THE IMPACT OF MARINE PROTECTED AREAS TO THE FISH STOCK: CASE STUDY IN PULAU PAYAR, KEDAH

By

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ABSTRACT

Malaysia has established Marine Protected Area or Marine Parks since 1984 to alleviate the problem of low fishery catches due to overfishing. Since its establishment, it is not known whether the marine parks are performing as expected, as there were lack of information available on the productivity status of fish and coral reef in the MPAs. One of the main concerns regarding MPAs are their effectiveness on preventing the ongoing loss of biodiversity. Thus, the study sought to identify the impact of MPAs in increasing the fish stock in Pulau Payar. This study also want to identify the relationship between the independent variables that impact the total fish stock. Secondary data was collected from the Fisheries Department of Kedah and Department of Marine Park Kedah. The method of analysis using the Ordinary Least Square (OLS) criterion to estimate the parameters of the total fish stock in Pulau Payar. Regression results showed that variables such as number of violators getting caught, number of visitors, number of visitors doing scuba diving and government allocation had significant effect to the total fish stock. Policy implication such as implementing more education and awareness programme, enforcing Marine Park regulations, establishing monitoring and evaluation programmes were proposed.

ABSTRAK

Malaysia telah menubuhkan Kawasan Perlindungan Marin atau Taman Laut sejak tahun 1984 untuk mengurangkan masalah jumlah tangkapan ikan yang rendah kerana penangkapan ikan yang berlebihan. Sejak penubuhannya, ia tidak diketahui sama ada MPAs dapat melaksanakan fungsinya seperti yang dijangkakan, kerana terdapat kekurangan maklumat mengenai status produktiviti ikan dan batu karang di kawasan MPAs. Salah satu daripada kebimbangan utama mengenai MPAs ialah keberkesanannya mencegah kehilangan biodiversiti yang berterusan. Oleh itu, kajian ini bertujuan untuk mengenal pasti kesan MPAs dalam meningkatkan stok ikan di Pulau Payar. Kajian ini juga ingin mengenal pasti hubungan antara pembolehubah bebas yang memberi kesan kepada jumlah stok ikan. Data sekunder dikumpulkan dari Jabatan Perikanan Kedah dan Jabatan Taman Laut Kedah. Kaedah analisis Kuasa Dua Terkecil (OLS) digunakan untuk menganggarkan parameter jumlah stok ikan di Pulau Payar. Keputusan regresi menunjukkan bahawa pembolehubah seperti jumlah penceroboh yang ditangkap, jumlah pengunjung, jumlah pelawat yang menjalankan aktiviti menyelam dan peruntukan kerajaan mempunyai kesan yang besar kepada jumlah stok ikan. Implikasi polisi seperti melaksanakan lebih banyak program pendidikan dan kesedaran, menguatkuasakan peraturan-peraturan Taman Laut, mewujudkan program-program pemantauan dan penilaian telah dicadangkan.

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TABLE OF CONTENT

CHAPTER 2

LITERATURE REVIEW

CHAPTER 3

RESEARCH METHODOLOGY

LIST OF TABLE

LIST OF FIGURE

.

CHAPTER 1

INTRODUCTION

1.0 Background

Marine Protected Areas (MPAs) are essential for biodiversity conservation. They are areas set aside to maintain the functioning of natural ecosystems, to act as refuges for marine species and to maintain ecological processes that cannot survive in most intensely managed landscapes and seascapes.

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 (Hiew, 2000). 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-used and environmental degradation have resulted. The degradation of marine parks might affect the sustainability of ecotourism in the future while 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 subjected 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 changes and potential environmental degradation.

In the long run, Malaysia has committed itself into transforming 10percent of its marine areas into marine parks by the year of 2020 (Malaysian Marine Park Unit,

2011). These parks form huge warehouses that host treasures like coral, fish, sea-lives habitats and so on that could uniquely defined 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.

The MPAs benefit the society in many ways. Besides their indirect global ecological functions and the commercial fisheries they also indirectly support the biodiversity and scenery as well as providing direct recreational benefits to the visitors. MPAs are important components for local, national and international biodiversity conservation and sustainable development policies. They also provide ranges of benefits such as:

1. 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 nature or assist recovery of areas affected by pollution, over-fishing or natural causes.

2. 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.

3. 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 evidence around the world on the importance of MPAs in maintaining or enhancing fisheries. There are 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.

For Malaysia, the coral reefs that situated along its certain islands such as Pulau Payar in Kedah, Pulau Tioman in Pahang and Pulau Perhentian in Terengganu also act as a tourist attractions as they attract the domestic and foreign visitors. For example, Pulau Payar receives more than 100,000 tourists every year (Table 1.1).

Table 1.1: Numbers of visitors to Pulau Payar Marine Park, 2000-2010

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

(Source:Marine Park Unit, Kedah)

MPAs in Malaysia are threatened by the very success they have created. There is an increasing environmental pressure from the growing number of tourists who visited them to scuba dive or snorkel. 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 be allocated for this protected areas. To overcome this problem and link funding to the levels of use, the Department of Fisheries introduced a fee 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. A Marine Park Trust Fund in 2007 until 2011 for Department of Marine Park Kedah is RM2,910,926 and expended for Marine Park management based on a stipulation in the deed of Marine Park Trust Fund (Malaysian Marine Park Unit, 2011).

Protected areas act as benchmarks against which we understand human interactions with the natural world. There are 53 MPAs in Malaysia. The first MPA in Malaysia is Tuanku Abdul Rahman Marine Park in Sabah. Declared in 1974, it established a 49.29km^2 area by Sabah state government. Malaysia has 37 MPA sites

established more than 20 years. Table 1.2 shows the number of marine parks in peninsular Malaysia, Sabah and Sarawak.

Table 1.2: Marine park in peninsular Malaysia, Sabah and Sarawak

LOCATION OF MARINE PARK	GAZETTED	NUMBER OF MARINE PARKS
Peninsular Malaysia	Marine Park Order of 1994 of The Fisheries Act	42 marine parks
Sarawak	The National Park and Reserve Ordinance	6 marine Parks
Sabah	Parks Enactment,1984, Wildlife Conservation Enactment 1997	6 marine parks and 2 propose
Total		53 marine parks

Source:Marine Park Unit, Kedah, 2011.

1.1 Relationship between Coral Reef and Fisheries Management

Many countries faced the declining trend of fish stock due to the exploitation and deterioration of coastal habitat which need them to choose other management strategies that support existing conventional management measures. As a result, more conservation efforts were implemented to replenish fish population and to rehabilitate coastal habitats (Roberts & Hawkins, 2000). In Malaysia, more conservation efforts have been focused on the coral reef restoration ecosystems at the beginning through the construction of artificial reefs around the country. But the research on the artificial reefs were confined to construction aspects such as better design, suitable material and finding suitable sites for the reef to be launched. Then,

more marine parks and fisheries protected areas were created, and more studies were conducted (Najib, 2002).

1.2 Marine Protected Areas and Stock of Fish

MPAs have had remarkably similar effects. Protections from fishing simply allow exploited species to live longer, grow bigger and become more numerous. MPAs contribute to sustaining a population by allowing marine species within MPAs to mature and spawn, thus increasing the reproductive output of populations above what it would have been under the pressure of fishing activities. The population persists regardless of the intensity of fishing activities outside the MPA. For a population to be self-sustaining, a single large MPA need to ensure that sufficient eggs and larvae survive within the boundaries of the MPA. In contrast, a network of smaller MPAs could provide protection to spawning aggregations in one MPA and juveniles in a second MPA that receives eggs and larvae from the egg. In the case of mobile species, the extent of the area contained in an MPA will have to be large to sustain the population, particularly if the fishing activities' intensity outside the MPA is high. MPAs can also have positive effects on fish populations not targeted by fisheries. If fishing is restricted through MPAs in areas where by catch is an issue, the reduced fishing effort on by catch species can support the sustainability of these fish populations.

