marine parks. |
| 1994 | <ul style="list-style-type: none"> 38 Islands in Kedah, Terengganu, Pahang, Johor, and Labuan declared as marine parks under the Fisheries Act 1985. |
| 1998 | <ul style="list-style-type: none"> Nyireh Island and Tenggol Island gazetted as marine park islands in Terengganu under the Marine Park Order 1994 (Amendment 1998), making a total of 40 marine park islands in Malaysia. |
| 2004 | <ul style="list-style-type: none"> Marine Park Section shifted from the Fisheries Department to a new management under the Ministry of Natural Resources and Environment (NRE) with new vision, mission, objectives and functions to complement the overall vision of the Ministry. |
| 2006 | <ul style="list-style-type: none"> The memorandum on the formation of a Department responsible to manage and administer marine parks approved. |
| 2007 | <ul style="list-style-type: none"> Marine Park Section became Department of Marine Park Malaysia on the 16 July. |
| 2008 | <ul style="list-style-type: none"> Yu Besar and Yu Kecil Islands gazetted as marine park islands in Terengganu, making a total of 42 islands. |

Table 2: Number of islands and its area gazetted as marine parks in Malaysia

| State | Gazetted islands | Area (km ²) |
|-----------------------------|------------------|-------------------------|
| Kedah | 4 | 187.73 |
| Terengganu | 13 | 530.29 |
| Pahang | 9 | 676.61 |
| Johor | 13 | 765.65 |
| Federal Territory of Labuan | 3 | 158.15 |
| TOTAL | 42 | 2,318.43 |

Source: Department of Marine Parks, Malaysia

Benefits of marine parks

A very comprehensive classification of MPA benefits is provided in the marine reserve benefits statement by Sobel (1996). It identifies a total of 69 MPA benefits organised into four main categories as listed below:

- Protect ecosystem structure, function and integrity;
- Improve fishery yields;
- Expand knowledge and understanding of marine systems; and
- Enhance non-consumptive opportunities.

Generally, scientists working on the management of fisheries have realized that there are probably few other viable management alternatives available. This is visible from the extensive literature available on the subject matter (refer to Table 3). Furthermore, in many cases, traditional fisheries management (i.e. effort, catch controls) has generally failed to prevent massive overfishing globally. Therefore, marine reserves was seen as areas of the sea that could provide refuges where populations of exploited species can recover and habitats modified by fishing could regenerate (Gell and Roberts, 2003).

Table 3: Selected list of latest reviews on marine reserves with strong emphasis on the role in fisheries management

