Effectiveness of Marine Protected Areas as a Management Tool for the Management of the Seas of Malaysia

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Abstract: This study analysis the need for more research on marine protected areas and how regulation and recreational activities of marine protected areas, using fish stock indicators. Secondary data was collected from the Department of Fisheries Kedah and Department of Marine Park, Kedah, Malaysia. The finding shows that the key elements for good management are implementing an educational and awareness program, enforcing Marine Park regulations, limiting visitor’s use, establishing monitoring and evaluation programs. Coupled with the promotion of alternative activities and alternative islands to disperse pressure on the reefs of Pulau Payar Marine Park, these actions can help to ensure that the tourism industry at the marine park is environmentally, socially and economically sustainable.

Key words: Effectiveness, Marine protected area, Natural resource management

INTRODUCTION

A Marine Park is a sea area zoned as a sanctuary for the protection of marine ecosystems especially coral reef and its associated flora and fauna, like the sea grass bed, mangrove and the seashore (Kenchington et al., 2003). Protecting special biological and environment values have been the main objectives behind the establishment of marine parks in the country. However, due to open access to marine park resources and failure of the market system in restricting their use, over-use and environmental degradation have resulted. The degradation of marine parks might affect the sustainability of ecotourism in the future. In addition, the market failure is associated with users not paying the full costs of using the natural resources in the marine parks. Thus it is possible that the park may be subject to excessive use, overcrowding and biological degradation. The high level of usage may result in conflicts between users, the social and biological carrying capacity, limits of acceptable change and potential environmental degradation.

In Malaysia, several marine protected areas (MPA) in the form of marine parks and fisheries protected areas have been created since 1983 (Hiew 1996; Ramli, 2002). At the beginning, besides creating the marine parks, more conservation efforts were concentrated on the rehabilitation of coral reef ecosystem, through the construction of artificial reef throughout the country (Department of Fishery, 2000). Research on the artificial reef were confined to construction aspects such as better design, suitable material and finding suitable sites for the reef to be launched. The construction of the artificial reefs was then slowed down in the 1990's. Beside discouraging outcomes like coral encrustation, more studies found that the reef acts just like other fish aggregating devices (FAD) that aggregates surrounding fishes rather than generating new fish biomass. It seems that the natural coral reef ecosystems cannot be replaced by the artificial one, and protecting the natural coral reef ecosystems through the creation and establishment of marine parks as a conservation measure was opted.

In the long run, Malaysia has committed itself into transforming 10% of its marine areas into marine parks by the year of 2020 (Ramli, 2002). These parks form huge warehouses that host treasures like coral, fish, sea-lives habitats and so on that could uniquely define the health and wealth of the nation. For now, these treasures form unique attractions to national eco-tourism and also form a unique indicator that reflects the nation’s sustainability into the future.

Marine protected areas benefit society in many ways. Besides their indirect global ecological functions, and the commercial fisheries they indirectly support, the biodiversity and scenery. They also provide direct recreational benefits to people that visited them. MPAs are important component of local, national and international biodiversity conservation and sustainable development policies and provide ranges of benefits such as:

Conservation of Biodiversity and Ecosystems:

MPAs protect entire habitats and their full range of animals and plants, preserving genetic diversity, age structures and the delicate balance among all the living component of an ecosystem. Well-managed MPAs typically result in significant and long lasting increase in population size, number of species, and reproductive
output of marine animals and plants. MPAs also provide reservoirs of genetic material for the natural or assist recovery of areas affected by pollution, over-fishing or natural causes.

**Protection of Rare or Threatened Species and Communities:**
MPAs are carefully selected areas of high biodiversity where human development, exploitation and other destructive activities are limited in order to preserve endangered species and replenish threatened commercial fishing stocks. Thus MPAs are effective in conserving habitat and supporting the recovery of exploited species.

**Potential Contribution to Ecosystem-Based Management of Fisheries:**
MPA is a high profile and well-documented tool for protecting marine ecosystems and for managing marine fisheries. There is a growing body of evidence around the world on the importance of MPAs in maintaining or enhancing fisheries, three basic benefits of MPAs to fisheries:
(i) Improved social-economic outcome for local communities. MPAs benefit local fisheries by protecting fish from unsustainable harvesting during spawning and vulnerable life stages. Fishermen benefit when mature fish swim from protected areas into fishing grounds.
(ii) Support in improving the catch in nearby fisheries creating larger catches with increased body size and reducing the year to year variability in catches.
(iii) Support stock management including the protection of specific life stages such as nursery grounds, protection of critical functions, provision of spillover of an exploited species, and provision of dispersion centers for supply of larvae to a fishery.