1.3 MPAs Benefit the Fisheries

There are some evidence in favor of the beneficial role of MPAs in a range of different types of fisheries, in different global localities, and within different fisheries management regimes. MPAs on their own are not sufficient as a single management

tool, except possibly in small-scale subsistence fisheries where other management systems may not be very effective. For fisheries, MPAs generally can be considered to provide four basic benefits:

(i) Support for stock management, including protection of specific life stages such as nursery grounds, protection of critical functions (feeding grounds, spawning grounds), provision of spillover of an exploited species and provision of dispersion centers for supply of larvae to a fishery.

(ii) Improved socio-economic outcomes for local communities.

(iii) Support for fishery stability.

(iv) Ecological offsets such as trade-off for ecosystem impacts and better understanding of impacts and options.

1.4 Pulau Payar as MPAs

Pulau Payar is one of the many islands off mainland Kedah in the Straits of Malacca. It is situated at the south of Langkawi, a more famous archipelago. Pulau Payar's status as a marine park offers protection for its diverse marine life. Traditionally, before the Pulau Payar group of islands were gazetted as a marine park, their surrounding waters were important fishing grounds for fishermen based in Kuala Kedah. Fishing activities that were carried out around the islands include drift netting, purse-seining, long-lining and bottom traps (Aikanathan & Wong, 1994). Pulau Payar itself has in the past been a sheltering place for fishing vessels, particularly during the monsoon period. In addition, rock oysters used to be harvested from Pulau Payar, Pulau Lembu and Pulau Kaca on a yearly basis up until the Marine Park Center was established (De Silva & Ridzwan, 1982). The islands

were gazetted as a marine park in 1994 under the Fisheries Act 1985 (Amended 1991). Pulau Payar is also a snorkeling and diving site famous for its corals.

The Pulau Payar Marine Park is situated in the northern part of the Straits of Melaka, 19 nautical miles (35 km) south of Langkawi and encompasses the islands of Pulau Payar, Pulau Lembu, Pulau Segantang and Pulau Kaca which are surrounded by coral reefs. Pulau Payar is the largest of the islands, with an area of 31.2 hectares and an approximate length of 1.75 km and about 500 meter wide (Malaysia Marine Park Department, 2011). It rises to 80-90 meters above sea level at the highest point. Coastline of the island is about 3.35 km with very limited beach and flat land with no freshwater sources. Four sandy beaches are found at eastern side of the island. The entire length of its north-western coast is predominantly rocky and characterized by steep cliffs and wave-cut gullies. Two longest beaches (around 100 meter) are located in front of marine park information centre and commercial tourist platform.

Figure 1.1 : Map of Pulau Payar Island Marine Park

Source: Malaysia Marine Park Department, 2011.

Figure 1.2 : Coral Reef Area in Pulau Payar Marine Park

Source: Malaysia Marine Park Department, 2011.

Pulau Payar Marine Park offers abundance of opportunities for ecotourism activities especially through its terrestrial and marine environment. Water sports like

snorkeling and swimming are the most popular services enjoyed by tourists on the island. Relaxing, fish feeding and sunbathing were also the other major activities participated by the tourists (Zaidnuddin *et al.,* 2000). There are man-made environment available such as toilets and rubbish bins. At the entry point, tourists are greeted with an informative gallery that provides brief information about the island and services offered.

The other interesting and unique package that attracts tourist attention is the Pontoon which is located on the eastern shore of Pulau Payar. Sheltered from the south-west winds and surrounded by Pulau Kaca, Pulau Lembu and Pulau Segantang, its clear water and rich diversity of marine life offer visitors a firsthand encounter with nature. The pontoon is specially built to cater for both environmental and recreational needs which are strategically positioned away from authorities and sensitive marine life, and away from the coral colonies to prevent from any damaging effects to the corals.

1.5 Pulau Payar Marine Park as Tourism Attraction

Tourism is now a primary source of income in many developing countries and frequently exceeds the value, particularly the foreign currency value, of marine fisheries in those nations. Despite the importance to tourism of the quality of the natural environment, coastal and marine tourism areas are vulnerable to hasty and inappropriate development. Poorly managed tourism can lead to site degradation and a decline in visitor numbers. MPAs attract divers and other eco-tourists, thereby helping to establish sustainable alternative sources of income for local communities and building grass roots support for conservation programs (Commnwealth Department of Environment and Heritage, 2003). The establishment of MPAs is an

excellent way to raise the profile of an area for marine tourism and to broaden the local economic options. It is important that the introduction and development of tourism is carefully planned to ensure that it is acceptable and sustainable for the local human communities.

Since Pulau Payar was declared as a marine park, it received more 100,000 visitors in 2001 and make Pulau Payar Marine Park as the highest among all marine parks in Malaysia which received visitors. Pulau Payar is the most popular island as its sheltered waters are ideal for snorkeling, diving and swimming (Lim, 1997). Unfortunately, in November 2011, Pulau Payar Marine Park is suffering from excessive coral bleaching at critical level due to excessive carrying capacity and persistently extreme sea temperatures.

1.6 Background of Study

The aim and objective of this study is to provide the readers with an overview of the impact of Marine Protected Areas to the fish stock in Pulau Payar. This study is important in order to discover the effectiveness of the Marine Protected Areas in Pulau Payar as a fisheries management tool. This study will also indentify the status and challenges exist in implementing MPAs in Pulau Payar.

1.7 Problem Statement

Malaysia, through the Department of Fisheries, has established marine protected area or marine parks since 1984 to alleviate the problem of low fishery catches due to overfishing. Since its establishment, it is not known whether the marine parks are performing as expected, as there were lack of information available on the

productivity status of fish and coral in these marine parks. One of the main concern regarding protected areas on land and sea is their effectiveness at preventing the ongoing loss of biodiversity. There are multiple case studies indicating the positive effects of protected areas on terrestrial and marine species. However, those cases do not represent the majority of protected areas. Several limitations that may preclude their success include their small size and large isolation to each other their limited role at preventing the large of factors affecting biodiversity such as climate change and pollution, their large cost and their increasing conflict with human demands for nature's goods and services. Furthermore, the previous studies did not represent the total of fish stock in Malaysia increasing or decreasing.

1.8 Objective

General objective

The purpose of this study is to investigate the impact of Marine Protection Areas (MPAs) to the fisheries in increasing the fish stock in Pulau Payar.

Specific objective

i. To identify relationship between the stock of fish with the variables chosen.

ii. To calculate the density of fish stock in MPAs and the area surrounding Pulau Payar.

1.9 Scope and Limitation

This study was conducted in Marine Protected Area in Pulau Payar and used secondary data which was collected from the Fisheries Department of Kedah and the Department of Marine Park Kedah.

1.10 Conclusion

In this chapter, an overall brief explanation about this study is clarified. In the next chapter, a few literature reviews regarding this study will be acknowledged. It will put on view the definition and concept of Marine Protected Areas, coral reef and the theory of Marine Protected Areas as well as empirical framework that has been discussed by other scholars.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, a list of literature and past studies will be analyzed. The first part of this chapter will discuss about the definition of coral reef and MPAs. The next part of this chapter will review the evidence from empirical studies on the impact of MPAs to the fish stock and the coral reefs which are threatened by human activities, its effectiveness, and other factors such as size and the location of the MPAs. All these will help us to have a clearer picture on this study.

