CORAL TRIANGLE INITIATIVE
ON CORAL REEFS, FISHERIES AND FOOD SECURITY

State of the Coral Triangle Report HIGHLIGHTS

MALAYSIA

Executive Summary

A Comprehensive Action Plan for the Sulu-Sulawesi Sea Marine Ecoregion (SSME) was developed that is consistent with the goals of the Coral Triangle Initiative (CTI). Among others, the Action Plan includes the full application of the ecosystem approach to the management of fisheries and other marine resources. The Action Plan is a response of the member governments to meet the targets not only of the SSME Initiative, but also the CTI and the Millennium Development Goals (MDGs) to improve fisheries stocks by 2015 and improve the socioeconomic condition of coastal communities.

Biophysical attributes

Malaysia is comprised of two distinct regions: Peninsular Malaysia on the southeastern part of the Asian continent; and East Malaysia, which includes Sabah and Sarawak on Borneo Island. The coastline borders seven major seas, viz., Andaman Sea, Malacca Strait, Straits of Singapore, Gulf of Thailand, South China Sea, Sulu Sea, and Sulawesi Sea (Celebes Sea). The total coastline of Malaysia is 4,809 km long (Peninsular Malaysia, 2,031 km; Sabah, 1,743 km; and Sarawak 1,035 km).

Over 60% of the country is still **rainforest** with 8,000 species of flowering plants in Peninsular Malaysia alone. Sabah, the second largest State of Malaysia after Sarawak, faces three main seas: Sulu Sea, Celebes Sea, and South China Sea. Located near the equator, Malaysia is generally warm throughout the year, with temperatures ranging from 21°C–32°C. Annual rainfall is recorded at 2,500 mm, and humidity level is high at 80%.

Coral reefs cover an estimated 4,000 km^2 of coastal area in Malaysia. Information about the health of coral reefs in Malaysia is somewhat limited. Survey data are fragmented and distributed among numerous institutions. Data reported in the Global Coral Reef Monitoring Network's "Status of Coral Reefs of the World" showed that 38% of the reefs have greater than 50% coral cover in 2004. However, a comparison of data from 1994-2004 revealed a general decline in the reefs previously classified with greater than 50% coral cover.

Mangroves are scattered along the coastline and are very well developed in sheltered estuaries, deltas, lagoons, and coral reef terraces. Mangroves cover 5,750 km^2, of which 60% are found in Sabah, 23% in Sarawak, and 17% in Peninsular Malaysia. Malaysia has lost approximately 36% of its mangrove forest area and 22% of mangrove forest reserves to unsustainable human uses of mangrove lands and overexploitation of natural resources.

Seagrasses are restricted to sheltered areas in the shallow intertidal zone and associated ecosystems, semi-enclosed lagoons and sub-tidal zones, and between mangrove and coral reef ecosystems. There are currently 18 species of seagrasses recorded in Malaysia. There is a paucity of information on the total area covered by seagrass beds in Malaysia, and a quantitative assessment of their status is not available. However, this ecosystem is highly threatened by sedimentation resulting from coastal development activities.

Malaysia has about 200 gazetted **marine protected areas** (MPAs) under various legislations and departments. These include marine parks, state parks and fisheries protected areas, mangrove reserves, bird sanctuaries, wildlife sanctuaries, and RAMSAR sites. More than half of these MPAs are mangrove reserves.

The government of Malaysia has indicated the importance of economic valuation of

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Key Statistics

BIOPHYSICAL	
Total land area	329, 847 km²
Total coastline	4,809 km
Total sea area	614,159 km²
> Internal waters	97,307 km²
> Territorial waters	63,666 km²
> Exclusive economic zone	453,186 km²
Continental shelf area	476,762 km²
Total coral reef area	4,000 km²
Total mangrove area	5,750 km²
Total seagrass area	No data

SOCIO-ECONOMIC	
Population (2010)	28.3 million
Mean annual population growth rate (2000-2010)	2.0%
Fish consumption per capita	56 kg
Fisher population (2011)	144,424
Total landed catch (2010)	1,428,881 tons

these ecosystems and the potential monetary gains they may generate through the application of the payment for ecosystem services (PES) mechanism. However, not much research has been done on the economic valuation of corals and coral reef resources, or other marine resources for that matter.

Governance

Both the federal and State governments have jurisdiction over the management and enforcement of laws on the use of marine and coastal resources. State governments have authority over land matters up to three nautical miles seaward, measuring from the low water mark, while the federal government has jurisdiction over the marine estate of up to 200 nautical miles out to the sea.

Several **federal laws** are relevant to marine and coastal resources management and conservation. These include the *Fisheries Act* (1985), *Environment Quality Act* (1974), *National Forestry Act* (1984), *Wildlife Protection Act* (2010), *National Parks Act* (1980), *Malaysian Maritime Enforcement Agency Ac*t (2004), *Customs Ac*t (1967), *Exclusive Economic Zone Act* (1984), *Merchant Shipping Ordinance* (1952) and *Merchant Shilling (Oil Pollution) Ac*t (1994). At the Sabah State level, relevant laws include the *Environment Protection Enactment* (2002), *Forest Enactment* (1968), *Forest (Constitution of Forest Reserves and Amendment) Enactment* (1984), *Parks Enactment* (1984), *Sabah Biodiversity Enactment* (2000), and *Wildlife Conservation Enactment* (1997).

Policies relevant to biodiversity and resources management are also in place. At the federal level, these include the National Biodiversity Policy (1998), National Forestry Policy, National Environment Policy, National Agro-Food Policy, National Physical Plan, National Ecotourism Plan, and National Policy on Climate Change. At Sabah State level, relevant policies include the Sabah Forestry Policy (2005), Sabah Agricultural Policy (1999-2010), and Sabah Environmental Education Policy.

On the international front, Malaysia is party to many **international conventions** and member of several regional fisheries bodies (RFOs). One of the main conventions is the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which was ratified by Malaysia in 1996. Other international conventions ratified by Malaysia include the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), 1975; Convention on Biological Diversity (CBD), 1992; United Nations Framework Convention on Climate Change (UNFCCC), 1992; RAMSAR Convention, 1971; and Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979.

Social and economic importance of marine resources and ecosystems

Malaysia's **general population** was estimated to be 28.3 million in 2010, of whom 74.1% live in Peninsular Malaysia. There are three main ethnic groups, viz., Malays, Chinese, and Indians. The Malays make up the majority of the population at 53.5%, with an additional 11.8% consisting of bumiputras. As of 2003, approximately 98% of the total population resided within 100 km of the coast.

The **fisher population** in the country was estimated at 144,424 in 2011. Local fishers constitute 72% of the total fisher population; the remainder are foreign fishers, mostly from Thailand, Indonesia, and Vietnam. The number of foreign fishers is increasing at a faster rate than the local fishers. Despite various policies and programs introduced by the government, the fishing community remains one of the poorest sectors in the country, majority of whom reside in Sabah, where they comprise 53.4% of the total fisher population.

Total fish catch landing in 2010 was recorded at 1,428,881 tons (t), representing about 70.93% of the total national fish production. The fish landings consist of pelagic fish (37.28%); demersal fish (20.38%); and molluscs, crustaceans, and others (42.34%). The offshore fishery (beyond 30 nautical miles from the coast) is still relatively small compared to the coastal fishery (within 30 nautical miles from the coast). In Sabah, landings are mainly from the coastal fisheries. However, there are increasing efforts by the government to pursue deep sea fishing.

Threats, vulnerabilities, and emerging issues

Coral reefs in Malaysia face many threats. The **major ecological threats** in in Peninsular Malaysia are related to agriculture development, resulting in increased sedimentation and nutrient runoff. In East Malaysia, destructive fishing practices, such as cyanide fishing, are prevalent, especially in Sabah, while river sedimentation is the main threat to coral reefs in Sarawak.

Coastal fisheries resources have declined substantially, and the coastal fishing sector suffers from excess fishing capacity. Many have advocated for a more sustainable approach to the management of fisheries resources, such as the implementation of the ecosystem-based management of fisheries (EBMF) to manage fish stocks and their surrounding habitats. Ongoing programs, such as the SSME Initiative, strongly support the implementation of EBMF. Within the CTI program itself, efforts are underway to develop and implement EBMF as a means of ensuring sustainable food supply while, at the same time, preserving and maintaining the marine environment. However, without adequate institutional and legal provisions, programs like these will remain ineffective.

Threatened species in Malaysia include marine turtles, marine mammals (such as the dolphins and dugongs), sea cucumber, and the humphead wrasse. These species are vulnerable in the face of habitat destruction, poor marine water quality due to a variety of pollutants, and inadequate institutional arrangements. Species-specific threats include fisheries by-catch (for marine turtles and marine mammals), direct poaching, and long-term egg harvest (for marine turtles).

Other emerging issues for marine resource management in Malaysia include threats from mariculture activities, increased events of harmful algal blooms, introduction of invasive species through ballast water, ocean acidification and climate change impacts on the marine environment and biophysical characteristics, economic activities, and social well-being. However, more research is needed to evaluate these emerging threats.

Malaysia and its National Plan of Action

Since Malaysia's involvement in the CTI, committees have been set up, and plans and programs have been developed on an ongoing basis. At the 3rd CTI Ministerial Meeting in October 2011, Malaysia was appointed Chair of the CTI Council of Ministers for a two-year term effective November 2011. Some of the main challenges during this period are to (i) ensuring a smooth transition from the CTI Interim Regional Secretariat to a permanent Regional Secretariat to be based in Manado, Indonesia by April 2012; (ii) ensuring implementation of the CTI Activities Roadmap 2012; and (iii) strengthening regional cooperation towards sustainable financing for the CTI.

Malaysia has established its own **CTI National Coordinating Committee** (NCC) chaired by the Ministry of Science, Technology, and Innovation (MOSTI), with the National Oceanography Directorate (NOD) serving as the National Secretariat. The NCC members comprise high-level decision

makers and senior officers from relevant government departments and agencies. The main task of the NCC is to provide guidance and support in the implementation of Malaysia's CTI National Plan of Action (NPOA) and Regional Plan of Action (RPOA). The NCC is supported by three technical Working Groups (TWGs), viz., (i) Coordination Mechanism Working Group (which will be responsible for monitoring and evaluation); (ii) Scientific Working Group; and (iii) Financial Resources Working Group.

Malaysia developed its NPOA based on the RPOA principles, goals, and targets. The NPOA includes programs that are in various stages of implementation and led by several government and nongovernment organizations (NGOs). However, the implementation of these action plans require addressing some gaps such as capacity building for training and skills officers, sustainable financing for longer term programs, and public awareness among decision makers and the general public.

Linking the NPOA-RPOA to sustain ecosystem services, establish sustainable fisheries, and food security

Recognizing lessons learned from past regional cooperation initiatives, such as SSME, the CTI embarked on the expansion of the broader regional context of the six Coral Triangle countries (CT6) to find synergies and meet the challenge of sustaining ecosystem services, fisheries management, and food security. The country's State of the Coral Triangle Report (SCTR) contributes to the initial benchmarks that can help the Monitoring and Evaluation Working Group to track the progress of CTI interventions. The Regional SCTR helps summarize and synthesize the value-adding opportunities and insights that can be derived from cooperation among the CT6.

Coral reefs have great economic values as they harbor potential pharmaceutical products. The tourism industry has benefited from healthy coral reef ecosystems and stands to lose if these sources of revenue are not well maintained. A 2003 report estimated that conservation charges collected from visitors to Malaysia's marine parks amounted to RM1 million and revealed that marine parks attracted 778,482 foreign and 820,116 local tourists. This number could be much higher if the collection of the charges/fees is strictly enforced. The total use and non-use value of mangroves along Peninsular Malaysia's west coast was estimated at RM5.4 billion, with 46% accounting for use values.

The **dependency of Malaysia on fisheries and other coral reef resources** has increased over time. Total fish consumption was expected to reach 56 kg/capita in 2010, based on annual income growth rate of 1% since 1999, representing an 18% increase over 1999 consumption levels. A resource assessment undertaken by the Department of Fisheries (DOF) itself indicated that demersal stocks had declined from 80-96% since the 1970s.

In 2010, the **marine capture fisheries** (comprised of inshore and deepsea fisheries) produced 1,428,881 tons with a value of RM6.7 billion. Estimates of potential yield for coastal demersal fish, coastal small pelagic fish, neritic tunas, offshore demersal fish, and offshore/deepsea small pelagic resources are available from the Malaysia SCTR and indicate overexploitation of coastal fisheries compared to offshore fisheries. However, offshore fisheries are dominated by foreign fishing vessels. Catches from these foreign fleets are not fully accounted for and probably result in a declining trend in fish catch as well.

At the Regional SCTR Workshop held in April 2012, the participants from Malaysia did not identify any change in the 2002 report "Reefs at Risk" values. However, they cited specific areas of concern for each threat. Reef dependence is highest in Sabah. Coastal development is highest in Kota Kinabalu. Blast fishing is rated highest in Sabah. Marine-based pollution and damage pertain largely to shipping routes from Port Klang to Sabah, while watershed-based pollution is notable in major cities such as Kota Kinabalu and Kuala Lumpur. Agricultural runoff from palm oil also impacts upon coastal systems in Sabah.