There are two main motivations for Marine Protected Areas: ensuring sustainability of economic resources, and protection of species, biodiversity and landscapes (Man, 2008). Marine Protected Areas (MPAs) has been suggested as an important tool for fishery management in recovering overexploited populations and to make fishing sustainable (Christie, 2004). However, economic literature on MPAs has provided limited empirical evidence on the socio-economic benefits to fishers. A number of empirical studies economic instruments to protect marine natural areas (Planter & Pina, 2008; Sumaila et al., 2000) and effects of recreational activities on coral reefs ecosystem (Inglis et al., 1999; Baker & Roberts, 2004).

Only few studies have addressed the biodiversity and the status of flora and fauna in marine waters in Malaysia (Lim, 1997; Man, 2008; Ahmad, 2009). Despite the importance of sustainable management of Marine Parks, limited attempts have been made to study the economic and social value of the coral reefs in the marine waters in Malaysia. Only few studies have simultaneously addressed ecosystem and economic consideration in the selection of potential MPA sites (Balmford et al., 2004; Gjertsen, 2005). Intensity of human activities in the marine environment is useful in identifying regions that may need policy support for sustainable management. However, analysis of the socio-economic characteristics in marine regions has received little attention to date. Human activities such as over fishing, diving and boating harm the coral reef. Chadwick (1998) notes that one third of coral reef in the world are degraded and one-tenth of the coral reef in the world already been destroyed because of human activity.

According to Bryant et al. (1998), 85 percent of coral reef in Philippines are at high risk of degradation because of human activities and less than 5 percent of coral reef are in good condition. They also estimated that 80 percent of coral reef in South East Asia are under high risk. CoRIS (2005) noted that within 10 to 20 years, 30 percent of coral reef in critical condition by 2050, 50 percent of world coral reef may die because of degradation.

The aim of this paper is to obtain the effectiveness of Marine Protected Areas (MPAs) in increasing the economic, social and ecological benefits of the seas of Malaysia for sustainable natural resource management.

**MATERIALS AND METHOD**

There are several ways in which MPAs, number of visitors and number of fish stock are linked together. One of the basic of MPAs is that by protecting the coral reef from human intrusion and extraction, coral cover and fish abundance inside the MPAs can be maintained or increased, which leads to an increase in fish abundance outside the MPAs.

There are several factors that caused an increase to the number of visitors in MPAs. Marine activities such as fish feeding, snorkeling and scuba diving will attract visitor’s especially foreign visitors to come to MPAs. By protecting the coral reef, the abundance of fish will increase inside and outside of MPAs. This will increased the number of visitors that doing the marine activates. The visitors especially foreigner recorded the total number of visitors who visit the MPAs. Number trespassing cases is one of the factor that influence the fish abundance and coral cover inside and outside the MPAs. The fishing activities in the MPAs area is most popular cases and recorded a high number of compounds collected each year. Aware of tourism and fisheries activities around the marine park is also capable of causing damage to coral reefs; the Marine Department established the micro enforcement to control the recreational activities that can damage coral reef directly and indirectly. This
enforcement body act directly monitor the activities in the water, especially in the area of marine parks for example recreational activities such as snorkeling and scuba diving showed that it will impact the number of fish stock inside and outside the MPAs. If the number trespassing cases increased, it will increase the number of abundance of fish inside and outside the MPAs thus it will lead to deterioration of fish stocks.

![Fig. 1: Relationship between MPAs and marine resource management.](image)

For Malaysia, the coral reefs situated along its certain islands such as Pulau Payar, Kedah, Pulau Tioman, Pahang and Pulau Perhentian, Terengganu attracts domestic and foreign visitors to this island. For example, Pulau Payar receives more than 100,000 tourists every year (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Local Visitors</th>
<th>International Visitors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>19,944</td>
<td>86,836</td>
<td>106,780</td>
</tr>
<tr>
<td>2001</td>
<td>38,027</td>
<td>89,514</td>
<td>127,541</td>
</tr>
<tr>
<td>2002</td>
<td>56,259</td>
<td>77,516</td>
<td>133,775</td>
</tr>
<tr>
<td>2003</td>
<td>44,291</td>
<td>70,393</td>
<td>114,684</td>
</tr>
<tr>
<td>2004</td>
<td>36,282</td>
<td>98,990</td>
<td>135,272</td>
</tr>
<tr>
<td>2005</td>
<td>19,607</td>
<td>74,492</td>
<td>94,099</td>
</tr>
<tr>
<td>2006</td>
<td>26,043</td>
<td>86,605</td>
<td>112,648</td>
</tr>
<tr>
<td>2007</td>
<td>24,580</td>
<td>86,049</td>
<td>110,629</td>
</tr>
<tr>
<td>2008</td>
<td>23,298</td>
<td>72,773</td>
<td>96,071</td>
</tr>
<tr>
<td>2009</td>
<td>25,454</td>
<td>77,412</td>
<td>102,866</td>
</tr>
<tr>
<td>2010</td>
<td>26,429</td>
<td>69,668</td>
<td>96,097</td>
</tr>
</tbody>
</table>