| Author(s) | Title & Reference |
|--------------------------------------|---|
| Jaworski <i>et al.</i> (2010) | Fish assemblages inside and outside marine protected areas of northern Iceland: protection effects or environmental confounds? <i>Fisheries Research</i> , Volume 102, Issues 1-2, February 2010, Pages 50-59. |
| Williams <i>et al.</i> (2009) | Impacts of a Hawaiian marine protected area network on the abundance and fishery sustainability of the yellow tang, <i>Zebrasoma flavescens</i> . <i>Biological Conservation</i> , Volume 142, Issue 5, May 2009, Pages 1066-1073. |
| Cinner <i>et al.</i> (2009) | Linking social and ecological systems to sustain coral reef fisheries. <i>Current Biology</i> , Volume 19, Issue 3, 10 February 2009, Pages 206-212. |
| Francini-Filho and Moura, (2008) | Evidence for spillover of reef fishes from a no-take marine reserve: An evaluation using the before-after control-impact (BACI) approach. <i>Fisheries Research</i> , Volume 93, Issue 3, 28 September 2008, Pages 346-356. |
| Wielgus <i>et al.</i> , (2008) | Assessing the ecological and economic benefits of a no-take marine reserve. <i>Ecological Economics</i> , Volume 67, Issue 1, 15 August 2008, Pages 32-40. |
| n/a | No-take marine reserves a boon to Great Barrier Reef fish. <i>The New Scientist</i> , Volume 198, Issue 2662, Pages 6-7. |
| Russ <i>et al.</i> | Rapid increase in fish numbers follows creation of world's largest marine reserve network. <i>Current Biology</i> , Volume 18, Issue 12, Pages R514-R515. |
| Harmelin-Vivien <i>et al.</i> (2008) | Gradients of abundance and biomass across reserve boundaries in six Mediterranean marine protected areas: Evidence of fish spillover? <i>Biological Conservation</i> , Volume 141, Issue 7, July 2008, Pages 1829-1839. |
| Patrick and Strydom (2008) | Composition, abundance, distribution and seasonality of larval fishes in the shallow nearshore of the proposed Greater Addo Marine Reserve, Algoa Bay, South Africa. <i>Estuarine, Coastal and Shelf Science</i> , Volume 79, Issue 2, 20 August 2008, Pages 251-262. |
| Cartigny <i>et al.</i> (2008) | The spatial distribution of small- and large-scale fisheries in a marine protected area. <i>Ecological Modelling</i> , Volume 212, Issues 3-4, Pages 513-521. |
| Pollack <i>et al.</i> (2008) | Fishing for social realities - Challenges to sustainable fisheries management in the Cape Horn Biosphere Reserve. <i>Marine Policy</i> , Volume 32, Issue 2, Pages 233-242. |
| Kar and Matsuda (2008) | A bioeconomic model of a single-species fishery with a marine reserve. <i>Journal of Environmental Management</i> , Volume 86, Issue 1, Pages 171-180. |
| Kulbicki <i>et al.</i> (2007) | Opening of an MPA to fishing: Natural variations in the structure of a coral reef fish assemblage obscure changes due to fishing. <i>Journal of Experimental Marine Biology and Ecology</i> , Volume 353, Issue 2, Pages 145-163. |
| Pitchford <i>et al.</i> (2007) | Uncertainty and sustainability in fisheries and the benefit of marine protected areas. <i>Ecological Modelling</i> , Volume 207, Issues 2-4, Pages 286-292. |
| Barrett <i>et al.</i> (2007) | Changes in fish assemblages following 10 years of protection in Tasmanian marine protected areas. <i>Journal of Experimental Marine Biology and Ecology</i> , Volume 345, Issue 2, Pages 141-157. |
| Samoilys <i>et al.</i> (2007) | Effectiveness of five small Philippines' coral reef reserves for fish populations depends on site-specific factors, particularly enforcement history. <i>Biological Conservation</i> , Volume 136, Issue 4, Pages 584-601. |
| Claire (2007) | A note on the ecological-economic modelling of marine reserves in fisheries. <i>Ecological Economics</i> , Volume 62, Issue 2, Pages 242-250. |

However, there are some other journals that argue on the need to differentiate the clear distinction between establishing marine reserves for protection of biodiversity and establishing them for fisheries management. Generally, although there are evidences of positive effects for fisheries attributed to marine reserves, it is clear that there are other benefits beyond fishing. They maintain the aesthetic qualities of reefs for tourism, while also providing sustainable fisheries. For instance, Ray *et al.* (2004) discussed in great details that the successful use of marine reserves requires a case-by-case understanding of the spatial structure of impacted fisheries, ecosystems and human communities, and this demands for careful planning and evaluation processes.

In general, the basic expectation of designating marine parks is that the spatial closure will act as a refuge for local fish communities, enhancing their densities and diversity; which would then have a positive effect on fishery resources in the surrounding waters as adult fish may migrate and/or fish larvae might dispersed beyond the park areas (Roberts *et al.*, 1991). Basically in a fisheries context, one can define seven basic expectations of marine reserves, both inside and outside the reserve (refer to Table 4) (Russ, 2002). In general terms, to be effective as a fisheries management tool, marine reserve should display net export of fish biomass that more than compensates for the loss of fishing area required to set up the reserves. The five expected effects are as listed below.