Drivers of these pressures in Malaysia are urbanization, tourism and industrial development, conflicting government priorities, overpopulation, demand on high-value fish species (e.g., live reef food fish), lack of public awareness of marine environment issues, garbage dumping, ballast discharge, and greed. Overlapping policies are also slowing down the implementation of laws.

Malaysia is committed to the implementation of its NPOA, as shown by the pledge made by the national government to allocate US$1million annually for CTI implementation. Following the signing of the Manado Leaders' Declaration during the CTI Leaders' Summit in Manado, Indonesia in 2009, Malaysia has ratified several important policies and legislation that are aimed at the protection of its marine resources, such as the Wildlife Protection Act of 2010 and the National Policy on Climate Change of 2009. Meanwhile, a draft of the Ocean Policy (2010) is presently undergoing consultation. Malaysia is actively involved in the conservation of resources in the SSME and the implementation of the ecosystem approach to fisheries management (EAFM) through the Sulu-Celebes Sustainable Fisheries Management Project.

Priority Research Issues

- Threats from mariculture activities
- Triggers and ecological and health impacts of harmful algal blooms
- Ecosystem impacts of marine pollution in major shipping routes such as that from Port Klang to Sabah and introduction of invasive species through ballast water
- Ocean acidification and climate change impacts on the marine environment and biophysical parameters, economic activities, and social well-being
- Impact of land-based activities such as palm oil plantations on coastal ecosystems
- Coral reef and coastal resources valuation and dependency studies to support future efforts for payments for ecosystem services

Malaysia's responses and implementation of its NPOA directly address two higher-level outcomes of the CTI, namely, sustaining coral reef ecosystem services and sustainable fisheries utilization. However, linking mangroves or seagrass reserves to mainstream marine environmental protection or fisheries sustainability remains a gap. Threats on coral reef ecosystem destruction posed by water quality degradation associated with unsustainable land development on islands adjacent to marine parks is still very much a concern. Malaysia's high dependence on fish imports to augment its fish food needs and supply deficit remains a challenge for the government.

An initial scoping study of PES prospects and potential buyers for a PES program would benefit from the identification and allocation of equitable costs and benefits within the local, national, and CTI-wide governance context. Moreover, laudable efforts made in the SSME provide excellent springboards for enhancing the complementation of efforts of national agencies with regional partner organizations as well as with the CTI Regional Secretariat and working groups.

Availability of Full Reports

This document is to be read as a supplement to the CD version of the complete State of the Coral Triangle Report.

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CHAPTER I: INTRODUCTION

This chapter is meant to provide background information, in particular programs that are under implementation and those in planning stages that are not covered extensively in the Report. For Malaysia, one of the more notable programs of relevance to the Coral Triangle Initiative is the Sulu-Sulawesi Marine Eco-Region (SSME) Initiative.

SULU SULAWESI MARINE ECO-REGION (SSME) INITIATIVE

During the 7th Conference of Parties (COP7) of the Convention on Biological Diversity held in Kuala Lumpur (February 2004), a Memorandum of Understanding (MoU) to adopt the eco-region approach to conservation contained in the Ecoregion Conservation Plan (ECP), which was ratified by the three member countries in 2006. The ECP for SSME is a product of region-wide consultations by three (3) countries; i.e. Indonesia, Malaysia and Philippines that would allow conservation of coastal and marine resources without having to compromise on the livelihood of the people. Following the signing of the MoU, a Tri-National Committee for the SSME was established in 2006 and supported by three (3) sub-committees; (i) Threatened, Charismatic and Migratory Species – lead by Indonesia; (ii) Sustainable Fisheries – lead by Malaysia; and (iii) Marine Protected Areas (MPAs) and Networks – lead by Philippines.

The first set of Work Plan for the Sub-Committees was published in 2009. Subsequently a Comprehensive Action Plan was developed within which contains:-

- Vision, mission, goals, objectives, strategies and actions;
- Purpose statements, strategies (or key result areas);
- Indicators to monitoring and evaluation framework;
- Estimated costs for implementation of the strategies (or key result areas);
- Potential revenue generation mechanisms; and
- Lessons learned.

These sub-committees are supported by Technical Working Groups formed in each country.

The Comprehensive Action Plan is consistent with Goal 2 of the Coral Triangle Initiative, which refers to the full application of the ecosystem approach to management of fisheries and other marine resources. The Action Plan is a response of the member governments to meet the targets of not only the SSME Initiative but also the CTI and Millennium Development Goals (MDGs) to improve fisheries stocks by 2015 and improve the socio-economic condition of coastal communities.

SUSTAINABLE FISHERIES: THE SULU CELEBES SEA SUSTAINABLE FISHERIES MANAGEMENT (SCS SFM)

The SCS SFM Project is the first regional, collaborative project for the Sustainable Fisheries Sub-Committee. The Project is funded by the Global Environment Facility (GEF) through its implementing agency, the United Nations Development Programme (UNDP). It is a four (4) year Project spanning from 2009-2014.

The scope of the Project is as follows:

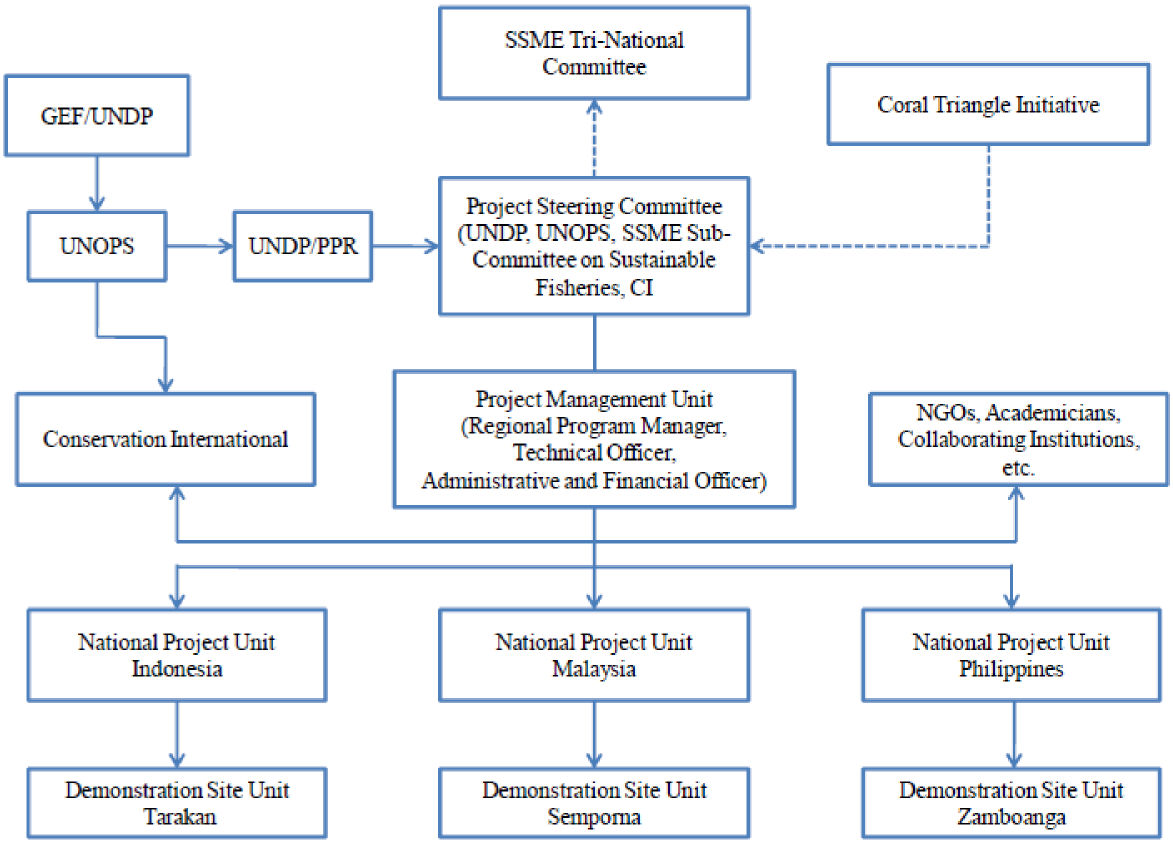
- **Component 1**: Conducting a Transboundary Diagnostic Analysis of Marine Fisheries;
- **Component 2:** Strategic Action Planning to agree on regional and national legal, policy and institutional reforms for improved ecosystem and fisheries management;
- **Component 3**: Introduction of institutional reforms to catalyse implementation of policies on the reduction of overfishing and improve fisheries and overall ecosystem management, and strengthen national fisheries laws and policies;

- **Component 4:** Demonstration of best management practices in critical sites; and
- **Component 5:** Managing knowledge management and replication of lessons learned.

It is important to note that the Technical Working Group for this Sub-Committee has the mandate of the governments and the focus to review project designs, provide information, and facilitate government decisions to commit and mobilise resources for project development and implementation.

This GEF-approved project will be implemented under the Coral Triangle Initiative.

FIGURE 1- 1: ORGANOGRAM OF THE SULU-CELEBES SEA SUSTAINABLE FISHERIES MANAGEMENT PROJECT



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The organogram of the Project is presented in Figure 1-1 above. The Project will have a Project Steering Committee (PSC) to provide overall guidance and advise related to regional, national, local and overall activities of the Project. The PSC will be composed of one representative each from the UNDP, UNOPS (The UN Office for Project Services) and CI (Conservation International) and three representatives from the SSME Sub-Committees on Sustainable Fisheries representing the three countries. In the conduct of its functions, the PSC will interact and receive inputs from the CTI which covers the SSME as a sub-region.

Project Risks

For the policy components of the Project, institutional risks could be the major concerns at the regional, national and local levels. The formulation and the subsequent implementation of the SAP (Strategic Action Plan) would depend on stakeholder support at the national and local levels.

The stakeholders include regional and national government institutions, non-government organizations and the private sector. The private sector is a critical partner especially in the implementation of measures that would address the overexploitation of fishery resources. The institutional risks at the local level mirror those at the national and regional levels, although at a much smaller geopolitical scale.

A summary of Project risks and outcome is reflected in Table 1-1 below.

TABLE 1- 1: PROJECT RISKS AND OUTPUT ASSOCIATED IN THE IMPLEMENTATION OF THE PROJECT

Outcome/Output	Risks and Assumptions
Outcome 1: Regional consensus on transboundary priorities, their immediate and root causes	**Assumptions** – national consultations will be implemented in a coordinated and timely manner, leading to the regional consultations; funds will be disbursed to national implementers efficiently; data and information from (Output 4.2 - ICM) are available for the analysis **Risks** – National consultations may be delayed by local events, e.g., elections, unavailability of stakeholders
Output 1.1: Consensus on the TDA for SCS LME	As above
Outcome 2: Agreement on regional and national legal , policy and institutional reforms for improved fisheries management	**Assumptions** – Continuing cooperation within the entire SSME governance structure at the regional, national and local levels **Risks** – Among others, these would include the non-cooperation and change of priorities of the national governments, lack of budgets, resources and overall capacity to implement the needed reforms, and deterioration of security relationships between countries that could hamper regional cooperation.
Output 2.1: Regional Strategic Action Program	**Assumptions** – Interest and cooperation of local, national and regional stakeholders are assumed; availability of scientific knowledge and expertise **Risks** – Major disagreements between stakeholders on the mission, vision, programs, projects and activities in the SAP and national action plan are potential risks.
Output 2.2: Collaborative agreements with relevant regional and subregional organizations	**Assumptions** – Interest of relevant regional and sub-regional organizations in SSME management and the project is assumed. Full capacity of both parties to implement signed agreements is assumed. **Risks** – Conflict of interests and mandates between the regional and sub-regional organizations and the SMME program, limited capacity for implementation, and rivalry and conflicts between organizations and their managers.
Outcome 3 – Introduction of institutions and reforms to catalyze implementation of policies on reducing over-fishing and improving fisheries management in the SCS that will benefit the SCS coastal communities; strengthened national fisheries laws and policies	**Assumptions** - Active involvement of the management and staff of regional and national institutions involved in SSME management is assumed. Capacity of regional and national institutions to implement reforms is assumed. Willingness of national lawmakers to prioritize the revision or amendment of fishery laws is assumed. **Risks** – The risks include the bureaucratic red tape in national governments that make it difficult to institute reforms, indifference or resistance of government personnel in institutional reforms, and the change of leadership and short term-tenures at the national and ministerial/department levels that can change national priorities.
Output 3.1: Strengthened SSME Tri-Com and its Sub-Com on Sustainable Fisheries	The assumptions and threats are closely similar to those of Outcome 3. An added risk is the current financial crisis which could make the search for sustainable financing difficult at least in the short-term.
Output 3.2: Strengthening of existing national inter-ministerial committees for the effective implementation of the agreed action plans for SCS	The assumptions and threats are closely similar to those of Outcome 3 and Output 3.1. An added risk is the low priority that lawmakers may place on the revision and amendment of fishery plans. Another risk is the implementation record of SSME countries with limited capacities.