2.1 Definition and Concept

2.1.1 Definition of Coral Reef

Reefs are concretions produced by living organisms. According Bigot, Chabanet, Charpy, Conand, Quod and Tessier (2000), some reefs are formed by calcareous algae, others by molluscs or polychaeta, but most of the reefs in the world are composed of hermatypic coral which contains microscopic symbiotic algae (*zooxanthella*). These complexes form the substrate on which the reef ecosystems are based. Coral reefs are solid, long-lasting structures. Their solidity is due to the fact that they are formed by the hard parts of the animal skeletons. Their longevity is due to their ability to resist shocks even after the death of organisms. The interstices are sealed and soldered by sediments and coral secretions.

Coral reefs are amongst the most biologically diverse and productive ecosystems on earth. Associated with coral reefs are a myriad of organisms; fish and invertebrates, especially molluscs, crustaceans and echinoderms predominate, and algae are also abundant. Coral reefs are the feeding, breeding and nursery grounds for many fish and invertebrate species, many of which are commercially important. They are thus crucial for supporting the fisheries sector, and it has been estimated that reef fisheries have the potential to contribute approximately 12 per cent of all fish caught annually throughout the world (Wells & Price, 1992). Coral reefs act as a natural protection between the open seas and coastlines by acting as wave breaks, thus effectively preventing coastal erosion. They may also perform a vital role in protecting coastal areas from the consequences of predicted sea level rise such as storm flooding (Markham *et al.*, 1993). Furthermore, there is increasing evidence of the potential of reefs to act as bio-indicators for climate change, as they are sensitive to sea level rise and sea temperature. In addition, reefs are good indicators of coastal pollution, as they are sensitive to changes in their ambient environment. Coral reefs are also a potential storehouse of medicinally valuable species, many of which have yet to be discovered. Several reef-dwelling organisms have been found to produce highly active biochemical compounds with antibiotic, antileukumic, anticoagulant and cardioactive properties (De Silva & Ridzwan, 1982).

2.1.2 Definition of MPAs

A Marine Protected Areas (MPAs) is essentially a space in the ocean where human activities are more strictly regulated than the surrounding waters − similar to parks we have on land. These places are given special protections for natural or historic marine resources by local, state, territorial, native, regional, or national authorities.

Authorities differ substantially from nation to nation. In International Union for the Conservation of Nature and Natural Resources (IUCN) definition, marine protected areas is a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. Malaysia defined MPAs as a protected area of the sea zoned two nautical miles from the shore at lowest low tide. Marine Park or Marine Protected Area remains the same purpose which is to protect and conserve the critical marine habitats and its aquatic flora and fauna. This is in line with the approach taken by the (IUCN) under the World Commission on Protected Areas (WCPA) which promotes the establishment and effective management of terrestrial and marine protected areas (IUCN, 1997). There are several functions of MPAs:

(i) Accord special protection to aquatic fauna and flora, to preserve and manage the natural breeding grounds and habitat of aquatic life.

(ii) Allow natural regeneration where depletion has occurred.

(iii) Promote scientific study and research.

(iv) Preserve and enhance the undamaged system and productivity of the environment.

(v) Regulate recreational and other activities in order to avoid irreversible damage to the environment.

2.2 Issues Related To Coral

2.2.1 The Benefits of Coral Reef

Coral reef brings myriad benefit to the human. According to Costanza *et al*. (1997), reef provides crucial ecological services such as shoreline protection and maintains the biodiversity. In Philippines, reef fisheries provide more than a million small scale fishers that contribute almost one billion US Dollar to the economy (White, Vogt & Arin, 2000).

There are lots of benefits of coral reefs to humans. First, as a source of food and livelihood for at least 100 million people worldwide (Lesser, 2004) from fisheries that are supported by coral reefs. Second, it acts as a natural barrier that protects coastlines from tides, storms and hurricanes. Reefs dissipate the wave energy and decrease the destructive stress upon the coast (Sorokin, 1993). Third, as a source of alternative medicine (Quinn, R. J *et.al.*, 2002). Two examples are a potent pain-killing drug from the toxin of a reef-dwelling snail developed by scientists in California that is used for the treatment of severe pain in the terminally ill who are resistant to morphine; and the usage of coral skeletons as bone substitutes in reconstruction bone surgery. Fourth, reefs are important land builders in tropical areas, forming islands and altering continental shorelines (Goreau *et al.* 1979). Fifth, as a storehouse for biodiversity, and sixth as a recreatorial resource.

2.2.2 Coral Reefs are Threatened by Human Activity

Human activities such as over fishing, diving and boating harm the coral reef. Chadwick (1999) 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, Burke, Mcmanus and Spalding (1998), 85percent of coral reef in Philippines are at high risk of degradation because of human activities and less than 5percent of coral reef are in good condition. They also estimated that 80percent of coral reef in south east Asia are under high risk. CoRIS (2005) noted that within 10 to 20 years, 30percent of coral reef in critical condition by 2050, 50percent of world coral reef may die because of degradation.

Destructive fishing, also known as fish bombing or dynamite fishing, has been reported from almost all countries in the Southeast Asia region. This is done with the use of home-made explosives composed of fertilizers such as ammonium and potassium nitrate, kerosene (fuel oil) and fuse caps inserted into empty bottles (Woodman *et al.,* 2003). Blast-fishers hunt for schooling reef fish, which aggregate in groups in the open or hide under large coral heads. The bombs are usually dropped into the centre of an area judged to have many fish and after the bomb has exploded the fishermen use dip nets to collect the stunned and dying fish. Fish blasting at high intensity is particularly destructive because it transforms a reef from a productive and solid structure to an area of mobile rubble instead of a reef crest and upper reef slope that takes years to recover (Woodman *et al.,* 2003). One of the most destructive fishing methods involves the use of cyanide. An aqueous solution of sodium cyanide or other chemical is squirted at fish to stun them, after which they are collected and sold to the live-fish trade. In the process of stunning the fish, the cyanide affects corals, small fish and invertebrates. A solution, which is narcotising to large fish, is often lethal to smaller ones (Kolm & Berglund, 2003). Cyanide has also been shown to limit coral growth, cause diseases, bleaching, and ultimately, in many coral species, leads to death.

2.2.2 MPAs Effectiveness

MPAs can be a useful tool not only for fisheries management, but also for maintaining coral cover. Furthermore, the benefits of MPAs appear to increase with the number of years since MPA establishment. Selig and Bruno (2010) note that on average, coral reef in MPAs remained grow constant, while coral reef on unprotected reefs declined. Although the short-term differences between unprotected and protected reefs are modest, they could be significant over the long-term if the effects are temporally consistent. They also suggest that older MPAs were generally more effective in preventing coral loss.

The evaluation of the effectiveness of MPAs in sustaining fisheries was among the key activities described by IUCN in order to ensure that MPAs were given sufficient time to re-establish viable fish stocks (Williams, 1998). Although there are numerous potential benefits to MPAs, there are costs associated with their establishment and implementation. Surrounding fished areas could become congested due to too many fishers concentrated in a smaller area.