Table 4: Expectations of marine reserves (Adapted from Russ (2002))

| Effects inside reserves | | Effects outside reserves | |
|-------------------------|--|---|--|
| 1. | Significant lower fishing mortality than in fished areas. | Effects 1- 4 result in net export of adult fishes (the "spillover effect"). | Effects 1- 5 result in net export of eggs/larvae (the "recruitment effect"). |
| 2. | Significant higher density of target species. | These simply arise because higher densities of larger than average fishes occur in reserves and these fishes flux randomly across the unfished - fished boundary. | The result is an enhanced supply of recruits to fished areas. |
| 3. | Significant higher mean size/age of target species. | | |
| 4. | Significant higher biomass of target species. | | |
| 5. | Significant higher production of propagules (eggs/larvae) of target per unit area. | | |

Table 5 for instance represents the total number of fish species recorded in the country's marine park waters in 2007. The numbers recorded has basically increased compared to the figures recorded in a study by Harborne *et al.*, 2000, where a total of 298 species of fishes from 44 families and 132 genera were found in the coral reefs of three marine parks studied at that time (Redang Island, Tioman Island, and Tinggi Island).

Table 5: Fish species recorded in the waters of Malaysian marine park islands

| Marine Park Island | Fish Species |
|--------------------|--------------|
| Redang | 149 |
| Perhentian | 127 |
| Tioman | 233 |
| Tinggi | 219 |
| Total | 728 |

Source: Department of Marine Parks, Malaysia (2007)

Some success stories

Experiences at some of the marine parks around the region have shown that protected spots also recover very quickly and experience a rapid increase in fish numbers after disturbances were removed and vice-versa. For example:

- Buxton and Smale (1989) recorded that the densities of a commercially important sparid fish, *Chrysoblephus laticeps*, were an estimated 42 times higher in the Tsitsikamma National Park in South Africa (established in 1964, making it one of the oldest reserves in the world) than in nearby fishing grounds.
- Alcala and Russ (1990) studying coral reef fishes at Sumilon Island in the Philippines, demonstrated a significant decline in catch rates and total catch after a marine reserve (under 10 years of protection) was heavily fished.
- The densities of 11 fish species in the Scandola Nature Reserve in Corsica were five times higher in reserve than in the fished sites after 13 years of protection, according to the work published by Francour (1991).
- Russ and Alcala (1996) reported some circumstances evidence from monitoring of densities of large predatory coral reef fishes inside and adjacent to a small marine reserve, at Apo Island in the central Philippines over a 10 year period (1983-1993).
- Albogast *et al.* (2004) compared the density of the blackspot snapper, *Lutjanus fulviflamma* (Forsskal 1775) in Mafia Island Marine Park in Tanzania, with adjacent intensively fished areas. The species was four times more numerous, its biomass 6-10 times higher and individual sizes on an average 37 percent larger on reefs in the marine park compared to the fished area.
- One good example from Malaysia is the evidence from the removal of all resorts/chalets on the Sipadan Island in Sabah (2004) as a positive action to allow the island to recover from the exhausting role of playing host to hundreds of visitors, where marine life have recovered from tourism pressure, and this included fishes as well.

Current Status in Malaysia

Realizing the need to enhance fisheries resources, the use of marine protected areas management has been widely promoted by the Department of Fisheries Malaysia since 1980s as one of the management tool. This means some of these marine parks have been in existence for more than 20 years, yet little data exists regarding their overall performance on fisheries conservation. In general, there is very limited information available on the fish larval dispersal patterns, fish population distribution, as well as species abundance inside and outside the marine parks islands in Malaysia. There is still uncertainty on the level of contribution and success of these marine parks as one of the important fisheries management tool available in the country. Furthermore, there are several issues and challenges faced in the current management of marine parks (and this will be discussed further in the following parts).