Outcome 4 – Increased fish stocks at demonstration sites (5-10 percent increase)	**Assumptions** – The small pelagic fisheries stocks are shared and transboundary stocks; Stock definition study is successfully conducted (Output 1.3); Fisheries Management Plans in Demonstration Sites across the SCS are implemented in timely and coordinated manner **Risks** – IUU fishing is not regulated successfully; the impacts of global climate change have been occurring during the life of the project.
Output 4.1 –Establishment of one demonstration site and another replication site for each country	**Assumptions** – Integrated Coastal Management Plan is prepared and approved by appropriate body; Fisheries Management Plans are prepared and accepted by stakeholders for implementation **Risks** – Changes in District Officer or Mayors in Local Government Units; local government leaders, with jurisdiction on fishing grounds and coastal habitats, do not cooperate; Secondary or tertiary stakeholder block establishment of Demonstration Site; frequent and more severe storms due to Climate Change
Output 4.2 – Integrated Coastal Management (ICM) plans for fisheries management, prepared and implemented at demonstration sites and initiated at each replication sites	**Assumptions** – GIS technical support is available; local government unit is supportive; governmental agencies cooperate; stakeholders cooperate and participate in consultations **Risks** – Change in leadership in local government unit; a secondary or tertiary stakeholder blocks enactment of ICRM Plans; Intense and frequent storms destroy habitats of small pelagic fishes; frequent and more severe storms due to Climate Change
Output 4.3 – Establishment of new or strengthening of existing local inter-sectoral committees for effective implementation of local ICM plans	**Assumptions** – Local government units will work closely with the fisheries managers of each country; the ICM Plan will be adopted by the government **Risks** – The concept of integration of fisheries management in local planning is not understood or accepted by local government units; frequent and more severe storms due to Climate Change
Output 4.4 – Better understanding of stocks of small pelagic fisheries in the SCS	**Assumptions** – The human resources are available for the studies; Funds for supporting research studies are available; Fishing industry accommodate and assist research activities; Research collaboration with SEAFDEC and 3 countries is agreed upon and implemented **Risks** – Costs of chemicals increase beyond the budget; molecular analyses are delayed due to cofinancing constraints; frequent and more severe storms due to Climate Change
Output 4.5 – Per capita income at demonstration sites increased by 10 percent	**Assumptions** – Fishing households cooperate in providing information on income; Non-fishing households cooperate in providing information on income; Municipal/District Fisheries Statistics are gathered regularly **Risks** - Increased international demand for small pelagic fishes; increased IUU; unregulated entry; frequent and more severe storms due to Climate Change
Outcome 5 – Facilitated uptake of knowledge and lessons learned **Output 5.1** – Captured, applied and disseminated knowledge, lessons and best practices within the SCS and other LMEs	**Assumptions** – Outputs from the project are of the expected quality that would merit publication and dissemination. **Risks** – None

source:http://www.thegef.org/gef/sites/thegef.org/files/repository/9-3-09%20GEFID%203524%20Regional%20-%20for%20web%20posting.pdf

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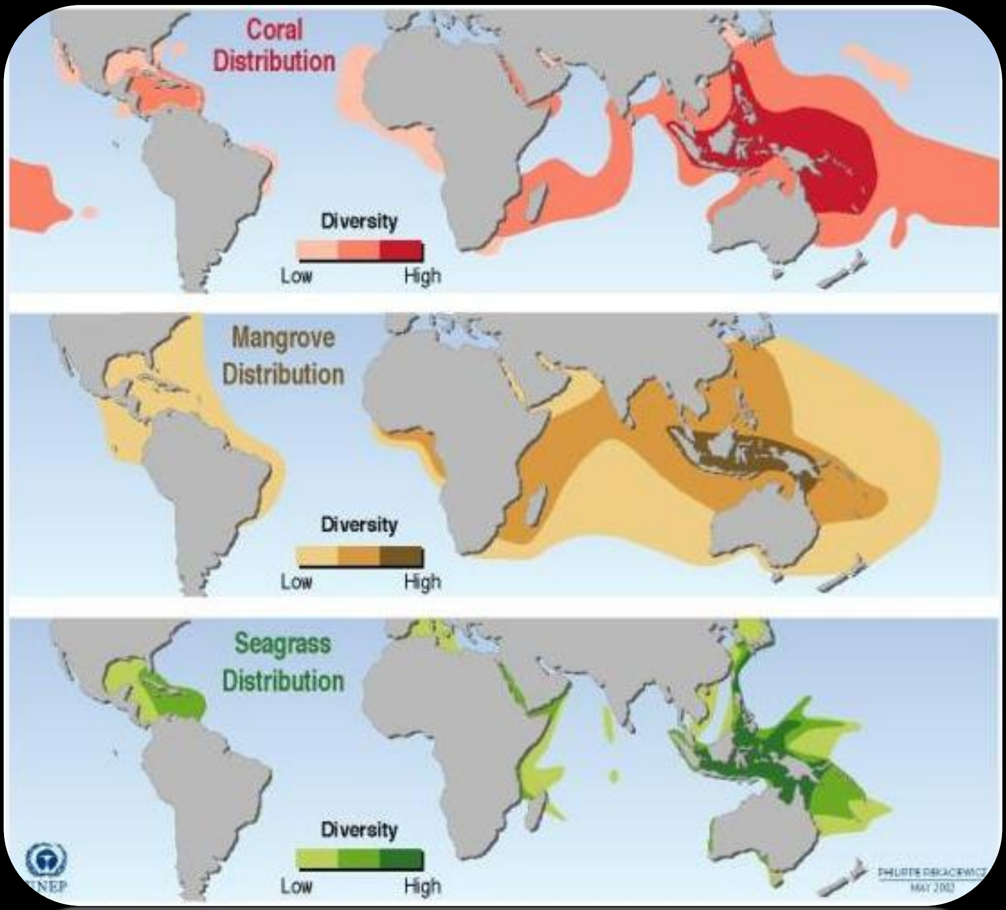
Chapter II: Biophysical Characteristics

This chapter describes the biophysical characteristics of Malaysia of which includes the geographical description of the country, its general oceanographic features and climate condition. A brief description of the many biodiversity of coastal and marine ecosystems such as coral reefs, mangroves and seagrasses are also included. A short narrative of the interaction between these valuable ecosystems and the assessment of its economic value are also included in this chapter. A special mention on marine protected areas in Malaysia can be found in this chapter.



Global distribution of coral, mangrove and seagrass diversity, UNEP-WCMC, 2001, cartographer / designer : Philippe Rekacewicz, UNEP/GRID-Arendal, source: http://www.grida.no/graphicslib/detail/distribution-of-coral-mangrove-and-seagrass-diversity_30dc

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CVM	Contingent Valuation Method
DC	Damage Costs
EEZ	Exclusive economic zone
EIAs	Environmental impact assessments
EoP	Effect of Production
IOPs	Organization Partners
MEA	Multilateral Environmental Agreements
MPA	Marine protected areas
NE-SW	North East-South West
NGO	Non-governmental organisation
NW-SE	North West-South East
PCA	Priority Conservation Area
PRFs	Permanent Reserved Forests
RC	Replacement Costs
STRP	Scientific and Technical Review Panel
TC	Travel Costs
TEV	Total Economic Value
TIHPA	Turtle Islands Heritage Protected Area
UNEP	United Nations Environment Programme
UV	Ultraviolet

Physical Geography (and Oceanography) of Malaysia

Extension and Boundary

The United Nations Convention on the Law of the Sea divides the maritime space into several distinct but contiguous areas namely the internal waters, territorial sea, contiguous zone, continental shelf, exclusive economic zone (EEZ) and the high seas. The information provided by the Malaysia Department of Survey and Mapping indicates the size of each of these areas as depicted in Table 2-1 below. Figure 2-1; 2-2 and 2-3 illustrates the international boundary of the country as of 2010.

TABLE 2- 1: MALAYSIA'S SEA AREAS

Maritime Zone	Size (km^2)
Internal waters	97,307
Territorial sea	63,666
Exclusive Economic Zone	453,186
Total Sea area	**614,159**
Continental Shelf	**476,762**

Extent of Malaysia Sea

Malaysia is located on the geographical coordinates of 2°30' North and 112°30' East latitude and longitude respectively. It is a country that comprises of two (2) distinct regions, namely Peninsular Malaysia on the south-eastern of the Asian continent and East Malaysia which includes Sabah and Sarawak on the Borneo Island. Peninsular Malaysia land borders with Thailand on the North of Peninsular and East Malaysia borders with two (2) countries; Brunei Darussalam and Kalimantan, Indonesia. Malaysia has a total landmass of 329,847 square kilometres (127,350 sq mi). Its coastline borders with eight (8) major seas namely the Andaman Sea, Malacca Straits, The Straits of Singapore, Gulf of Thailand, South China Sea, Sulu Sea, Sulawesi Sea and the Celebes Sea (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Andaman Sea

The Malaysian maritime border in the Andaman Sea consists of a few lines. On the southwest side, the limiting line is from Oedjong Raja (Lat. 5° 32' N., Lon. 95°12' E.) in Sumatera to the Sandy Point on Little Andaman Island, in such a way that all the narrow waters appertain to the Andaman Sea. On the northwest side, the lines are identical to the eastern limit of the Bay of Bengal[1]. On the southeast the delineated line joins Lern Voalan (Lat. 7°47' N., Lon. 98° 18' E.) on Phuket Island in Thailand and Pedropunt (Lat. 5° 40' N., Lon. 95° 26' E.) in Sumatera (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

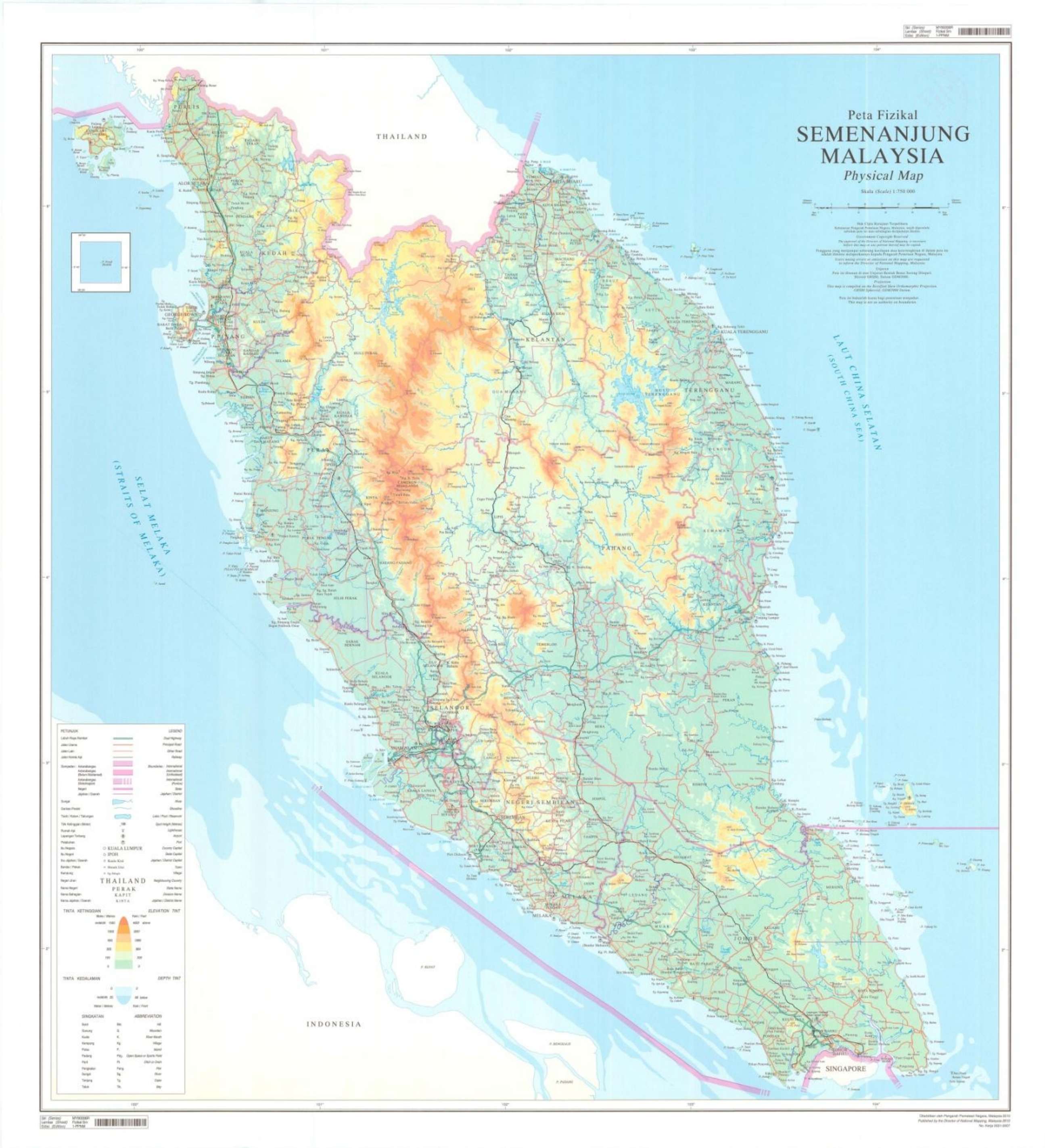
Malacca Straits

Within the Malacca Straits, to the west is the line joining Pedropunt in Northern Sumatera and Lean Voalan, Phuket while a series of line on the east joins Tanjong Piai (Bulus), the southern extremity of the Peninsular Malaysia (Lat. 1°16' N., Lon. 103° 31' E.) and the Brothers (Lat. 1° 15' N., Lon. 103° 21' E.) and thence to Pulau[2] Karimun (Lat. 1° 10' B., Lon. 103° 23.5' E.). South-western coast of the Peninsular Malaysia is located to the north and the north-eastern coast of the Sumatera off to eastward Tanjong Kedabu (Lat. 1° 06' N., Lon. 102° 58' E.) thence to Klein Karimun is the southern limit (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

[1] *On the East*. A line running from Cape Negrais (16° 03' N) in Burma through the larger islands of the Andaman group, in such a way that all the narrow waters between the islands lie to the Eastward of the line and are excluded from the Bay of Bengal, as far as a point in Little Andaman Island in latitude 10° 48'N, longitude 92° 24' E and thence along the Southwest limit of the Burma Sea. *On the South*. Adam's Bridge (between India and Ceylon [Sri Lanka]) and from the Southern extreme of Dondra Head (South point of Ceylon) to the North point of Poeloe Bras (544' N ; 95° 04' E).