2.2.3 Enhancement of Fish Stock Due to the Implementation of MPAs

The abundance of fish in a specific location can be attributed to many factors. Habitat arrangement and complexity, depth or distance from shore, seasonality and exploitation are among the important parameters. In term of seasonality, the abundance of fish in Malaysia is known to be different from the pre and the post northeast monsoon season, while the abundance and diversity of demersal fish are known to be different from sandy to muddy bottoms. Coastal habitats are also known to be more productive than open water habitats (Man, 2008). Protected areas can increase reproductive output and diversity of species than adjacent unprotected areas

(Schmidt 1997; Roberts 1998; Roberts *et al.,* 2001;. Gell &Roberts 2003; Worm *et al.,* 2006;. Gladstone 2007). Unprotected areas adjoining commercial catch, through migration will increase in abundance, and increase the size of the fish (Roberts *et al.,* 2001).

A case-study of a marine reserve in the Philippines, used by many authors, suggests the existence of a positive effect on catches in adjacent fishing zones (Russ & Alcala, 1996). The survey revealed a decrease in landings following the reopening of the reserve to fishing. This study provided some confirmation of the assumption of a transfer effect of adult fish from the reserve to the fishing zone. Another study showed an increase in catches per unit of effort (CPUE) in the St-Lucia islands, by comparing the CPUE of artisanal fishermen before the creation of the reserve and 5 years later (Roberts et *al.* 2001). Recreational fishing is also used as an example to demonstrate the benefits of MPAs for fishing. According to Johnson *et al.* (1999), the change in the frequency of official records concerning sport fishing indicates a positive impact of the reserve that was created around the Cape Canaveral launching base in Florida.

2.2.4 Location and Size of MPAs

Protected area size and location are important in protecting habitat and ecosystems. Small MPAs may show positive results but have a larger border to protected area ratio than large MPAs. Therefore the chances of a spill-over of recruits to adjacent areas are higher than chances of species remaining within small MPAs, resulting in low biomass development (Walters, 2000). Large reserves may provide a higher spill-over into adjacent areas while allowing the stock the space to bounce back in times of high stress or shock (Sumaila *et al.,* 2000). Large protected areas limit the

proportion of stock exposed to perturbation and therefore a few large areas may protect ecosystems better than several small ones (Walters, 2000). Large MPAs may be required in temperate and Arctic/Antarctic latitudes due to highly migratory species with high dispersal rates. Laurel and Bradbury (2006) found that with each degree of increase in latitude, there was on average an 8percent increase in dispersal potential and decrease in population substructure. Therefore MPAs placed in high latitudes may need to be extremely large in size in order to retain an increase in biomass of species. Additionally, small MPAs, MPAs close to coastal communities, and MPAs located in developed countries may have higher operating costs. A global network of MPAs that protects 20-30percent of the world's marine ecosystems may cost between 5 and 19 billion US dollars and create more than one million jobs (Balmford *et al.,* 2004).

Location in relation to preferred habitat is extremely important because large aggregations of species may occur in or around a specific habitat feature or oceanographic feature (Roberts *et al.,* 2006). If MPAs are created at random and preferred habitat is not taken into account, benefits may be minimal. MPA benefits may also depend on whether MPA location is near features that minimize dispersal (Walters, 2000). Protected areas located in feeding grounds may affect size structure in certain fish populations, while protection in spawning grounds may enhance larval production. Dunlop *et al.* (2009) determined that reserves located in feeding habitats could potentially reduce evolutionary-selected pressures on species and therefore preserve evolutionary traits such as age and size at maturation.

2.2.5 Weather and Global Warming

Global warming, resulting from the greenhouse effect and the build-up of carbon dioxide in the atmosphere, might also kill corals. The extensive coral-bleaching event that took place in 1998, which was particularly severe in the Indian Ocean region, is accepted as having been the result of a rise in sea surface temperature. Bleaching of coral colonies occurs through the expulsion of *zooxanthellae* as coral polyps become stressed by adverse thermal gradients. If not matched by coral growth, this will mean that corals will be submerged deeper and will not receive the levels of sunlight required for photosynthesis by the *zooxanthellae*. Additionally, the ability of coral reefs to protect coastlines from erosion will be lost if the waves are able to wash over the newly submerged reefs (Ahmad, 2009).

According to a report from the World Trade Organization (WTO), more than a quarter of the world's reefs are at high risk, and just under a third of these habitats are at moderate risk, from human disturbance (Bryant *et al.,* 1998). Of the four broad categories of potential threat to coral reefs evaluated (overexploitation of marine resources, coastal development, inland pollution and marine pollution), overexploitation of marine resources, including destructive fishing practices, and coastal development present the greatest threat. Globally, 36 percent of all reefs were classified as threatened by overexploitation, 30 percent by coastal development, 22 percent by inland pollution and erosion, and 12 percent by marine pollution. When these threats are combined, 58 percent of the world's reefs are at risk (Bryant *et al.,* 1998).

2.2.6 Visitors' Activities in MPAs

Human activities in the MPAs area also bring effect to the coral reef and will affect the fish stock adjacent to MPAs. Human activities such as coral collection, snorkeling and scuba diving will cause the coral reef damaged more worse. The effect can be very severe where tourists especially those lacking of understanding about the delicacy of the corals can damage the corals. Large increases in tourism market have been accompanied by concerns about deterioration of marine parks caused by diving and snorkelling (Plathong *et al.*, 2000; Rouphael & Inglis, 2001). There are proofs of tourists stepping on the corals while snorkelling and divers accidentally bruise corals with their hands, body, equipment and fins while diving near the corals (Rouphael & Inglis, 2001). The total of damaged coral reef increased will affect the fish stock in the area of MPAs.

A study done by Hawkins and Roberts (1993) showed that divers can damage reefs in several ways. In their study at three very popular Red Sea dive sites recorded several key attributes (numbers of hard coral species, colonies, broken coral, loose fragments of coral and abraded coral) at the three sites. They did the same for several non dived sites to be used for comparison, monitoring all sites for a year. The study found significant differences between the dived and non dived sites, the former containing more damaged coral, thus indicating that divers do cause damage to coral reef systems. This damage can cause the corals to be unable to fight off disease and parasites. Rouphael and Inglis (2001) also found that the increasing popularity of scuba diving has put more strain on coral reefs around the world. Divers frequently make contact with fragile corals, breaking them or damaging their fragile tissue surface, leaving them susceptible to bacterial attack and disease.

2.3 Conclusion

This chapter had shown some of the literature reviews that are relevant to this study. In chapter three, this study will explain the methodology that will be used to measure the impact of number of invasion cases, number of visitors, type of visitors, visitors activities in scuba diving, visitors activities in snorkeling and government allocation to the total fish stock.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter will describe the design and research process, explained the data collection procedure, the data analysis procedure as well as the validity and reliability of the result. This chapter will also explained the theoretical framework and measurement variables that has been used in this study.

3.1 Data Collection

The information used for the study was derived using the following approaches:

(i) The secondary data were collected from annual reports of Fisheries Department of Kedah and Marine Park Department of Kedah.

(ii) The other variable information is through phone interviews to Travel Agencies that operate their business related to visiting to Pulau Payar.

3.2 Study Area

Study sites were chosen for the following reasons:

(i) Active management committees: The area has an active management board that effectively oversees the marine parks with most of its members participating in its endeavors.

(ii) Amount of data available: The area has an abundance of existing independent studies regarding the different aspects of the MPAs, to facilitate the need of the study for secondary data collection.