Major Issues and Challenges

The following section will provide an overview of the current threats and major issues facing the marine parks in Malaysia in not only protecting the natural habitats for fisheries replenishments, but also to the fisheries resources as well. Basically, these would be divided into two main areas for brief explanations.

- (i) Threats to the marine fisheries resources from overexploitation.
- (ii) Threats to the habitat management.

- (i) Over-exploitation of marine fisheries resources

Overall, landings from capture fisheries in Malaysia recorded a quantity of 1,394,531 metric tonnes for year 2008, compared to 1,381,424 metric tonnes in 2007 and only 1,215,206 metric tonnes in 1998 (Annual Fisheries Report, 1998-2008). Although it may be seen as the national waters being rich fishing grounds as reflected by the ever increasing fish landing, there is a general consensus that fishery resources are being intensively exploited. For example, despite the fact that the total landings are increasing, available data on catch per unit effort (CPUE) as well as sizes of the fisheries caught over the years have indicated declines (refer to Table 6).

Table 6: Fisheries in Malaysian waters (caught using trawling method)

| Description | Data | Reference |
|---|---|---|
| Demersal fisheries in Malaysian waters. | CPUE decreased from 131.1 kg/hr (year 1970) to 55 kg/hr (year 1981). | Saharuddin (1995) |
| Demersal and pelagic fish survey in Malaysian EEZ / offshore fishery resources. | A catch rate of 43.41 kg/hr recorded for demersal fish, 6.38 kg/hr for pelagic fish, and trash fish contributed 7.10 kg/hr. These figures showed a decline of 57% from the survey conducted by the DOAF in year 1985-1987. | Department of Fisheries Malaysia (1997) |
| Surveys in the area between 10-50 m deep in the West Coast of Peninsular Malaysia on commercial and trash fish. | Exploratory trawling by the M.V. Selayang provided an average catch rate of 168.6 kg/hr. A coastal demersal fish resource survey in 1970 recorded an average catch rate of 130.49 kg/hr. Surveys conducted in year 1980 and 1991 recorded average catch rates of 59.00 kg/hr and 36.74 kg/hr, respectively. | Department of Fisheries Malaysia (1965) Mohammad Shaari <i>et al.</i> (1974) Lui and Ahmad Adnan (1988) |

Source: Department of Fisheries Malaysia

For example, the estimates of exploitation rates by trawlers showed the gravity of the problem of over-exploitation of the fisheries in Malaysia, based on the CPUE values and increase in trash fish caught. This could be mainly attributed to the efficiency of the trawling method compared to those used in the mid 1960s, when they were first introduced to the west coast of peninsular Malaysia (Department of Fisheries Malaysia, 2000). While licensing has helped to control the increase in fishing effort, limitation through merely controlling the number of boats and gear might be insufficient since fishing efficiency and total fishing effort has increased through the use of new technology.

As such, marine parks could be seen in this context as one of the important management tools available for natural fisheries replenishments. Some available literatures on the subject matter even highlight them as “an insurance policy against other fisheries resources management failures”. However, it is important that gazetted marine parks are managed effectively to achieve this objective.

(ii) *Threats imposed on the management of the marine parks*

The report *Reefs at Risk* (1998) found 85 per cent of Malaysian reefs to be under medium to high level of threats from mostly human activities (Tun *et al.*, 2004). Some of the major threats faced in the management of the marine parks in Malaysia are:

- a. Impacts from tourism industry / recreational activities
- b. Coastal development
- c. Impacts from marine pollution
- d. Impacts from land-based pollution
- e. Over exploitation and destructive fishing practices
- f. Fragmented areas of marine parks

Malaysian marine parks were primarily established for resource conservation, protection and management of the environment. However, marine park managers are presently faced with the task of maintaining an uneasy balance between conservation and tourism activities. For example, the number of visitor to the marine parks in Malaysia has grown dramatically from just about 1,373 people in 1988 to 508,488 people in 2008. Fig. 1 shows the total number of tourists to the major marine parks in Kedah, Terengganu, Pahang and Johor from year 2000 to 2008. In average, the marine parks receive about half a million tourists a year.