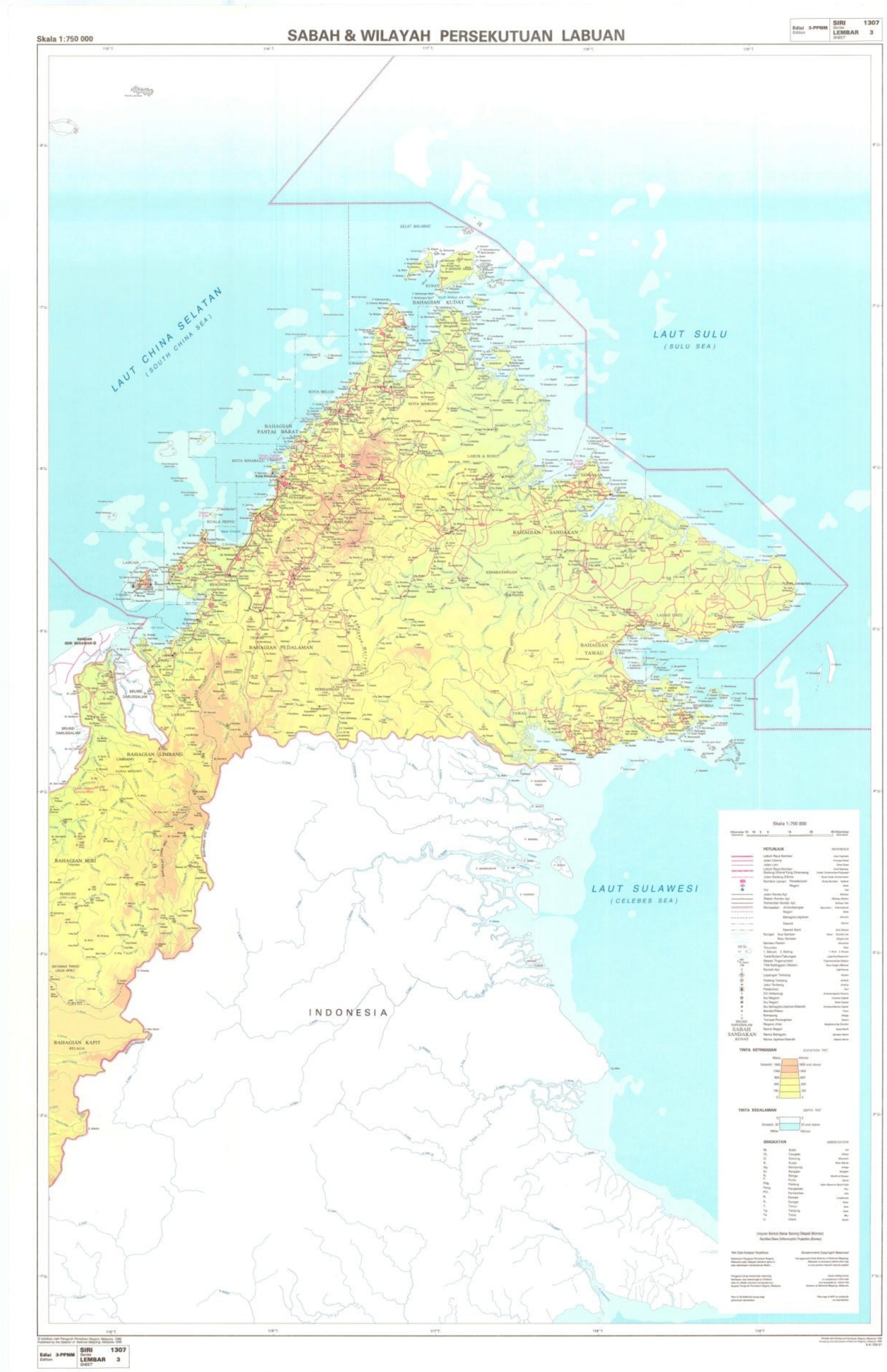
[2] *Pulau - Island*

FIGURE 2- 1: MAP OF PENINSULAR MALAYSIA AS OF 2010 (RED LINE INDICATING INTERNATIONAL BORDER)



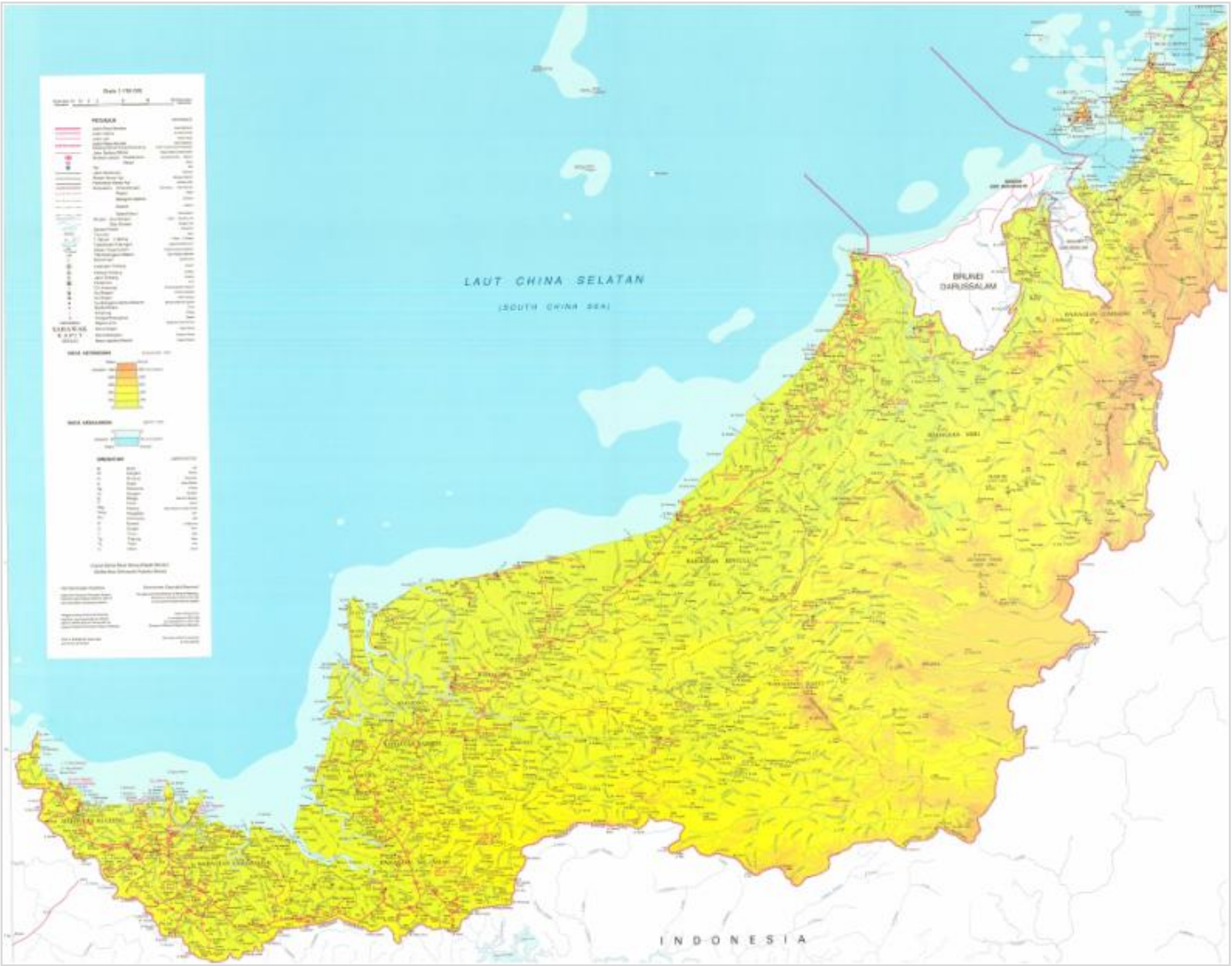
Source: Department of Survey and Mapping, Malaysia

FIGURE 2- 2: MAP OF SABAH AS OF 2010 (RED LINE INDICATING INTERNATIONAL BORDER



Source: Department of Survey and Mapping, Malaysia

FIGURE 2- 3: MAP OF SARAWAK AS OF 2010 (RED LINE INDICATING INTERNATIONAL BORDER



Source: Department of Survey and Mapping, Malaysia

The Straits of Singapore

The limiting line to the west of the Straits of Singapore is identical to the eastern limit of the Malacca Strait. The line joining Tanjong Datok (Lat. 1° 06.5' N., Lon. 104° 17' E.) all through to Pulau Bintan (Lat. 1° 35' N., Lon. 104° 35' E.) limits the bound to the east. Southern shore of Singapore Island, Johor shoal and the south-eastern coast of the Peninsular Malaysia outlines the north boundary of the straits while the line joining Klein Karimun to Pulau Pemping Besar (Lat. 1° 06.5' N., Lon. 103° 47.5' E.) thence along the coasts of Pulau Batam, Pulau Bintan and Pulau Koko is the southern boundary (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The South China Sea

The two (2) mainland of Malaysia is separated by the South China Sea where the south limit is the eastern and southern limits of the Straits of Malacca and Tanjong Kedabu (Lat. 1° 06' N., Lon. 102° 58' E.), Singapore, along the east coast of Sumatera to Lucipara Point (Lat. 3° 14' N., Lon. 106° 05' E.) thence to Tanjong Nanka, the south-west extremity of Pulau Bangka, thence to Tanjong Djemang (lat 2° 36' S., Lon. 107° 37'E.) on the Pulau Billiton, along the north coast of this island to Tanjong Boeroeng Mandi (lat. 2° 46' N., Lon. 108° 16' E.) and thence a line to Tanjong Sambar (Lat. 3° 00' N., lon. 110° 19' E.) to the south-west extreme of Borneo Island with Karimata Strait within the defined limits. A line from Tanjong Sambar through Tanjong Sampanmangio, West points of Balabac and Secam Reefs, on to the west point of Bancalan Island to Cape Bulilulyan, south-west of Palawan Island thence to Cabuli Point and further northwards beyond the scope of the atlas. The west boundaries of the South China Sea are the mainland, the southern limit of the Gulf of Thailand and the East Coast of the Peninsular Malaysia (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Sulu Sea

The Sulu Sea has a western limiting line starts at Tanjong Sampanmangio at the north point of Borneo Island, thence the eastern limit of the South China Sea to Cape Calavite situated at the northwest point of Mindoro Island. The north coast of Borneo between Tanjong Labian and Tanjong Sanpanmangio bounds the south-west limit Malaysia in Sulu Sea (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Sulawesi Sea/ Celebes Sea

Malaysia's northern boundary in Sulawesi Sea and Celebes Sea is the south-west coast of Mindanao and the southern limit of the Sulu Sea. The western limit is the east coast of Borneo between Tanjong Mangkalihat and Tanjong Labian while the eastern limit and southern limits are beyond the scope of the map. The Makassar Strait forms part of the Sulawesi Sea (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Geography

Peninsular Malaysia

Peninsular Malaysia accounts for 40% of the country's landmass. There are several mountain ranges running north- south along the backbone of the peninsula. A wide, fertile plain trails the West Coast, while a narrow coastal plain runs along the east. Sabah and Sarawak are covered by dense jungles and have large river networks. These rivers are still the main means of transportation to the natives of these two states. Over 60% of the country is still rainforest, and there are 8000 species of flowering plants (in Peninsular Malaysia alone) which includes 2000 tree species, 800 different orchids and 200 types of palm, and a myriad of wildlife animals. There are also an abundance and variety of bird populations in the world that can be found in East Malaysia (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sabah

Sabah is one of the 14 member states of Malaysia, located across the South China Sea on the northern tip of the Borneo Island. Sabah is the second largest state after Sarawak and shares its borders with Kalimantan, Indonesia and Brunei Darussalam (Jakobsen, F. et al., 2006). The second largest state covers a land area of 74,000 km^2 and has 1,800km coastline facing three (3) main seas; namely the South China Sea on the north-west, the Sulu Sea on the north-east and the Celebs Sea on the south-east. Total coverage of sea including the Exclusive Economic Zone (EEZ) is approximately 102,000 square kilometers with many inshore and offshore islands ranging from tiny islets to sizable ones with permanent settlements (M.W.Ranjith N. De Silva, *et al*., 1999)

Sabah is known as "The Land below the Wind" due to its location to the south of the typhoon-prone region of Philippines. The capital of Sabah is Kota Kinabalu or formerly known as Jesselton. Sabah coastline stretches 4328 km, inclusive of islands and lagoons. The four major growth centres are the state capital Kota Kinabalu, Sandakan, Tawau and Kudat together with 300 villages situated along the coast. These coastal villages depend on fishery activities as their main source of income followed by industries such as agriculture and tourism as secondary source of income (Jakobsen, F. et al., 2006).