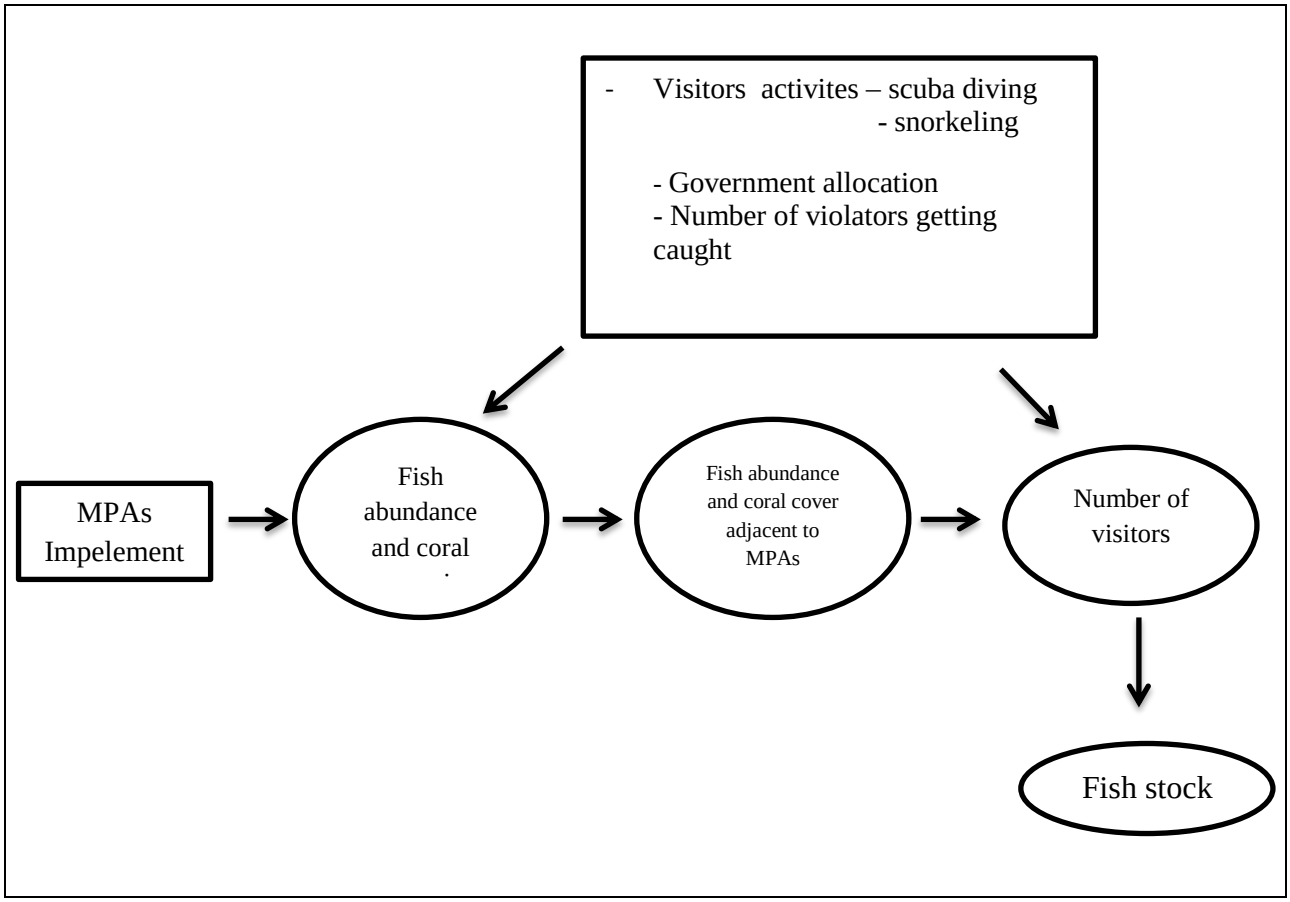
(i) The location: It is located at the centre of fishing activities of various fishing methods, where yield of fishes were reported to have improve after the 21 establishment of the MPAs. As one of the earliest MPAs and located in one of the most important fishing ground in the country, its selection as the study site would provide useful information about the impact of MPAs on the fishery.

(ii) The facilities: Being close to Penang and Langkawi, and connected through boat reliable services, the Marine Park authority on the island also provides good research facility for scuba diving, accommodation and assistance while carrying out research activities on the island.

3.3 Theoretical Framework

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 fi n abundance inside the MPAs can be maintained or increased, which leads to an increase in fish abundance outside the MPAs.

Figure 3.1: The relationship between MPAs and the independent variable to the fish stock.



Source: Gjertsen. H, 2005.

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 visitors 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 increase the number of visitors that doing the marine activities. The visitors, especially foreigners, recorded the total number of visitors who visit the MPAs. Lim (1996) in his study on Pulau Payar Marine Park, found that the nationality of visitors mostly come from Taiwan, Japanese and European countries. Government allocation is very important to ensure the good facilities in the MPAs. Costly activities of marine protected areas,

such as providing more chalets, improving coral reef health need a huge government allocation to complete the facilities.

Number of violators getting caught is one of the factors that influence the fish abundance and coral cover inside and outside the MPAs. The fishing activities in the MPAs' area are the 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 acts directly to monitor the activities in the water, especially in the area of marine parks for example recreational activities such as snorkeling and scuba diving which showed that it will impact the number of fish stock inside the number of violators getting caught and outside the MPAs. If number of violators getting caught increase, it will increase the number of abundance of fish inside and outside the MPAs thus will lead to deterioration of fish stocks.

3.4 Research Design

In order to analyze the specific relationship between dependent variable (fish stock) and independent variables (visitors activities in scuba diving, visitors activities in snorkelling, number of visitors, government allocation, and number of violators getting caught). This study perform an Ordinary Least Square (OLS) regression analysis by using SPSS and STATA.

To examine the relationship between both dependent variables and independent variables, the following linear regression model is used to examine this study.

F_STOCK = const + (VGC) + (N_VIS)+ (SCUBA)+ (SNOR) + (GOV_A) + e

F_STOCK = Fish stock

VGC = Number of violators getting caught

N_VIS= Number of visitors

SCUBA = Visitors activities (scuba diving)

SNOR = Visitors activities (snorkeling)

GOV_A = Government allocation

e : Error term

3.5 Variables' Measurement

3.5.1 Dependent Variable

3.5.1.1 Fish stock

Fish stock is the dependent variable in this study. According to Adjaye (2008), there are positive effect exist on catches in adjacent fishing zones in the Philippines since the survey revealed a decrease in landings following the reopening of the reserve to fishing. This study provided some confirmation of the assumption of a transfer effect of adult fish from the reserve to the fishing zone. Another study showed an increase in catches per unit of effort (*CPUE*) in the St-Lucia islands, by comparing the CPUE of fishermen before the creation of the reserve and 5 years later (Roberts *et al.*, 2001).

3.5.2 Independent Variables

3.5.2.1 Number of visitors

An uncontrolled increase in tourists is likely to generate congestion, or overcrowding. It may result in a lower quality of environment, leading to undesirable consequences. There is evidence to show that tourism has negative environmental consequences (Davis & Moretti, 2004). In the case of MPAs, divers may damage habitats, for instance when their fins hit corals or when they trample on reef-flat communities (Hawkins and Roberts, 1993; Harriott *et al.*, 1997). This variable which contradicts the objectives of protection assigned to MPAs, may in turn decrease the attractiveness of the MPA to tourists.