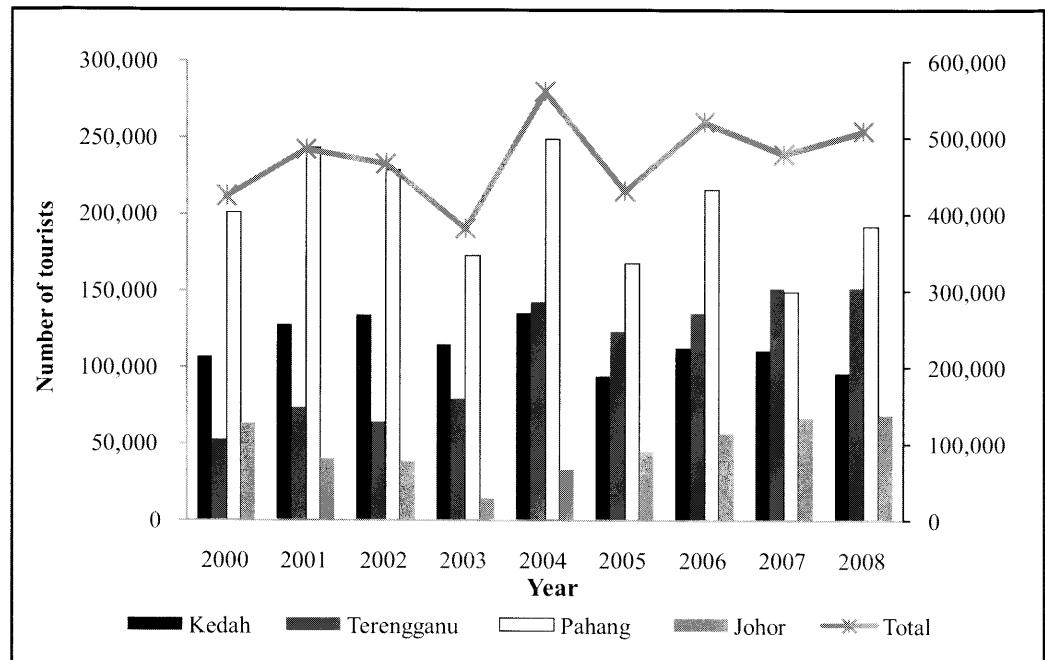


Figure 1: Tourists visiting Malaysian marine parks in Kedah, Terengganu, Pahang and Johor (2000-2008) (Data source: Department of Marine Park Malaysia)

Overcrowding of visitors into the marine parks has been the main culprit of the various accumulated impact on the marine parks' ecosystems. With the ever growing 'marine-based' tourism activities, great pressure is being put onto marine parks from the pressure of overwhelming presence of tourists. There have been literatures on the documented effects of human recreational activities of the consequences of trampling over intertidal areas (Brosnan and Crumrine, 1994; Eckrich and Holmquist, 2000), boats anchoring on tropical reefs (Walker *et al.*, 1989; Francour *et al.*, 1999), as well as SCUBA diving activities (Hawkins and Roberts, 1992; Harriot *et al.*, 1997).

However, these are not the only consequences of human activities in marine reserves. Mass tourism activities can also result in bringing other related problems to the ecosystem, such as increasing oil pollution from tourist boats, contamination of water by sewage and garbage, degradation of coral reefs' ecosystems due to boat anchors, pilfering of corals caused by poor attitude among tourists, contamination caused by detergents or sun blocks used by tourists as well as increasing use of freshwater as the islands gets congested with tourists. In addition, inefficient sewage treatment system is also one of the more prominent factors contributing to environmental degradation in the marine park islands. Nutrient runoff has been a significant threat to reefs, particularly near large population areas. Most of the chalets/resorts on the islands rely on individual septic tanks and these are inadequate.