Sabah is blessed with highly productive mangrove forests that stretches across 320,000 hectares coupled with biodiverse coral reefs along the coast and around its many islands. It also has coastal waters rich in sea grass and seaweed beds. These combinations have sustained the many fishing industries and increased tourism-related income (M.W.Ranjith N. De Silva, *et al*., 1999)

Sarawak

Sarawak is also known as the *Bumi Kenyalang* ("Land of the Hornbills") on the north-west of Borneo Island, bordering with Brunei on the north-east and Kalimantan, Indonesia on the east. Sarawak is the largest state in the Malaysia with area coverage of 124,450km^2, spreading between latitude 0° 50' and 5° N and longitude 109° 36' and 115^0 40' E, it makes up 37.5% of the land of Malaysia (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The state of Sarawak stretches over 750km along the north-east coastline of Borneo. Sarawak is separated from Kalimantan, Indonesia through ranges of high hills and mountains in the central mountain range of Borneo. These mountains range gets higher to the north and culminate near the source of the Baram River (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The major rivers in Sarawak from south to the north include the Sarawak River, the Lupar River, the Saribas River, and the 563km long Rajang River- the longest river in Malaysia. The Baleh River branch, the Baram River and the Libang River drains into the Brunei Bay as it divides into two (2) parts of Brunei and the Trusan River. The Sarawak River flows through the administrative capital, Kuching (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sarawak has large tracts of tropical rain forest and is home to a wealth of plant and animal species. In the coastal region, large extents of swamps and other wet environments can be found. The ports of Kuching and Sibu are built at a distance from the coast near rivers. Bintulu and Miri are close to the coastline where the hills stretch into the South China Sea (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

GEOMORPHOLOGY AND GEOLOGY

GEOMORPHOLOGY

PENINSULAR MALAYSIA

The coastal features of Peninsular Malaysia such as the estuaries, offshore islands, and irregular shorelines become more prominent since the last Quaternary sea-level rise. Most deltas situated at the mouth of large rivers becomes a modified estuarine due to accumulation of sediments on these bays. As a result of their alignment with the geologic structures accompanied by the strong abrasion by the South China Sea, a straight eastern coastline such as that of Kelantan River and Pahang River was formed. The wave strength of the South China Sea and Malacca Straits accounts for the development of beach ridges in the west and east coast of Peninsular Malaysia (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

COASTAL PLAIN BORDERING THE MALACCA STRAITS

The irregular coasts consisting of numerous embayments, offshore islands, sea stacks, and sea arches, especially along the limestones coasts of the southern islands are of wide estuaries at the mouths of the larger rivers and submerged former river valleys. These drowned characters are categorized as the Langkawi island group and usually consist of steep cliffs. Narrow sand beaches with low beach ridges may be found along the southwest coast of Pulau Langkawi. A tombolo[3] can be found formed between Pulau Rebak and the main island (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Recent aggradation is found in coastal plain of Kedah, Perlis and Penang Island. The isolated hill of Bukit Keriang, a recent offshore rocky islet was formed due to the accumulation process of deposits of wave-cut notches and marine beach deposits. In Penang Island, steep cliffs and irregular shorelines of submergence dominate the narrow 2km wide coastal plain (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The mouth of the Perak River is the widest western coastal plain in Peninsular Malaysia. It measures about 45km wide while the average width varies only 20-30km. Locally, cliffs mark the shorelines. While deltas of the estuarine type are found in other localities in the west coast, small cuspate deltas have developed at the mouths of the Kedah and Muda rivers. Besides the indication of aggradation, there are several locations indicating extensive drowning of coastal region. Swamps are present as an indication of extensive drowning such as the Trong region, where the coastal swamps stretches 10km wide; and the Sungai Panjang area in north Selangor measure 28km across. Occasionally a beach ridge zone lines the coastal plain up to few kilometers wide such as the Perak River ridges; of 2-6m above the present sea level (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In Penang, approximately 6km inland beach ridges have been recorded in the east and north of Butterworth. These sandy ridges rise a few meters above the surrounding plain. Raised beaches occur at 3m and 6m above sea level on the south while further inland, the coastal plain is fringed by alluvial terraces at about 35m, 25m, 16m and 8km above the present sea level. The degree of dissection of these terraces increases progressively with increasing height. Granitic clasts and sand grains constitute to these formations of terrace alluvium and some of the better sorted sands reflect a marine environment of deposition (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

[3] A tombolo is a line of sand that connects an island to the main land or to another island

Southern Coastal Plain

The southern coastal plain of Peninsular Malaysia has a typical submerged character with Pilai and Johor river mouth as two wide estuaries. The deflection of stream mouths to the east and the prevailing direction of long shore currents correspond to one another. Presence of features such as estuaries, irregular shorelines and rare narrow beaches indicates that Singapore Island has a shoreline of submergence. The lower Pleistocene 'Older Alluvium' in Johor and Singapore extends from the depth of 45m to an elevation of 69m above the present sea level (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Eastern Coastal Plain

The islands off the east coast of Peninsular exhibit drowned coastline, which consists of steep cliffs and small embayments with narrow coastal flats with irregular shorelines dominating certain parts of the coast. Irregular shorelines are evident between Sungai Kemasih and Sungai Kuantan, and between the Sungai Endau and Sungai Mersing, with oblique-cut structural ridges. The eastern coastal plain shows evidence of aggradation with straight sandy shorelines and wide coastal plains. The Kelantan River area is the widest coastal plain where it stretches 60km across while generally, the coastal plain is found to be 20-30km wide, covered extensively with freshwater swamps. Two wide swamps area are in the lower Merchang and lower Pahang regions of more than 30km wide. There is a zone of beach ridges that is 5km or less across on the seaward side of the swamps and traces of abandoned beach ridges can be seen as far as 2km inland region of Kelantan and Bebar rivers (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Two-beach ridges series-one with 12m crests and another 5-6km above sea level- has been identified. The rise of the east coast is considered as result of infilling of bays that had been protected from the open sea by offshore bars and is supported by the general presence of extensive swamps area behind the narrow zone of beach ridges.

The wide extent of the beach ridge zone and the presence of high hills among the coastal swamps suggest formation of swamps as a result of sitting and inadequate drainage of low-lying areas rather than down-warping as in the western coastal plain. In Kuantan area, the alluvium reached 50m thick in the Sungai Soi area where the base lies 47m below sea level while the fluviatile alluvium exceeds 30m in thickness (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sabah

West Coastal Plain

Quaternary deposits consisting of coarse gravel, sand, silt, clay, peat and coral accumulated along the coasts in west Sabah and are now found in raised terraces and in inland plains in Tenom, Klias, Padas Valley and the Sook-Keningau plains (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Numerous small coastal deposits of estuarine alluvium and large alluvium plains formed at the southern end of Marudu Bay and at Kota Belud both of which are located in the northern Sabah while smaller fluvatile deposits occur in some valleys. Coastal alluvium is extensive in the Sandakan Peninsular and makes up about one third of the whole peninsular (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In the western lowlands, a narrow strip of land bordering the South China Sea with the broadest at Klias and narrowest at Kota Kinabalu and Tuaran. This terrain is subdivided into the Crocker Foothills, the Crocker Plains, the Klias Hills, and the western Islands. Crocker Foothills and Western Cordillera division is arbitrarily set at 300m elevation while marine terraces of 24m at Klias and 30m at Sipitang in Brunei Bay area. Nine (9) meters (m) elevation terraces occur on Labuan, Klias, Beaufort and Sipitang. Three (3) to five (5) meters low-level terraces occur in Labuan, Klias, and Sipitang. Terraces at 4.5m, 9m, 15m, and 21m are also recorded near Kota Belud. Marine caves, 3.5m above sea level at Pulau Burong, have now all been quarried away. Shells and wood radiocarbon aged of 22,450 and 2,840 years have been obtained in Klias (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

East Coastal Plain

The eastern low plains can be divided into a few sub-districts: Northern Islands, Kaindangan and Lokan Plains, the Deltas of Kinabatangan, Segama, Sugut and Labuk Rivers, the Bongaya Hills, Sandakan Peninsular, Kinabatangan Lowlands, Segama Valley, Dent Hills, and the Semporna Lowlands. The major rivers flow to the Sulu Sea. The Segama River is thought to have once reached the sea at Lahad Datu, and captured due to the tilting of the country as a result of Miocene rifting in the Sulu Sea marginal Basin (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sedimentary rocks of the Garinono and Sandakan Formations covered parts of coastal areas of Beluran and Sandakan and quaternary alluvium overlies these rocks of the costal, deltaic, and riverside areas. Mud volcanoes on the islands off the north-eastern tip of Sandakan Peninsula periodically eject liquid mud containing blocks of wide variety of rocks (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

About half the Dent Peninsular area is comprised of swampy flat alluvial plain, including coastal, deltaic, and riverine flats, which grade into each other. The coastal and deltaic alluvial flats are widest along the north-east coast and narrowest along the south coast near Tungku. They include mangrove and nipah swamp, stranded beaches, raised coral reefs, and peat swamp forest. The alluvial flats along the Kinabatangan above the deltas are mostly between 6 and 12km wide and narrow to less than a kilometer wide near Sukau and west of Bulud Napu. The coastal zone towards Lahad Datu, Semporna Peninsular and Tawau were the main areas of later tertiary and quaternary volcanic activity in North Borneo, with a chain of volcanoes in various stages of dissection has been mapped. Wide coastal plains underlain by quaternary sediments are formed as a result of extensive changes in drainage pattern, and recent emergence of the land in relation to sea level caused by the eruptions of the young volcanic eruptions. Prominent coastal features are formed by raised coral terraces (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Low foothills, coastal plains and swamps lie between the Crocker Range and the South China Sea along the coast from Bongawan to Tuaran in the north-east. This lowland zone varies from 8 to 15km with fairly straight coastline with several broken points and headlands at Tanjung Aru, Sapangar and Tanjung Dalit (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sarawak

Rajang and Bara deltas represent result of deltaic deposition dominating large areas of coastal accretion. Alluvium terraces of different heights are widely developed throughout Sarawak. In Balingian valley and near the Sarawak-Brunei border, a change in the inland to paralic and continental conditions are due to the Pleistocene sedimentation of sand, clay, with some lignite and tuffaceous material, in a very shallow, nearshore marine environment (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Semi-consolidated sand, clay and boulder bed making the older alluvium is considered to be of Pleistocene or Recent age, was deposited in a fluvial-deltaic environment. Raised beaches are common along the coast. Cave deposits with archaeological remains are scattered mainly in limestones caves of Pleistocene age throughout the country. Niah caves marks an important archaeological finds of the activities of pre-historic man have been made (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Recent alluvium of varying thickness from few metres to at least 60m in some area, consists of unconsolidated gravel, sand, silt, clay and peat occurs inland along the river valleys and beached in the coastal areas (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

GEOLOGY

PENINSULAR MALAYSIA

Peninsular Malaysia is divided into four (4) regions consisting of eleven (11) states and two (2) federal territories. Perlis, Kedah, Penang and Perak is grouped in the Northern Region while Kelantan, Terengganu, and Pahang is in the East Coast Region. In the Central Region, there are two federal territories- Kuala Lumpur and Putrajaya and Selangor. Last but not least, Negeri Sembilan, Malacca and Johor are in the Southern Region of Peninsular Malaysia.

Peninsular Malaysia forms part of the Sunda shield[4] tectonically. It is a southerly continuation of the fold-mountain system and dominates the regional trend of which are of northerly to north-northwesterly from eastern Burma through Thailand, Peninsular Malaysia, the Banka and Billiton Islands and eastwards into Indonesian Borneo (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Peninsular Malaysia represents the fold-mountain system ranges from the Cambrian to the Quaternary. The Triassic rocks are of both marine and non marine origins but generally, the non-marine deposits where present, occur in the Upper Triassic and pre-Triassic rocks and are essentially of marine while the post-Triassic rocks are characteristically non-marine. There is a possibility of continuous sedimentation throughout the Palaeozoic and Mesozoic just within the Peninsular Malaysia. However, due to the instability of the basin, the sedimentary record in any one area is not complete to support the assumption (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Major breaks are apparent between the Paleozoic, Mesozoic, and Cainozoic group of rocks while the minor breaks are apparent within and between the systems themselves. The granitoids cover almost half the total surface area of the peninsular and these bodies usually form topographic highs, the largest of which is the Main Range situated on the western flank of the peninsular. The Main Range is about 480km in length, with an average width of 65-80km and rising to more than 2,100m above sea level in places.