3.5.2.2 Visitors' activities

For this variable, visitors' activities are divided into two types – scuba diving and snorkeling. Scuba diving and snorkeling activities were chosen because both activities recorded a high number of activities that has been done by the visitors. Large increase in tourism market has been accompanied by concerns about deterioration of marine parks caused by diving and snorkeling (Plathong *et al.*, 2000; Rouphael & Inglis, 2001). There are proofs of tourists stepping on the corals while snorkeling, and divers accidentally bruise corals with their hands, body, equipment and fins while diving near the coral and it will affect the fish stock in the area of MPAs.

Rogers *et.al* (1988) who have studied on assessing the damaged caused to coral reefs, has seen that significant impact that recreational activities in Virgin Islands National Park and Biosphere Reserve have caused the coral reef damaged in

that areas. This has proven that recreational activities bring negative impact to the coral reef.

3.5.2.3 Number of violators getting caught

Fishery resources in MPAs that are sanctuaries for fish breeding grounds will be affected if the amount of invasion increases. It is widely acknowledged that effectiveness of enforcement is a weak point in fisheries management (Jones, 1994). Jones also noted that number of trespassing cases reducing the benefits expected from a creation of the reserve and this problem is the major cause of MPAs failure. According to Crowder *et al.* (2000), simplifying enforcement requires that the borders of the reserve are easy to control. Other author noted the potential benefits in term enforcement depend on the marine park management to handle this problem.

3.5.2.4 Government allocation

There are several researches that have proved that it is very costly to manage the MPAs and it needs a huge allocation from stakeholders to support this cost especially the allocation from government. Government allocation to the fisheries sector represent a huge impact to the fish stock. Increased community and stakeholder involvement can increase the effectiveness of MPAs (Christie 2004; Lundquist and Granek 2005). If stakeholders do not support MPAs, conflict and disagreements can arise that may ultimately decrease the success of the MPA. In the Philippines, one MPA had a decline in fish abundance of 291 percent in one area due to social discord between the local community and the centralized government agency that controls the MPA (Christie, 2004). General allocation for fisheries research, management, and development especially improvement of infrastructure are important for ensuring

the sustainable utilization of fish stocks and protection of aquatic ecosystem. Some governments such as Philippines collect money in more far-reaching and indirect ways that are not linked to specific parks or conservation areas (Gjertsen, 2005). User fees, income taxes, taxes on sales or rental of recreation equipment, and license fees for activities such as hunting and fishing can provide governments with the funds needed to manage natural resources. Such funds can be used for overall conservation programs and activities, such as park ranger salaries and park maintenance.

3.6 Expected Sign of Independent Variables

Variables	Expectation Sign
Number of visitors (N_VIS)	-
Visitors activities in Scuba diving (SCUBA)	-
Visitors activities in snorkeling (SNOR)	-
Number of violators getting Caught(VGC)	+
Government allocation	+

3.7 Conclusion

In this chapter, the methodology of the study is clearly explained. The empirical model of this study is also clearly presented. In the next chapter, the result after estimating the model will be shown.

CHAPTER 4

RESULT AND FINDINGS

4.0 Introduction

This chapter is about the results and findings for the collected data. The main discussion is based on the research objectives stated in chapter one. This chapter is divided into four sections. Section 4.1 discussed the descriptive analysis. Section 4.2 provides the regression analysis of the data and variables for this study. Then section 4.3 concludes the chapter.

4.1 Descriptive Analysis

In order to conduct this study, information about the variables were collected from the Fisheries Department of Kedah and Department of Marine Park Kedah.

4.1.1 Total Fish Landings in Area of Pulau Payar

Figure 4.1 below shows the total fish landings in area of Pulau Payar. The highest reported landing was in 2009, where 106,486 tonnes of fish has been landed in that year. The lowest total fish landing was in 2006, where only 67,122 tonnes of fish has has been caught.

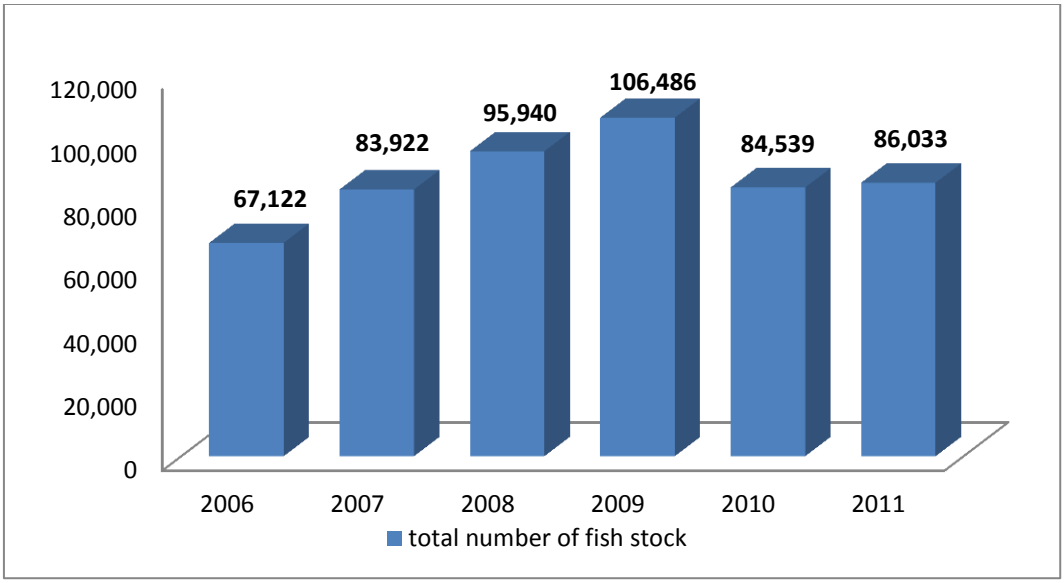
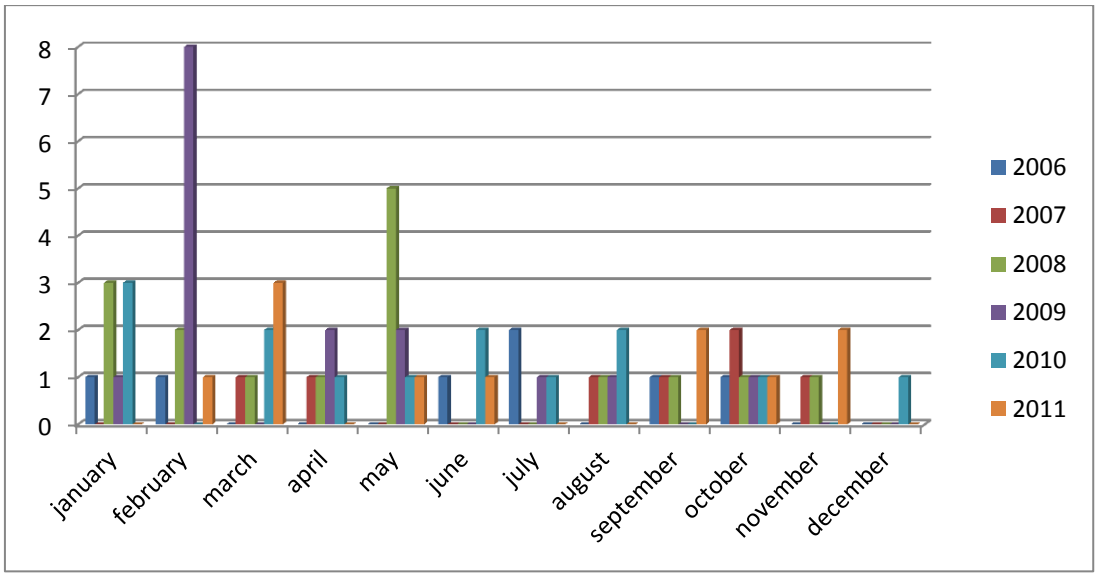


Figure 4.1: Total Fish Landings (tonne) in 2006 to 2011

Source: Marine Park of Malaysia Annual Report 2011.