For example, Fig. 2 and 3 illustrates the presence of oil and grease as well as *Escherichia coli* in water sampled from the different islands in Malaysia. *E. coli* presence is basically an indicative of the presence of fecal contamination in the water sampled. Although comparisons show generally lower levels of pollutants detected in the waters around marine park islands, it is important to note that these provide recognition of important areas or problems to tackle as they would affect the coral reef ecosystems in the long-run.

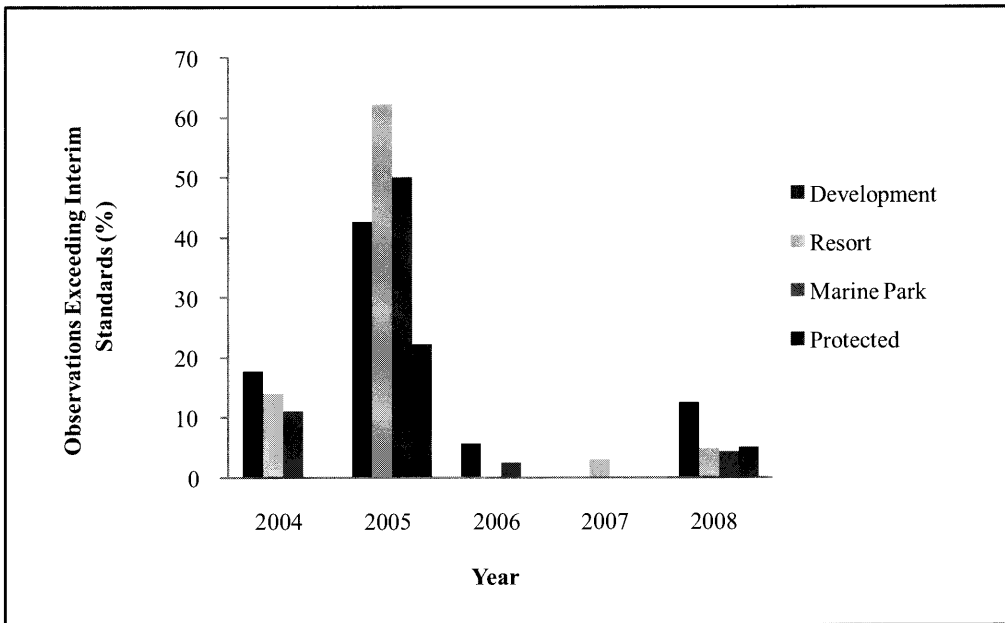


Figure 2: Presence of oil and grease in the waters sampled around different categories of islands in Malaysia (*Data source: Department of Environment Malaysia*)