Source: Marine Park Unit, Kedah, 2011

MPAs in Malaysia are threatened by the very success they have created. There is an increasing environmental pressure from the growing number of tourists that visited them to scuba dive or snorkeling. This has to do with the creation and expansion of tourism destinations in the coral reef coastal area. Pressure also developed from the various degrees of care and abilities exhibited by tourists and the tour operators. This is an important issue in Malaysia, given that new development of chalets and hotels provide easier access to non-specialized tourists, and that the new business opportunities attract new operators with less experience. To reduce this environmental impact the two aims of park managers are, first, to communicate and enforce better diving and anchoring practices, and second, to reduce the total number of visitors. The second part of the strategy can be achieved either by directly limiting entry or by setting an entry fee to curb demand. The use of fees can have the additional benefit of providing revenue for the government agency that involved in the development and enforcement of regulations.

In Malaysia, all MPAs receive funding from the federal budget, where they have to face strong competition from other development projects and social programs, a situation, which has inevitably resulted in limited budget to allocate for this protected areas. To overcome this problem and link funding to levels of use, the Department of Fishery introduce of RM5.00 (approximately US$1.70) per individual per entry to any Marine Protected Natural Area, earmarking all revenues to the park that generated them. A Marine Park Trust Fund has been established by the Government in 1987 with an initial grant of RM350,000 in order for the Department to start off the establishment and administration of the marine parks. Initially most of the fund was used to acquire assets like boats and vehicles and also to build infrastructure like the Marine Park Centre’s. However, since the mid 90’s, monies from the Trust Fund have not been used for such purposes but has been used mostly for the operation and maintenance of the parks (Department of Fisheries Malaysia, 2000).
Results:

**Total Fish Landings in Area of Pulau Payar:**

Figure 2 shows the total fish landings in area of Pulau Payar. The highest reported landing was in 2009, where 106,486 tons of fish has been landed in that year. The lowest total fish landing was in 2006, where only 67,122 tons of fish has been caught.

![Fig. 2: Total Fish Landings (tone) in 2006 to 2011.](image)

**Number of Violators Getting Caught:**

Until December 2011, Malaysian Marine Park Department has made arrests of 71 cases involving various categories of vessels with various offences under the Fisheries Act 1985 (Marine Park of Malaysia Annual Report, 2011).

![Fig. 3: Number of violators getting caught by month in 2006 to 2011.](image)

The highest number of violators getting caught was recorded in 2008 and 2009 with 16 cases and February 2009 recorded the lowest case with eight cases. Trespassing cases in 2011 decreased by three cases from 14 cases to 11 cases than in 2010. More law enforcements such as an increase on the rate of the compound and the fine imposed on trespassing a marine park has affected fishermen not to fish in the marine park. The declining of trespassing cases shows that there is awareness among fishermen on the importance of protecting the marine biodiversity.
Fig. 4: Total compound in 2006 to 2011.

The total compound decreased from RM33,200 in 2010, to RM20,300 in 2011. During the six year period, year 2009 recorded the highest total compound collected, which was totaled at RM63,350.

Number of Visitors:

In recent years, especially since the gazette of the Marine Park, Pulau Payar has been expanding rapidly as a tourist attraction, with number of visitors visiting this area increasing dramatically over the years. This can be attributed largely to the rapid development of the tourism sector of Pulau Langkawi as a major tourist centre for the northern region of Peninsular Malaysia. In addition, Pulau Langkawi is being promoted worldwide as a tourist destination (Lim, 1997) a visit to the Pulau Payar Marine Park is often included in package tours or sold separately as a day trip from Pulau Langkawi.

Fig. 5: Total number of visitor in Pulau Payar in 2006 to 2011.