4.1.2 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).



Year	2006	2007	2008	2009	2010	2011
January	1	0	3	1	3	0
February	1	0	2	8	0	1
March	0	1	1	0	2	3
April	0	1	1	2	1	0
May	0	0	5	2	1	1
June	1	0	0	0	2	1
July	2	0	0	1	1	0
August	0	1	1	1	2	0
September	1	1	1	0	0	2
October	1	2	1	1	1	1
November	0	1	1	0	0	2
December	0	0	0	0	1	0
TOTAL	**7**	**7**	**16**	**16**	**14**	**11**

Figure 4.2 : Number of violators getting caught by month in 2006 to 2011.

Source: Marine Park of Malaysia Annual Report 2011.

The highest number of violators getting caught were 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 show that there are awareness among fishermen on the importance of protecting the marine biodiversity.

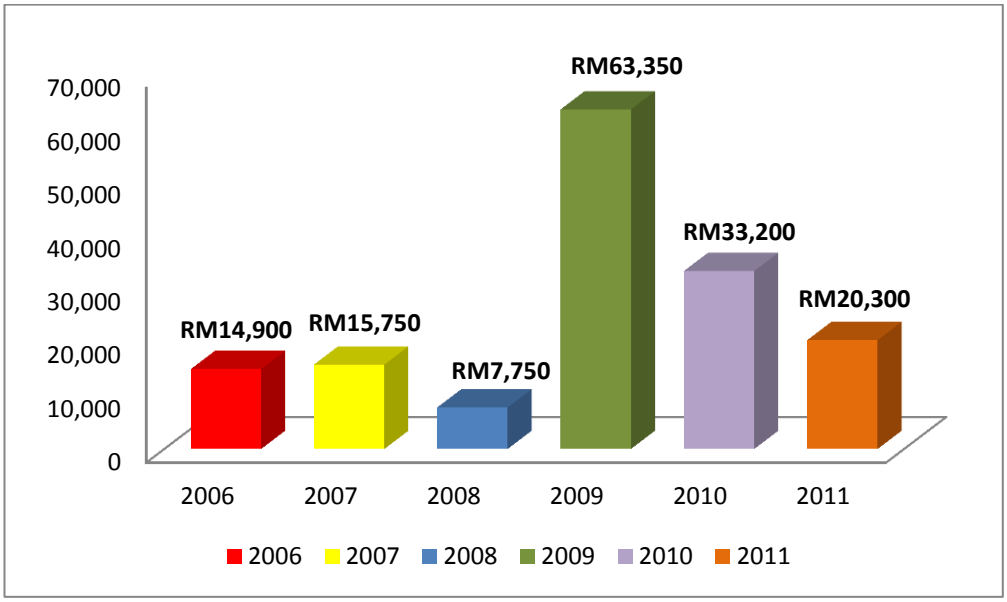


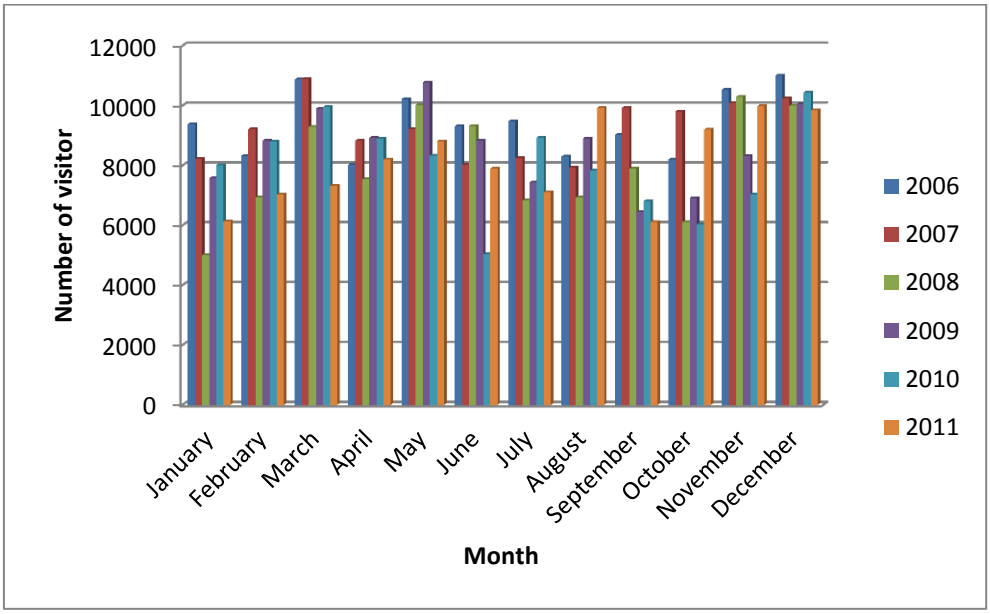
Figure 4.3 : Total compound in 2006 to 2011.

Source: Marine Park of Malaysia Annual Report 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.

4.1.3 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.



Year	2006	2007	2008	2009	2010	2011
January	9387	8219	5005	7572	8008	6131
February	8320	9211	6932	8832	8803	7032
March	10872	10893	9292	9892	9954	7321
April	8021	8823	7543	8922	8900	8201
May	10213	9218	10,021	10,772	8,328	8809
June	9311	8023	9,321	8,831	5,032	7900
July	9472	8248	6,832	7,432	8,932	7108
August	8300	7932	6,932	8,901	7,831	9931
September	9021	9932	7,890	6,437	6,801	6112
October	8200	9803	6,112	6,912	6,032	9200
November	10532	10094	10291	8321	7034	9984
December	10999	10233	10000	10042	10442	9843
Total	**112648**	**110629**	**96171**	**102866**	**96097**	**97572**

Figure 4.4: Total number of visitor in Pulau Payar in 2006 to 2011

Source: Marine Park of Malaysia Annual Report 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 emphasises its marine environmental attributes, and is sold as a Marine Park with some conservation emphasis.

4.1.4 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).