[4] South east extension of the continental shelf of Southeast Asia that covers an area of 1.85 million km^2 and consist of the Peninsular Malaysia, Sumatra, Borneo, Java, Madura, Bali and the surrounding small islands

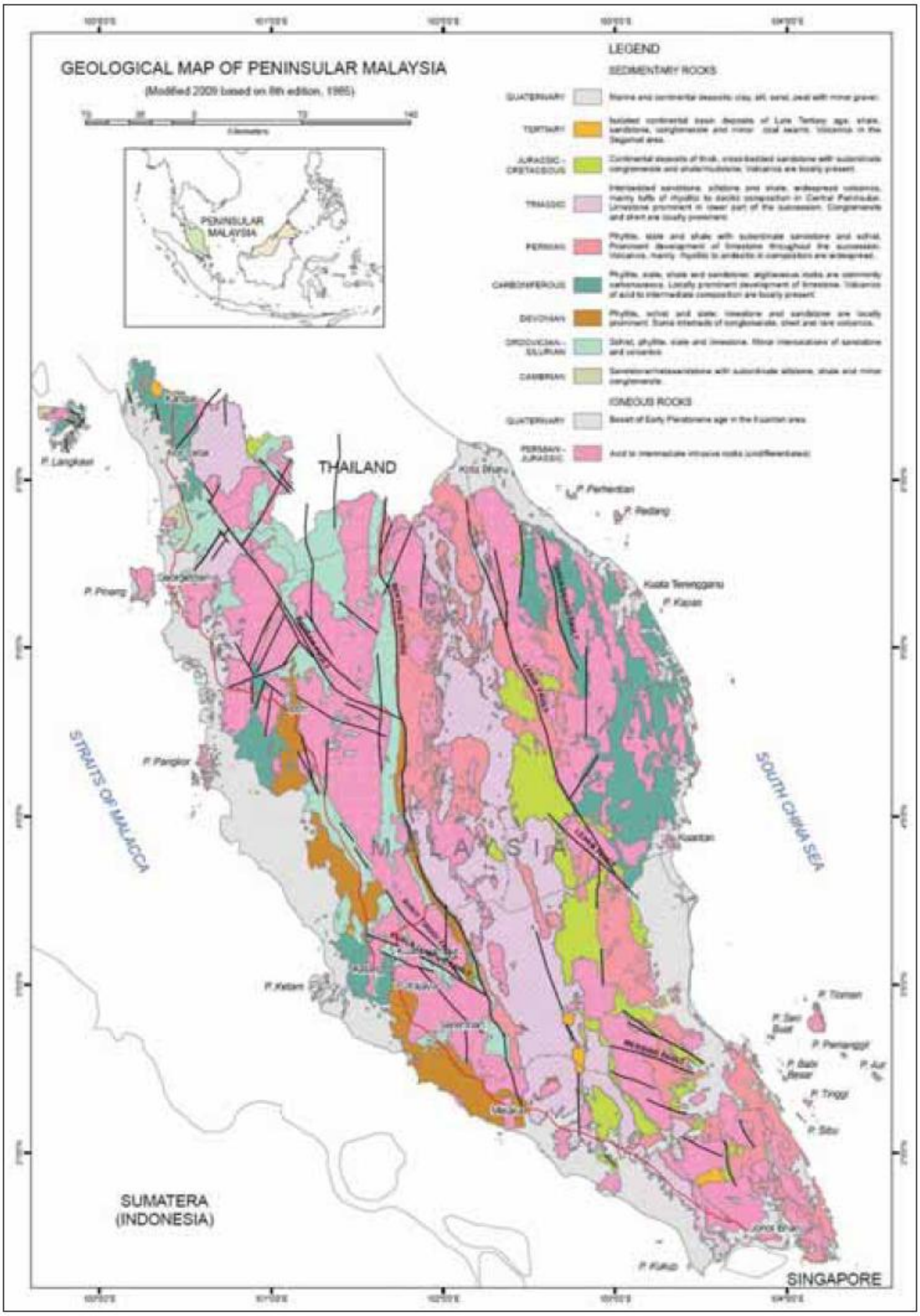
Granite bodies may usually aligned parallel to the structural trend of the country, they do not always occupy the anticlinal ridges of the sedimentary covers and some of the smaller bodies are found to cut across the structural trend (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Most of the Palaeozoic and Mesozoic rocks show slight to moderate deformation due to the widespread of regional metamorphism[5]. Generally, greater degree of metamorphism is shown in the older rocks than the younger ones. On the other hand, contact metamorphism[6] is not intense and is usually rocks that form narrow aureoles around the igneous bodies. There are at least four (4) major episodes of granitic emplacement and much of the known mineralization in the country is believed to be associated with the later episodes and commonly with faulting. Faulting is common in all rocks and there are at least three (3) sets recognized on a regional scale, the youngest of which is at most post-Early Cretaceous in age (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

FIGURE 2- 4: PENINSULAR MALAYSIA'S FOUR DOMAINS ARE ALMOST ENTIRELY BUILT UP OF PRE-TERTIARY ROCKS.

[5] Regional metamorphism occurs over large areas is accompanied by deformation under non-hydrostatic or differential stress conditions. Thus, usually results in forming metamorphic rocks that are strongly foliated, such as slates, schists, and gniesses.
[6] Contact metamorphism occurs adjacent to igneous intrusions and results from high temperatures associated with the igneous intrusion.

FIGURE 2- 5: GEOLOGICAL MAP OF PENINSULAR MALAYSIA



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

SABAH

This Land below the Wind situated at the northern part of the Borneo Island has a complex geological history. Several tectonic trends converge in this region Geological history of Borneo describes the drifting incident that occurs from minor landmasses of Gowandan origin to south-eastern side of Borneo during the late Jurassic time. Later in Cretaceous time, formation of southern borders of Darvel Bay from smaller stumps of Eurasian origin drifted into the area. The area has the most constant sea temperature in comparison since the formation of the semi-enclosed Sulawesi Sea Basin in the Middle of Miocene. The steep topography of the basin enables corals adapt to sea level changes without much horizontal displacement. Coasts along the Borneo are expected to maintain a fairly constant sea temperature among other seas around the world (Tun, K. *et al.*, 2004). The north-east trend of the Palawan-Balabac Island arc stops at the Northern Islands of Banggi and Balambangan and the crescent of the 'North-west Borneo Geosyncline' appears to bend east to south-east at Gunung Kinabalu. The Sulu Archipelago volcanic trend links to the Semporna Peninsular in south-eastern Sabah (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Crystalline Basement, the oldest rocks can be found in the east coast while basic and ultrabasic rocks and associated chert[7], spilite[8], gabbro of the ophiolite[9] suite occur along an arc stretching from Darvel Bay on the east coast through the upper Sungai Segama to upper Labuk Valley, Gunung Kinabalu and swinging north-east to Marudu bay and to the Northern Islands. In Semporna Peninsular, the Upper Segama and Gunung Kinabalu areas shows exposure of acid to basic igneous rocks, the products of at least three (3) periods of igneous activities (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

SARAWAK

The geology of Sarawak is described in two (2) distinct provinces corresponding to two (2) main geographic regions, namely the West Sarawak and Central-North Sarawak.

WEST SARAWAK

West Sarawak is the part of the State south and west of Batang Lupar, forming part of the West Borneo Basement which extends into Sarawak from the south. This part of West Borneo Basement is the exposed part of the Sunda Shield in the southwest Borneo that covers 11,000km^2 and is built up of concealed rocks of Paleozoic and early Mesozoic ages in places under a thick cover of Tertiary strata. The West Borneo Basement was tectonically active throughout Paleozoic and Mesozoic times, but subsequently has been a rather stable area (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Upper Carboniferous, Lower Permian, Triassic, Upper Jurassic, Cretaceous and lower Tertiary are the succeeding sedimentary formations found in this province. There are four major unconformities that represent major breaks in the sedimentary records. The unconformities are apparent between the pre-Upper Carboniferous and Carbo-Permian rocks, between the Carbo-Permian and Triassic rocks, between the Triassic and Jura-Cretaceous rocks and between the Upper Cretaceous and lower tertiary rocks (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

[7] fine-grained silica-rich microcrystalline, cryptocrystalline or microfibrous sedimentary rock that may contain small fossils.

[8] fine-grained igneous rock, resulting particularly from alteration of oceanic basalt

[9] a section of the Earth's oceanic crust and the underlying upper mantle that has been uplifted and exposed above sea level and often emplaced onto continental crustal rocks

Intrusive granitic rocks are confined mainly to this province with the oldest, the pre-late Jurassic grandlorite at Gunung Jagoi and Gunung Kisam. Serlan Volcanics with associated minor dloritic intrusions was formed from volcanic activities during the late Triassic, while the basic volcanic and intrusive rocks are found in the Serabang and Sejingkat Formations. The minor acid volcanic rocks are found in Pedawan Formation and extensive, feature-forming adamellite at Pueh, Gading, Tanjung Datu, Tinteng Bedil and Buri, the Sebuyau grandlorite and the Sernatan gabbro as a result from igneous activities during Jurassic to Late Cretaceous times (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Regional metamorphism is confined to the pre-Upper Carboniferous rocks and some of the Jurassiz-Cretaceous rocks west of Sematan and north of Kuching. Contact metamorphism mainly confined to narrow aureoles around igneous bodies. Localised faulting and folding are common where two (2) faults and three (3) folds on regional scale have been recognized at least of post-Eocene in age (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Central-North Sarawak

This is the part of the state north and east of Batang Lupar where the central starts from Batang Lupar northeast to the watershed dividing Batang Rajang from Batang Baram towards the north Sarawak which is the north and east of Rajang-Baram watershed. The geology of Central-North Sarawak forms a part of the so-called 'Northwest Borneo Geosyncline', covering an area of about 113,000km^2 and is underlain by rocks of the so-called 'Northwest Borneo Geosyncline'. Rocks of Cretaceous age are the oldest rock known and are found in the southwestern margin of the province, between Batang Lupar and the watershed between Batang Lupar and Batang Rajang. Tertiary rocks with some isolated basins of Quaternary rocks cover the rest of the province. There is only one major break in the sedimentary record and is marked by an unconformity during Late Eocene. In the Balingian area, small localized unconformities of early Pilocene and mid-Pilocene ages have been recorded (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In the Lupar Valley, gabbro, basalt and spillite of the Pakong Mafic Complex of the Cretaceous age are the oldest ignerous rocks found in the region. Simlar rock types probably of Paleocene or Eocene age occurs at Bukit Mersing. Formation of grandlorite, granphyre, andesite and rhyollite in the Balingian area and minor gabbro, andesite and basalt in the Lupar Valley may be result of continuous phase of igneous activity occurred during late Eocene-Oligocene times. Dacite, andesite and basalt lavas and pyroclastics and associated minor microtonalitic stocks in the upper Rajang and Tinjar areas are outcome of the last phase of igneous activity that has taken place in the Pliocene-Pleistocene (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Regional metamorphism is widespread, affecting rocks older than Late Eocene in age while thermal metamorphism found in only in this province is limited to narrow aureoles around some of the igneous bodies. Faulting and folding are commonly affecting all rocks in the area except the Quaternary and several on regional scale have been mapped. The Late Eocene folding and related regional metamorphism affecting the pre-Upper Eocene rocks are most intense in the Lupar Valley, decreasing in intensity towards the north and northeast. Figure 2-7 and 2-8 illustrates the geological map of Sabah and Sarawak (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