The majority of tourists to PPMP are foreigners with 72.1 percent of the total numbers of visitors in 2000 until 2012 compared than local visitors only 27.0 percent. Promotion is carried out overseas mainly by the Langkawi Development Authority (LADA). The Kedah State Economic Planning Unit (UPEN Kedah) tends to focus more on promoting Pulau Langkawi and Pulau Payar among domestic tourists. The promotion of Pulau
Payar emphasizes its marine environmental attributes, and is sold as a Marine Park with some conservation emphasis.

**Government Allocation:**
In 2011, Marine Park Department of Malaysia received RM9.30 million for development projects under the 10th Malaysia Plan which is divided into research projects (10 percent), the construction of boats and sea elements (65 percent), information technology (13 percent), for education and public awareness (3 percent) and alternative livelihood programs (9 percent).

Fig. 6: Government allocation according development projects in 2011.

In this section, an OLS regression was used to estimate relationship between dependent variable and independent variables. Referring to the table below, the dependent variable is the fish stock (F_STOCK) whereas the independent variable (VGC) is number of violators getting caught, variables (N_VIS) is number of visitors in Pulau Payar, (SCUBA) is total visitors activities in scuba diving, (SNOR) is total visitors in snorkeling and (GOV_A) is government allocation.

**Table 2:** Estimated OLS Model Results Of Factors Affecting Total Number of Fish Stock in Pulau Payar (OLS Model).

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of violators getting caught (VGC)</td>
<td>337.292</td>
<td>0.029***</td>
</tr>
<tr>
<td>Number of Visitors (N_VIS)</td>
<td>-0.364</td>
<td>-0.017***</td>
</tr>
<tr>
<td>Type of Activities (SCUBA)</td>
<td>-3.857</td>
<td>-0.000***</td>
</tr>
<tr>
<td>Type of Activities (SNOR)</td>
<td>0.338</td>
<td>0.350</td>
</tr>
<tr>
<td>Government Allocation (GOV_A)</td>
<td>0.004</td>
<td>0.000***</td>
</tr>
</tbody>
</table>

R² = 0.353  
Adjusted R² = 0.304  
F-statistic = 7.216

Note: *** Significant at 1 percent level  
** Significant at 5 percent level  
* Significant at 10 percent level

**Discussions:**  
Based on the regression result in the Table 2, the R-squared is 0.353 which means that only 35.3 percent of the variation in the dependent variable (F_STOCK) is explained by the independent variable, and 64.7 percent of the variations are explained by other variables. The OLS regression line fits the data statistically and the overall equation is significant. The result showed that, out of seven independent variables, four variables are significant.

The total number of violators getting caught (VGC) is an influential factor in total fish stock as implied by a positive and significant coefficient of VGC since the p-value for t-test was 0.029 which significant at 5 percent.
level. This positive relationship between VGC and total fish stock is following to our prior expectation. This result showed that strict law enforcement bring compliance among fisherman’s to obey the law given and its difficult to them to violate the regulation. It also showed that the effectiveness of enforcement in Pulau Payar in protecting marine resources.

Number of visitors (N_VIS) is hypothesized to have negative impact on total number of fish stock shows that is parallel with prior expectation. N_VIS has a negative relationship influence the total fish stock. Our regression result shows that the p-value for t-test was 0.017 which is significant at 5 percent level. An uncontrolled increase in tourists is likely to generate congestion and overcrowding, which affected to the quality of water surrounding the area, leading to undesirable consequences from cultural point of view. In the case of MPAs, Hawkins and Roberts (1993) found that visitors may damage habitats, for instance when their fins hit corals or when they trample on reef-flat communities when they do the recreational activities such as scuba diving.

The visitors activities in scuba diving (SCUBA) was an influential factor in the total fish stock as implied a negative relationship and this result parallel with prior expectation. Barker and Roberts (2004) found that most diver contact with the reef occurred from fin kicks. Camera users, male divers, and inexperienced divers were more likely to cause reef damage when they do diving activities. Damage was most likely to occur during the first 10 minutes of the dive. This variable was significantly influence the total fish stock since the p-value for t-test is 0.000 which is significant 1 percent level.

Variable visitor’s activity in snorkeling (SNOR) has a positive relationship with the fish stock and it does contradict with the expected result. Probably due to the highly awareness of the visitors about the importance of protecting the marine life. This result is contradict with previous research by Hawkins and Roberts, (1993), where they stated that the snorkelers caused more uneven, very patchy damage by standing up on the coral. While doing so, the snorkelers would have trouble controlling their fins and caused coral damage in this way. The snorkelers’ damage was spread over the coral flats because of the snorkeling activities, while the divers followed a narrow path to deep water. However, this variable was not significantly influenced the total fish stock.