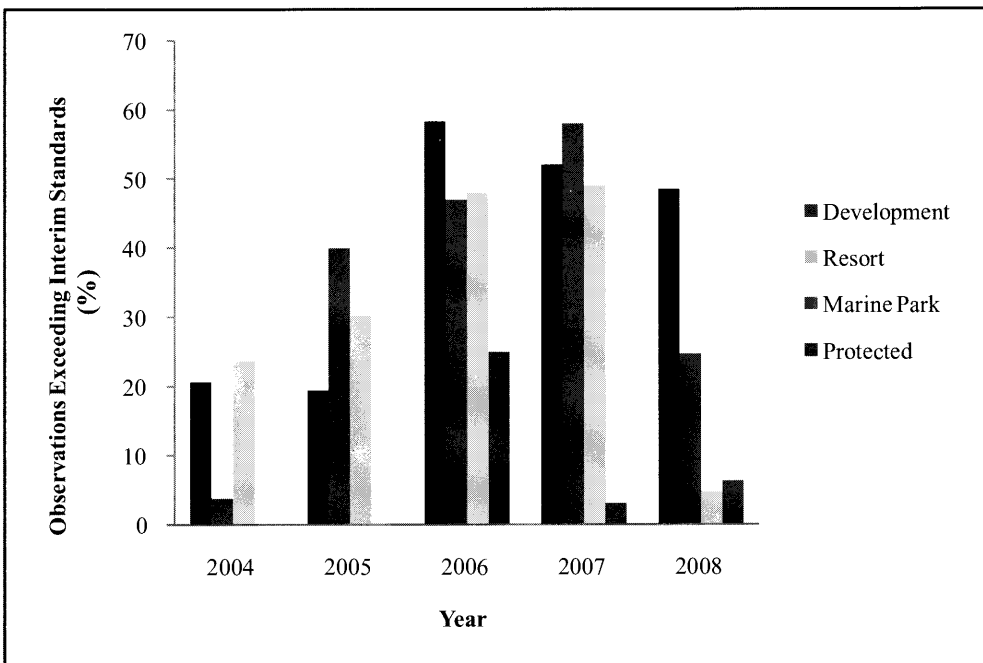


Figure 3: *Escherichia coli* bacteria detected in samples of water collected around different categories of islands in Malaysia (*Data source: Department of Environment Malaysia*)

Furthermore, the construction of general tourism infrastructure and facilities such as roads and airports, golf courses and marinas can also be linked to over-development activities for the marine parks. Some islands have also experienced the mushrooming of small resorts. Many resorts/chalets are built on the islands to accommodate the ever raising number of visitors. Sedimentation therefore becomes one of the main problems resulting from land development activities on the coastal areas. As more development and tourism activities have been taking place on the islands and on the mainland, so has pollution been on the rise (Fig. 4). In actual fact, such ecologically-rich and sensitive areas should only have low density development.

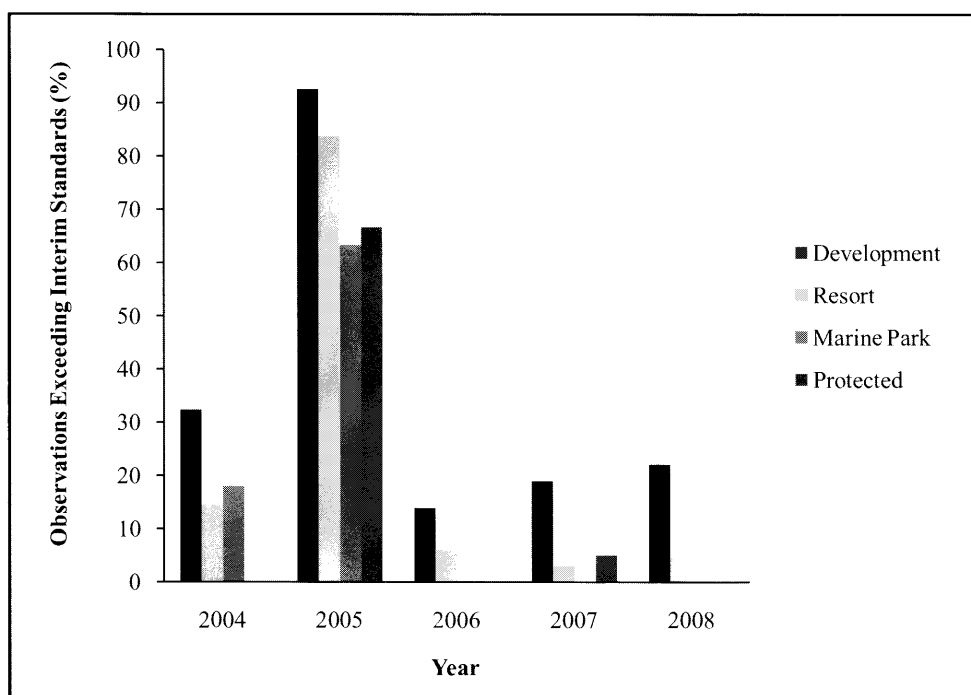


Figure 4: Content of total suspended solids in the water sampled around different categories of islands in Malaysia (Data source: Department of Environment Malaysia)