FIGURE 2- 6: GEOLOGICAL MAP OF SABAH

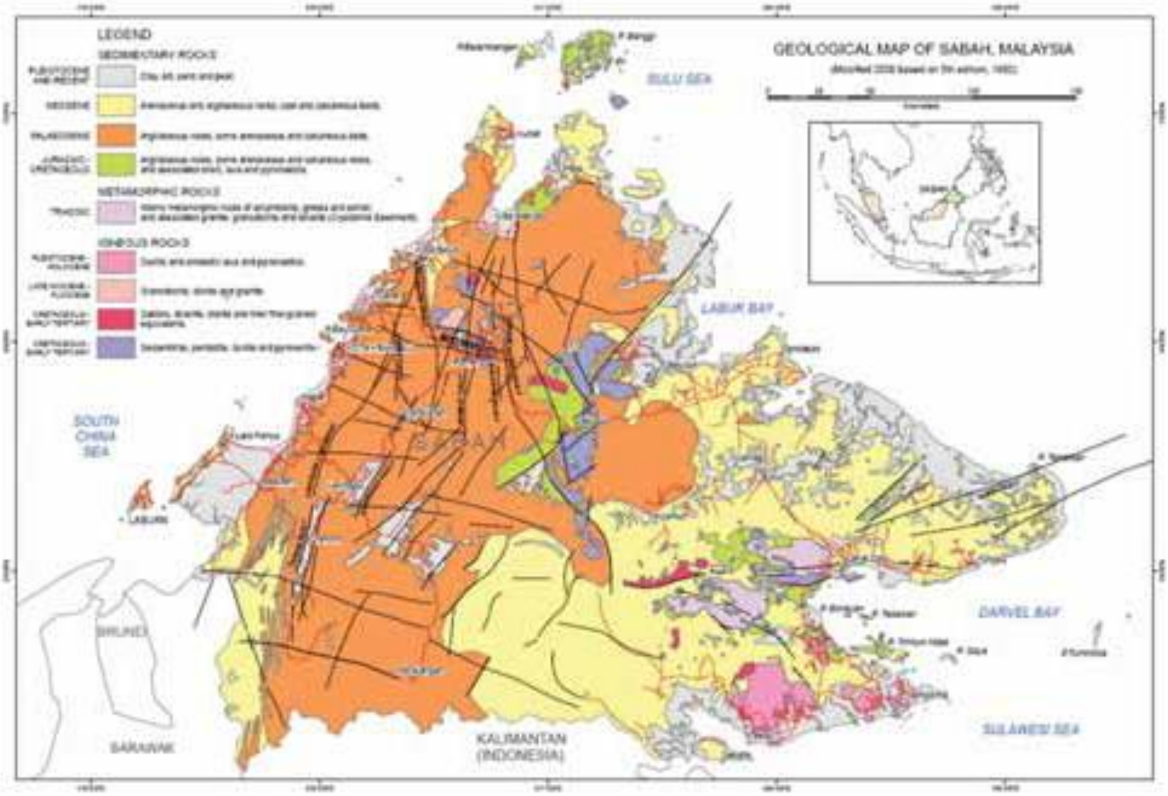
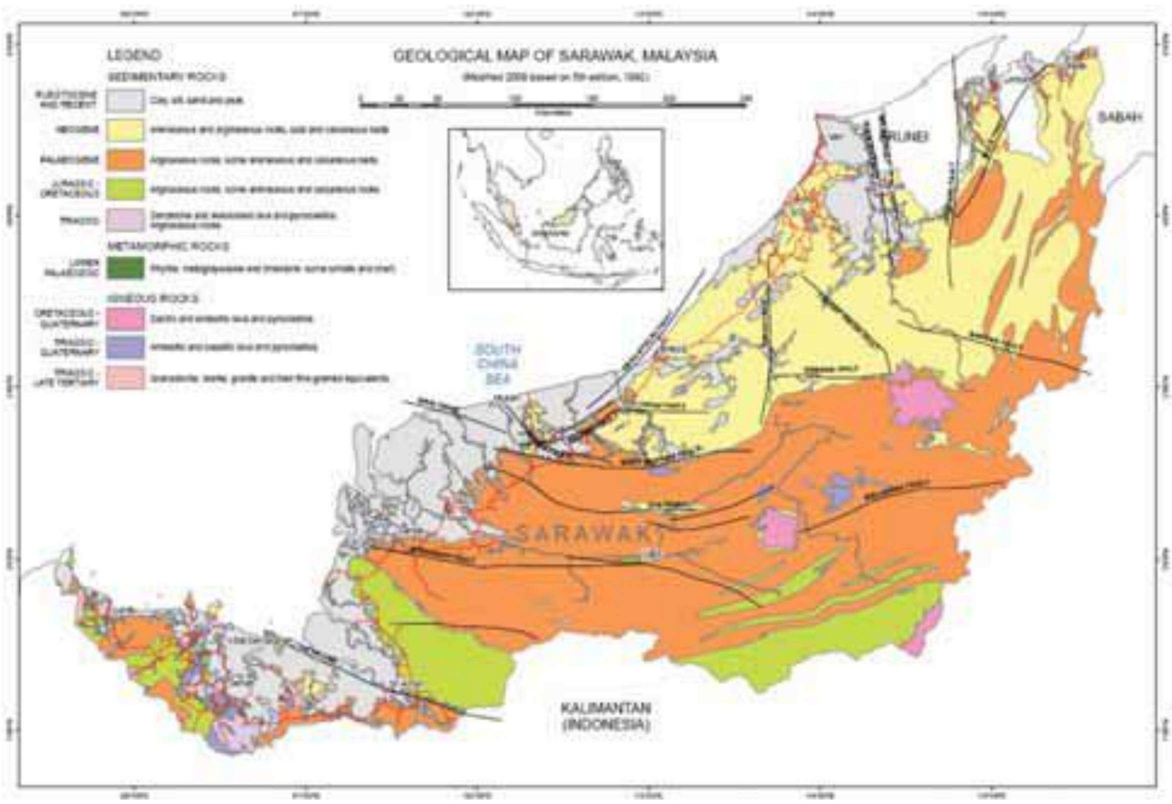


FIGURE 2- 7: GEOLOGICAL MAP OF SARAWAK



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

Offshore Geology and Resources

Malaysia's most interesting feature within the offshore area is the major sand waves. In areas of strong tidal currents, sand waves rises especially where there is an abundance of mobile sand at sea bed. These areas are transverse bedforms, oriented, in marine condition, at right angles to the direction of the dominant tidal flow. The sands ranges from very fine sand to gravel grain size, where mean current velocities exceed about 0.4 m/sec in the north of Tanjung Datu, Sarawak; off Port Klang, West Peninsular Malaysia, and off Kuantan, East Peninsular Malaysia, to name a few (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Straits of Malacca

In the region to the north of Perak river mouth, that is, the northern grabens, the Cenozoic begin with continental Upper Oligocene beds that rapidly changed into marine deposits. Structural highs are formed from Lower Miocene carbonate buildups. During the rest of the Cenozoic, shallow marine to coastal conditions were maintained except for minor subaerial exposures during the various Quaternary glacial episodes when the strait and the entire Sundaland formed a vast Southeast Asian continent. In the late Oligocene, the depressions in the Straits to the South of the Perak river mouth began as lakes and later received fluvio-deltaic deposits. The environment changes into lower coastal plain and shallow marine conditions from Pliocene onward and southern Straits of Malacca experienced subaerial exposure from the Quaternary glacial episodes (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Tertiary basement of the straits that hosts 15 north-trending grabens, slopes gently towards Southeast. The grabens range from 825m to almost 4,000m in depth. These North-southern zones' grabens are categorized into (1) Bengkalis Trough related, (2) Pematang-Balam Trought, (3) Asahan Arch-Kepulauan Arua Nose, and (4) Tamiang-Yang Besar High related depressions. They could be representing regional fracture zones that are separated from each other by zones of regional high. The grabens are categorized by zones of regional high and presume to have begun developing in the Late Oligocene by regional dextral shearing of the NW-SE treading Straits of Malacca belt. Wrenching is found on major but non-regional faults. Seismic lines show flower structures on some of the basement-involved faults while granben boundaries are defined by time structure maps N-S en enchelon normal faults. Many of the graben outlines at the basement level resemble rhombic or sigmoidal pull-aparts despite alteration by subsequent tectonic deformation such as the central, North Penang, East Penang, Port Kelang (Klang), and Johor (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Sunda Shelf

The waters between Peninsular Malaysia and Sarawak forms the part of the Northern Sunda Shelf which are of 40m to 80m deep, which became emergent during the Pleistocene glacioeustatic lowering of sea level. This part has a generally smooth form, sloping gently northeast-wards to the continental slope in the southern part of the South China Sea. Bathymetric contours show a series of open valley, draining north-eastwards towards the continental slope, where relief across the open shelf is low, and the valley interfluves are very gently sloping (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The Sunda Shelf is a stable area that has no significant vertical movements over the last 300,000 years (Pleistocene), but at the same time, global eustatic sea level fluctuated in correspondence to the change of volumes of continental ice. Thence, river system eroded the shelf and locally deposited an ocean-ward prograding and accreting wedge onto the erosion surface during periods of lower sea level. In contrast, during high sea-level; when the shelf was fully marine, the deposition of coarser fraction of the alluvial load occurs near the contemporary coasts while the finer-grained material are distributed widely onto the open shelf. However, area distant from an alluvial sediment source received limited sediment supply during high sea-level highlands, carrying a complex stratigraphic record of late Quaternary transgressions and regressions (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Tectonic evidence suggests that the least part of the shelf, where sea level could fall below -130m are limited subsidence of the area over the last 300,000 years and the numerous glasio-eustatic lowstands. Associated erosion was as deep and as extensive with the late Weichselian lowstands (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Offshore Northeast Sabah and Sulu Sea

The off-shore areas of Sabah in the north-eastern of Sabah extending to the Sulu Sea is characterized by several NE-SW trending tectonic elements e.g. the NW and SE Sulu Basin, Cagayan Ridge etc. A series of N-S to NE-SW trending horst and graben features including normal/growth faults are present off the Dent Peninsular. The splitting or rifting of the Cagayan-Sulu Ridge extended into Sabah and created NE-trending extensional structures features. A series of NW-SE strike-slip faults cut these NE-SW trending terrains and separate the Cagayan Ridge and the NE Sabah area including the Sandakan sub basin which probably continues northwesterly to join the sinistral strike-slip fault known as the 'Straits of Balabac Fault' in the north-west (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

This area of less displacement in terms of changes in sea temperature has maintained its status as the centre of biological diversity since the earliest models of Stehli & Wells (1971). New research and findings along the timeline affirms the status of the region (Status of Coral Reefs in SEA, 2004). Sabah's coastal environment is dominated by three ecosystems. One of the ecosystem dominates the turbid environments of the coast which consists of peat swamp, mangrove forest, mudflats and a wide range of animal species. The second ecosystem is the coral reefs found in low-turbidity and non-polluted fronting the sandy beaches that supports various marine micro and macro faunal species. The third ecosystem that dominates Sabah's coasts is the seagrass beds, usually found in sheltered lagoons in East and West Sabah, Darvel Bay and the surrounding islands. These three (3) ecosystems provide not only a layered physical protection of coastal habitat but also provide for sustainable fishing, aquaculture, forestry and tourism industries (Jakobsen, F. et al., 2006).

CLIMATE

This section describes historical changes and current climate condition for both Peninsular Malaysia and Sabah & Sarawak. Climate change variation and related threats and adaptation programs are described in more detail within Chapter V of this Report.

TEMPERATURE AND WIND PATTERNS

Located near the equator, Malaysia is generally warm throughout the year with temperature ranging from 21° to 32° Celsius (C) in the lowland and as low as 16°C in the highlands. Tropical weather in Malaysia throughout the year gives an annual rainfall at 2,500mm (100 inches) and high humidity level at 80 per cent (%) (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Wind patterns is generally light and variable. There are, however, some uniform periodic changes in the wind flow patterns. Based on these changes, Malaysia experiences four seasons, namely, the southwest monsoon, northeast monsoon and two shorter periods of inter-monsoon seasons.

The southwest monsoon season is usually established in the second half of May or early June and ends in September. The prevailing wind flow is generally southwesterly and light, below 15 knots (Malaysian Meteorological Department, 2010).

The northeast monsoon season typically commences in early November and ends in March. During this season, steady easterly or northeasterly winds of 10 to 20 knots prevail.The winds over the east coast states of Peninsular Malaysia may reach 30 knots or more during periods of strong surges of cold air from the north (cold surges) (Malaysian Meteorological Department, 2010).

During the two intermonsoon seasons, the winds are generally light and variable. During these seasons, the equatorial trough lies over Malaysia.

It is worth mentioning that during the months of April to November, when typhoons frequently develop over the west Pacific and move westwards across the Philippines, southwesterly winds over the northwest coast of Sabah and Sarawak region may strengthen to reach 20 knots or more (Malaysian Meteorological Department, 2010).

FIGURE 2- 8: MEAN MAXIMUM TEMPERATURE TREND FOR PENINSULAR MALAYSIA (1969-2010) (˚C/10 YEARS)

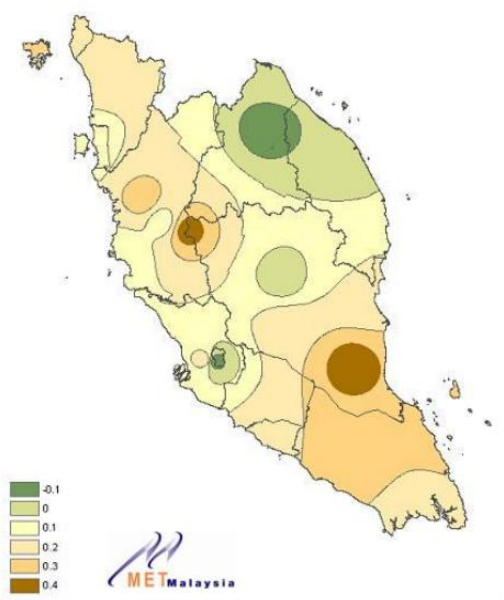
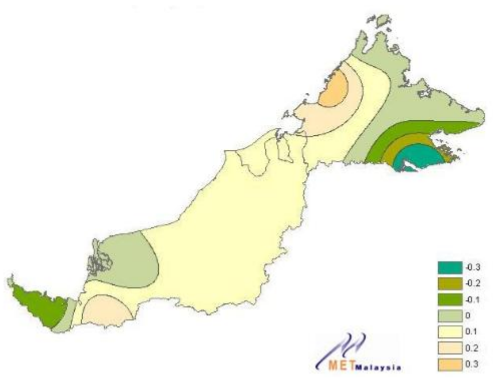


FIGURE 2- 9: TREND IN MAXIMUM TEMPERATURE FOR BORNEO (1969-2009)



Source: Malaysian Meteorological Department, 2010

Sea Surface Temperature

Sea surface temperature is generally defined as the water temperature closest to the surface of the ocean. In sub-tropic sub-area, the distribution of surface water properties is influenced by an excess of evaporation over precipitation, cycles of heating and cooling, convective mixing and currents. This area is characterized by higher temperatures and is influenced by excess precipitation, daily cycles of heating and cooling, wind mixing, and currents.