Government allocation (GOV_A) is hypothesized to influence positively the total fish stock and this result is parallel with the expected result. The coefficient of GOV_A is positive and significant since the p-value for t-test is 0.000 which is significant at the level 1 percent level. Government allocation can improve the effectiveness of MPAs in terms of improving facilities, increasing the number of officer and total number of patrol operations more frequently. Government allocation also can increase the economic value of marine tourism thus tourism revenue would be able to fund park operations and even provide social and economic benefits to local population.

The estimated coefficient in the model indicated that all three significant variables are positively and affecting the total fish stock. However, only variable SCUBA and N_VIS is negatively affecting the total fish stock. This is due to the activities itself that brings harm to the coral reef which will decrease the number of fish stock.

The total number of violators getting caught responding appreciably to the total fish stock with the highest coefficient by 337.3 tones. It showed that a number of violators getting caught have a very strong relationship with the dependent variable and it’s proved that the effectiveness of Pulau Payar’s management as a Marine Protected Areas in conserving marine biodiversity. Strong law enforcement will improve fisherman’s awareness to not intrude the Marine Protected Areas.

The increasing number of visitors showed that this variable able to improve the tourism sector in Malaysia in terms generate income and improving the facilities to the communities and around the MPAs. Moreover, the complete facilities such as hotels, tourism agents, food and beverage, and transportation can attract the local and foreign visitors come to MPAs. It means that the number of visitors will not affect to the total fish stock in Pulau Payar. A tourist sector is very important for Malaysian economy, terms of generating income, facilities and improving the socioeconomic in the MPAs.

Government allocation is very important to preserve marine life as one of the country's valuable resource for us. In 2011, RM6.9 million has been allocated for the construction of boats and equipment procurement sea elements such as increasing the number of patrol boats and a ship for the purpose of surveillance, patrols, and utility boats. Until the year 2011, the Department have 27 enforcement assets, which include 9 units boats type Barracuda, 6 units type Challenger, 5 units boat type Sentry, 6 units type Explorer and 1 unit 18 meter ship.

In 2011, a total of RM293,880 has been allocated for community development programs and public awareness. There are 25 educational programs and 13 public awareness programs have been conducted in Pulau Payar Marine Park such as Marine Education Camp, Artificial Reef Program and Reef Clean-Up Program.

In general, Pulau Payar Marine Park needs to limit the area for scuba diving activities. The level of diving at the Marine Park is sufficient at this moment, with limited impact on the coral reef environment. However, certain measures can be taken to further improve management of the reefs and to ensure that the diving activities do not impact adversely on the reefs in future. Appropriate management actions can minimize the impacts of
tourists on coral reefs and hence alleviate degradation, improve visitor’s satisfaction and ensure the adequate provision of necessary facilities.

**Conclusion:**
Research on the role of marine protected areas (MPA) in Malaysia in supporting the fisheries and tourism sectors is limited and needs to be improved. There is evidence from work done outside Malaysia to suggest that MPAs can play a very supportive role in developing the fisheries sector by enhancing the nursing, feeding and recruitment areas for fish stocks. Fish stocks have been heavily overfished and remain at some 8-12 percent of pre fishing stock levels. The ability of MPAs as a significant tool for rebuilding stocks have to be demonstrated and valued for defending MPAs as a sound policy tool for managing the seas of Malaysia. The lack of research in Malaysia on this issue is a cause of concern because of the importance of the fisheries and coastal tourism sectors. The valuation of the contribution of MPAs to both the fisheries and tourism sectors will be important for further expansion on the use of MPAs on the Malaysia seas and for supporting polices on the use of MPAs in different parts of the seas of Malaysia.

Government allocation in terms of implementing an educational and awareness program, enforcing Marine Park regulations, limiting visitor’s use, establishing monitoring and evaluation programs and capacity building are all important management actions that can be taken. Coupled with the promotion of alternative activities and alternative islands to disperse pressure on the reefs of Pulau Payar Marine Park, these actions can help to ensure that the tourism industry at the Marine Park is environmentally, socially and economically sustainable. Law enforcement in controlling the activities that harm the coral reef should be emphasized because its requires large amounts of government allocation in terms of facilities such as high technology boat and enforcement personnel for patrol, surveillance, beach cleanup and rescue activities.

**REFERENCES**