Illegal encroachments and fishing activities in the marine park waters by fishermen is another deterrent in conserving the environment and the natural fishery resources. However, this issue is recognized by the enforcing authority and actions have been continuously increased in curbing this problem in the Malaysian marine parks. This is crucial as whether or not a marine reserve can achieve its management objectives would depend greatly on the level of enforcements, compliance and awareness of the local resource

Another important point to note is the size of existing areas of marine parks in the country which are quite fragmented. Presently, only about 0.37 per cent of total water coverage for Malaysia is protected as marine parks. However, studies have shown that although the use of small protected areas under certain conditions, may bring direct benefits to reef ecosystems and fishing communities by allowing a buildup in fish biomass, there is still a need for larger, permanently closed areas for species that require long periods without disturbance or larger areas within which the fish can safely move and not be regularly caught (McClanahan *et al.*, 2006). On contrary, it is also important to acknowledge that coral reef ecosystem based on large MPAs with weak enforcement may still be ill-suited to the purpose (Christie, 2004).

Recommendations

Marine parks in Malaysia play a key role in the existing marine environmental management strategy and yet there is little quantitative understanding of the benefits they may provide in terms of protecting and enhancing fisheries resources. Effective management of these marine parks is essential because the conflicting demands of fishing, tourism activities and conservation must be reconciled to achieve the actual objectives of marine parks in the country.

It has been said that sound policy making requires sound science. If this is the case than research on the role of marine parks in Malaysia in supporting the fisheries sector needs to be improved to provide empirical evidence of this relationship and subsequently to enhance marine parks and fisheries management. Collaborative research is important as the information needed has to come from many disciplines, not just marine biology or ecology. The data would also serve as important tools in convincing policy-makers as to the need for more judicious development of marine park islands. In addition, data from the research activities would also support day-to-day running of marine parks and contribute towards the development of management plans, zonation or the application of various tools for marine protected area management such as the limits of acceptable change and carrying capacity of the islands.

As a whole, marine parks can be appropriate as a tool for the conservation of identified habitats, species, and biodiversity besides yielding economic returns through sustainable tourism activities. However, there is a need to evaluate the existing management strategy in the context of:

- (i) Clear objectives on biodiversity, ecosystem as well as fisheries management
- (ii) Social and institutional ability to maintain the closures
- (iii) Whether there are sufficient fisheries management actions presently
- (iv) Acquire the ability to monitor and evaluate the success, or as a guide to take action to improve the situation.

Although most of these would already be in place in Malaysia as the establishment of marine parks in the country is not new, there would always be room for further improvements based on the evaluation of existing situation faced in the midst of the changing human use and environmental conditions. And in this case, the depleting fisheries resources as a point to further develop the capacities and capabilities to improve natural stocks in the country waters by taking marine parks as one of the management tools available.

Conclusion

There is evidence to suggest that marine parks or marine protected areas play an important supporting role to the fisheries industry as nursing, feeding and recruitment areas for commercial fisheries stocks. However, almost all of this evidence came from research and published materials outside of Malaysia. The dearth of research in Malaysia on this issue is a cause for concern because of the size of our fisheries sector, its impact on the marine parks and the growing importance of the sector for the country's food security. This relationship however should not be viewed in isolation of the other activities occurring in the marine parks and on the marine park islands. Development and visitors also impact the marine ecosystems the marine parks are meant to protect and would indirectly impact the fisheries sector. The links between these activities highlight the importance of cooperation between the various stakeholders involved in the management of marine parks (be it the enforcement authorities, fisheries administration, environmental protection, development planning or the private sector) in ensuring that our marine parks is able to continuously support the fisheries sector and vice-versa

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