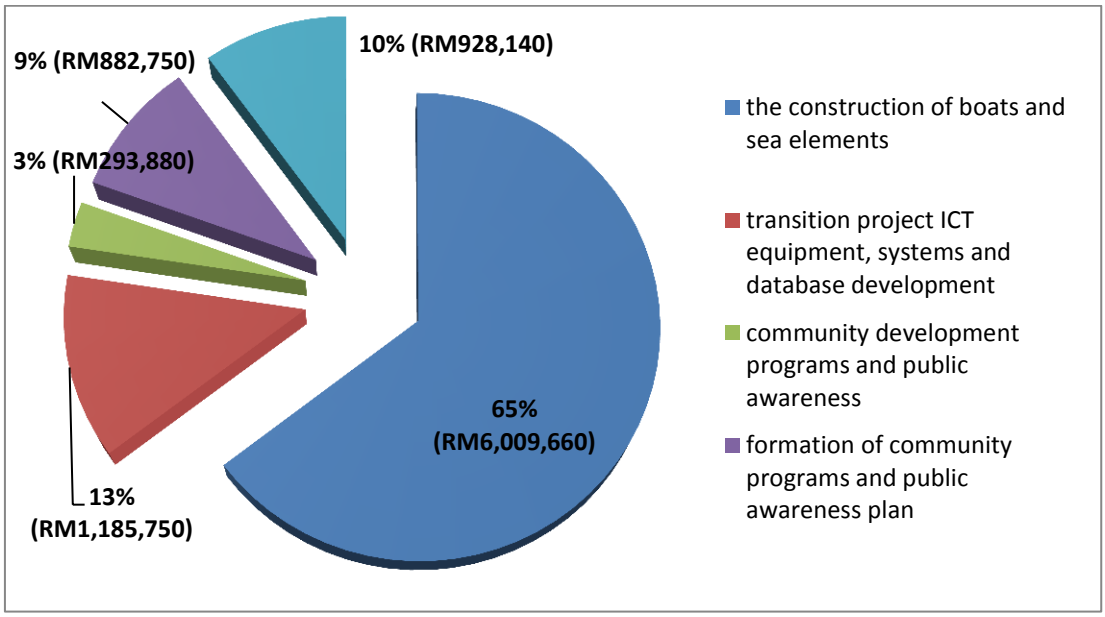


Figure 4.5: Government allocation according development projects in 2011.

Source: Marine Park of Malaysia Annual Report 2011.

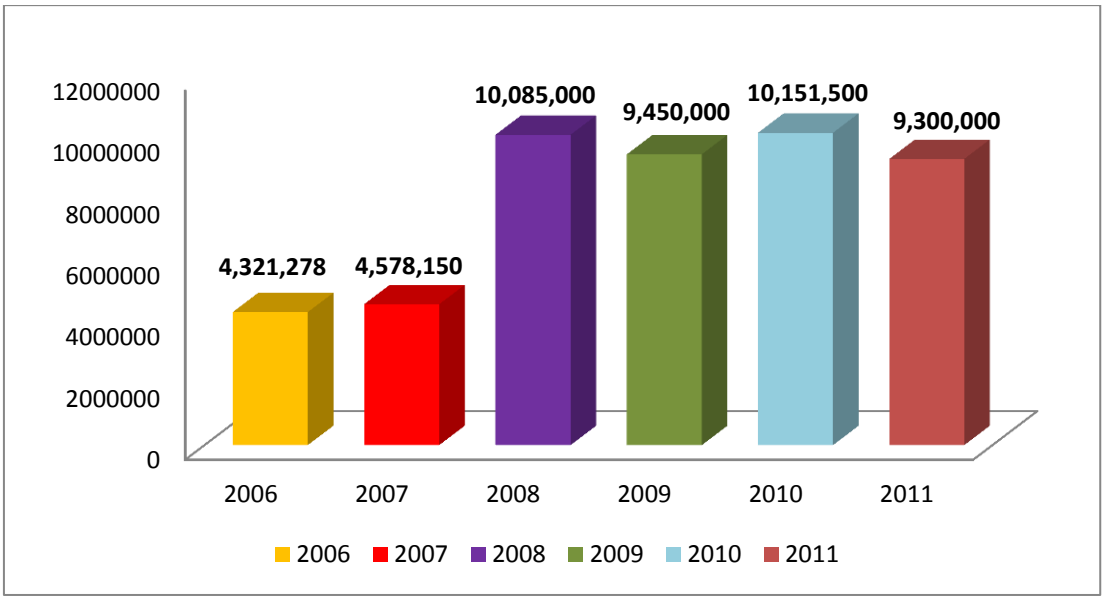


Figure 4.6: Total govenrment allocation to the Marine Park Department in 2006 to 2011

Source: Marine Park of Malaysia Annual Report 2011.

The figure above demonstrates that 2010 recorded the higher allocation compared to other years by RM10,151,500 million followed by 2008 which is RM10,085,000 million.

4.2 Regression Analysis

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 4.8: Estimated Ols Model Results Of Factors Affecting Total Number Of Fish Stock In Pulau Payar (OLS Model)

Dependent Variable : F_STOCK

VARIABLES	**Coefficients**	**Sig.**
Number of violators getting caught (VGC)	337.292	0.029**
Number of Visitors (N_VIS)	-0.364	- 0.017***
Type of Activities (SCUBA)	-3.857	- 0.000***
Type of Activities (SNOR)	0.338	0.350
Government Allocation (GOV_A)	0.004	0.000***

$R^2 = 0.353$

Adjusted $R^2 = 0 .304$

F-statistic = 7.216

Note : *** Significant at 1 percent level

** Significant at 5 percent level

* Significant at 10 percent level

Based on the regression result in the table 4.8, 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 constant value is 4252.0 which mean that if the value of the independent variables is 0, the total fish stock is 4252.0 tonnes, ceteris paribus (see Appendix A).

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 fishermans 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 sorrounding the area, leading to an undesirable consequences from acultural 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. This result support by other studies. 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 visitors activities in snorkeling (*SNOR*) has a positive relationship with the fish stock and its contradict with the expected result. Probably due to the highly awareness of the visitors about protecting the marine life. This result is contradict with previous research by Hawkins and Roberts, (1993), where they stated that the snorkellers caused more uneven, very patchy damage by standing up on the coral. While doing so, the snorkellers would have trouble controlling their fins and caused coral damage in this way. The snorkellers' 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. In this OLS regression, there are no heteroscedasticity and multicolinearity problem after OLS regression has been done (see Appendix B and Appendix C).

4.4 Conclusion

The result of this study showed that MPAs impact significantly to the fish stock. Some of the results obtained were equal to the estimated results in chapter 3 and some were not. The following chapter provides conclusion of this study as well as policy implications and recommendations.

CHAPTER 5

CONCLUSION AND POLICY RECOMMENDATION

5.0 Introduction

This chapter will present the summary of the major findings of the study. Policy recommendations and suggestions for further research will also be discussed in this chapter.

5.1 Major Findings of The Study

From this study, it can be concluded that only four variables significant at 1 percent and 5 percent. There are a number of violators getting caught, number of visitors, recreational activities such as scuba diving and government allocation has an impact to the number of fish stock in Pulau Payar. However, factor like snorkeling are not significant.

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 umber of violators getting caught responding appreciably to the total fish stock with the highest coefficient by 337.3 tonnes. It showed that a number of violators getting caught have a very strong relationship with the dependent variable and its 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 mean that the number of visitors and total fish stock did not bring effect to the total fish stock in Pulau Payar but it had a positive impact on the tourism sector in Malaysia in 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*.

5.2 Policy Recommendations

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.

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 controling 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.

5.3 Suggestions for Further Research

There is evidence to suggest that marine parks or marine protected areas play an important supporting role to the fisheries industry 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.

Research on the role of marine parks in Malaysia in supporting the fisheries sector needs to be improved and collaborative research is important as the information needed has to come from many disciplines, not just marine biology or ecology. Moreover, the further studies should be emphasizing on the types of visitor that able to have a big impact on MPAs.

5.4 Conclusion

Malaysia has come a long way in conserving our invaluable marine resources and sustainable management of our marine resources is important. The decline in marine ecosystems around the globe needs to be reversed. Otherwise a sustainable supply of marine products, such as high quality protein, cannot be maintained. Realizing the potential of other uses and values requires careful management of what remains. Marine protected areas are an important tool to help manage the oceans and meet the needs of the increasing world population and demands for a reasonable quality of life. Proactive and cooperative governance of our marine parks from our Federal Agencies, State Government, NGOs, and the public are crucial in order to fully realize and sustain the benefits of our marine resources loaned to us by our children.

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