Malaysia is surrounded by seas and is located near the equator, thus only slight variation has been recorded of between 26°C and 28° C during the month of January and 28°C and 29^{0}C in July. The temperature of the air near the sea surface seldom varies more than 1°C above or below the sea surface temperature (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Hydrology

The average annual rainfall for Malaysia ranges from 2,420 millimeter (mm) in Peninsular Malaysia to 3,830mm in Sarawak. Open evaporation is between 1,600mm and 1,800mm. The basic main sources of water for Malaysia are rainfall, surface runoff, groundwater and evaporation (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Seasonal Rainfall Variation in Peninsular Malaysia

a) Over in the east coast states, November, December and January are the months with maximum rainfall, while June and July are the driest months in most districts (Malaysian Meteorological Department, 2010).

b) Over the rest of the Peninsular Malaysia with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October - November while the secondary maximum generally occurs in April - May. Over the northwestern region, the primary minimum occurs in January - February with the secondary minimum in June - July while elsewhere the primary minimum occurs in June - July with the secondary minimum in February.

c) The rainfall pattern over the southwest coastal area is much affected by early morning "*Sumatras*" from May to August with the result that the double maxima and minima pattern is no longer distinguishable. October and November are the months with maximum rainfalls and February the month with the minimum rainfall. The March - April - May maximum and the June -July minimum rainfalls are absent or indistinct.

Seasonal Rainfall Variation in Sabah and Sarawak

a) The coastal areas of Sarawak and northeast Sabah typically experience rainfall regime of one maximum and one minimum (Malaysian Meteorological Department, 2010). While the maximum rainfall occurs during January in both areas, the occurrence of the minimum rainfall differs. In the coastal areas of Sarawak, the minimum rainfall occurs in June or July while in the northeast coastal areas of Sabah, it occurs in April. Under this regime, much of the rainfall is received during the northeast monsoon months of December to March. In fact, it accounts for more than half of the annual rainfall received on the western part of Sarawak.

b) Inland areas of Sarawak generally experience quite evenly distributed annual rainfall. Nevertheless, slightly less rainfall is received during the period June to August which corresponds to the occurrence of prevailing southwesterly winds. It must be pointed out that the highest annual rainfall area in Malaysia may well be at the hill slopes of inland areas. Long Akah, by virtue of its location, receives a mean annual rainfall of more than 5000 mm (Malaysian Meteorological Department, 2010).

c) The northwest coastal areas of Sabah experiences a rainfall regime of which two maxima and two minima can be distinctly identified. The primary maximum occurs in October and the secondary one in June. The primary minimum occurs in February and the secondary one in August. While the difference in the rainfall amounts received during the two months corresponding to the two maxima is small, the amount received during the month of the primary minimum is substantially less than that received during the month of the secondary minimum. In some areas, the difference is as much as four times.

d) In the central parts of Sabah where the land is hilly and sheltered by mountain ranges, the rainfall received is relatively lower than other regions and is evenly distributed. However, two maxima and two minima have been recorded, though somewhat less distinct. In general, the two minima occur in February and August while the two maxima occur in May and October (Malaysian Meteorological Department, 2010).

e) Southern Sabah has evenly distributed rainfall. The annual rainfall total received is comparable over central part of Sabah. The period February to April is, however slightly drier than the rest of the year (Malaysian Meteorological Department, 2010).

FIGURE 2- 10: MEAN RAINFALL TREND FOR PENINSULAR MALAYSIA (1951-2009)
(mm/10years)

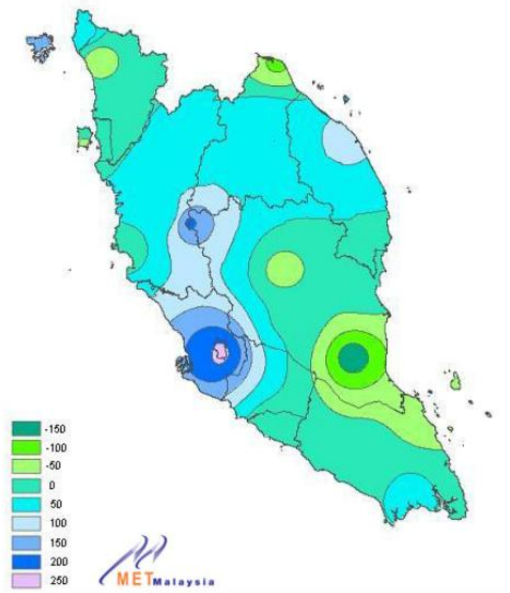
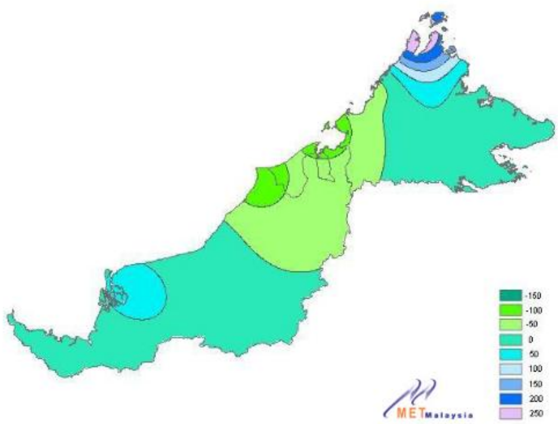


FIGURE 2- 11: MEAN RAINFALL TREND FOR BORNEO (1951-2009)
(mm/10years)



Source: Malaysian Meteorological Department, 2010

BIODIVERSITY OF COASTAL AND MARINE ECOSYSTEMS

MARINE PROTECTED AREAS (MPAs)

There are about 200 gazetted marine protected areas (MPA) under various legislations and departments, including marine parks, state parks, and fisheries protected areas, mangrove reserves, bird sanctuaries, wildlife sanctuaries, and RAMSAR sites. From the total, more than half of these MPAs are mangrove reserves along the coastlines (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

TABLE 2- 2: SUMMARY STATUS OF MPAS IN SOUTH EAST ASIA

	BN	KH	ID	MY	MM	PH	SG	TH	TP	VN
Total number of actively managed MPAs	6	2	114	83	6	339	3	23	0	36
Total number of MPAs with coral reefs	3	1	38	43	2	294	2	16	1	4
Total number of MPAs established ≤5yrs	0	0	12	0	0	Unk	0	0	1	21
% of Reefs within MPAs	0	Unk	9%	7%	2%	1%	0	50%	Unk	11%
% of MPAs with good management rating	0	10%	<3%	16%	0	20–30%	50%	18%	0	8%

BN: Brunei; **KH**: Cambodia; **ID**: Indonesia; **MY**: Malaysia; **MM**: Myanmar; **PH**: Philippines; **SG**: Singapore; **TH**: Thailand; **TP**: East Timor; **VN**: Vietnam; **Unk** = Unknown
Source: Tun. K, *et al.*, 2008

PENINSULAR MALAYSIA

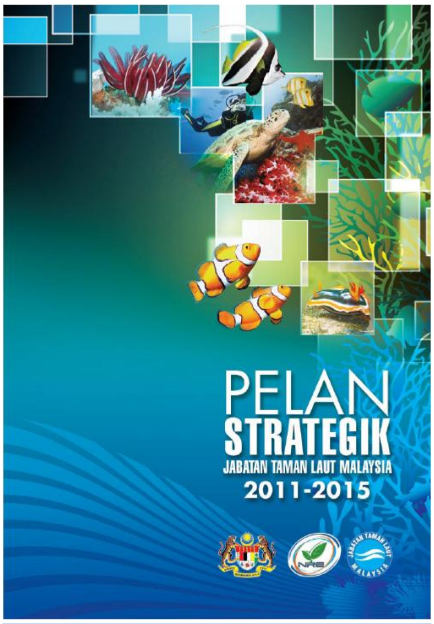
Fisheries Prohibited Areas are first established in the waters 8 kilometre (km) out from the island of Redang in 1983, marking the first marine protected area in Peninsular Malaysia. This area was designated in accordance to the Fisheries (Prohibited Area) Regulations, 1983 under the then Fisheries Act (1963). Waters of three (3) kilometers off twenty-one (21) islands in the states of Kedah, Terengganu, Pahang and Johor are subsequently added to the list. All of these islands were initially declared as Fisheries Prohibited Areas prior to being gazetted as Marine Parks in 1994. Table 2-3 lists the 42 islands that have been declared as marine parks in Peninsular Malaysia under the Establishment of the Marine Park Order of 1994 of the Fisheries Act 1985 (National Coastal Resources and Marine Environment Profile of Malaysia, 2010). These islands are grouped into six Marine Park centres for administrative and management purposes.

The goal of the establishment of marine parks is to create multiple-use areas for the protection, conservation and management of the marine environment. The "*National Marine Parks Malaysia-Policy and Concepts*" documents have identified specific objectives of these parks as following (National Coastal Resources and Marine Environment Profile of Malaysia, 2010):

a. Afford special protection to aquatic fauna and flora, to preserve and manage the natural breeding ground and habitat of aquatic life, with particular regard to rare and endangered species;

b. Allow natural regeneration where depletion has occurred;
c. Promote scientific study and research;
d. Preserve and enhance undamaged system and productivity of the environment; and
e. Regulate recreational and other activities in order to avoid irreversible damage to the environment

The jurisdiction of the Department of Marine Park only covers areas within Peninsular Malaysia and Labuan whereas the management of marine parks in Sabah and Sarawak is under its respective state offices such as Sabah Parks and Sarawak Forestry Corporation.



The Department of Marine Park's Strategic Plan (2011-2015) outlines its objectives to improve marine parks management level of efficiency to 50% in accordance to IUCN index / World Bank by 2015; and to encourage sustainable use of marine biodiversity.

TABLE 2-3: CHECKLIST OF MARINE PARKS IN PENINSULAR MALAYSIA AND LABUAN

State	Name	Size (ha)	Date Gazetted
Kedah (4)	Pulau Kaca	4290	20 October 1994
	Pulau Lembu	4613	20 October 1994
	Pulau Payar	5491	20 October 1994
	Pulau Segantang	4419	20 October 1994
Terengganu (13)	Pulau Susu Sara	1428	20 October 1994
	Pulau Perhentian Kecil	8107	20 October 1994
	Pulau Perhentian Besar	9121	20 October 1994
	Pulau Lang Tengah	6150	20 October 1994
	Pulau Redang	12750	20 October 1994
	Pulau Lima	4390	20 October 1994
	Pulau Ekor Tebu	4060	20 October 1994
	Pulau Pinang	4890	20 October 1994
	Pulau Yu Besar	NA	5 February 2008
	Pulau Yu Kecil	NA	5 February 2008
	Pulau Kapas	2133	20 October 1994
	Pulau Nyireh	1440	27 March 1998
	Pulau Tenggol	2400	27 March 1998
Pahang (9)	Pulau Tioman	25115	20 October 1994
	Pulau Labas	4478	20 October 1994
	Pulau Sepoi	4457	20 October 1994
	Pulau Gut	4520	20 October 1994
	Pulau Tokong Bahara	4513	20 October 1994
	Pulau Chebeh	4492	20 October 1994
	Pulau Tulai	6306	20 October 1994
	Pulau Sembilang	6060	20 October 1994
	Pulau Seri Bulat	7720	20 October 1994
Johor (13)	Pulau Rawa	5080	20 October 1994
	Pulau Hujung	5235	20 October 1994
	Pulau Tengah	5149	20 October 1994
	Pulau Besar	8414	20 October 1994
	Pulau Tinggi	10180	20 October 1994
	Pulau Aur	9745	20 October 1994
	Pulau Pemanggil	8790	20 October 1994
	Pulau Harimau	4900	20 October 1994
	Pulau Goal	4570	20 October 1994
	Pulau Mensirip	4660	20 October 1994
	Pulau Sibu	4260	20 October 1994
	Pulau Sibu Hujung	1183	20 October 1994
	Pulau Mentinggi	4399	20 October 1994
Labuan (3)	Pulau Kuraman	6695	18 August 2000
	Pulau Rusukan Besar	4470	18 August 2000
	Pulau Rusukan Kecil	4650	18 August 2000

Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

SABAH

Sabah has five (5) marine parks gazetted under the Sabah Parks Enactment, 1984 (amended 2002). The Tunku Abdul Rahman National Park was the first MPA in Sabah. The park is located off Kota Kinabalu and was established in 1974. Following that, the Turtle Islands National Park was established in 1975 and the Pulau Tiga National Park was designated as a marine park area in 1978. Tun Sakaran Marine Park off Semporna and Tun Mustapha Park off Kudat are in the list of marine protected areas in Sabah, which was declared as marine parks in 2004 and 2006 respectively.

Pulau Sipadan, which is under the authority of National Security Council is now proposed as an MPA under the management of the Sabah Parks due to the replacement of Sabah National Parks Ordinance, 1962 by Sabah Parks Enactment, 1984 (amended 2002) (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In addition, there are two proposed marine park areas; i.e. the Tun Mustapha Park and Ligitan Island (please refer to Figure 2-13).

The main goal in establishing and legally protect these parks are to enable relevant agencies to conserve the marine biodiversity especially its coral reef ecosystems. There are other park-specific objectives such as Pulau Tiga Park for protection of its unique island ecosystem which includes mud volcanoes, coral reefs and nesting habitat for sea snake while the Turtle Islands for the nesting sites of green turtles and hawksbill turtles.

FIGURE 2- 12: SABAH MARINE PROTECTED AREAS

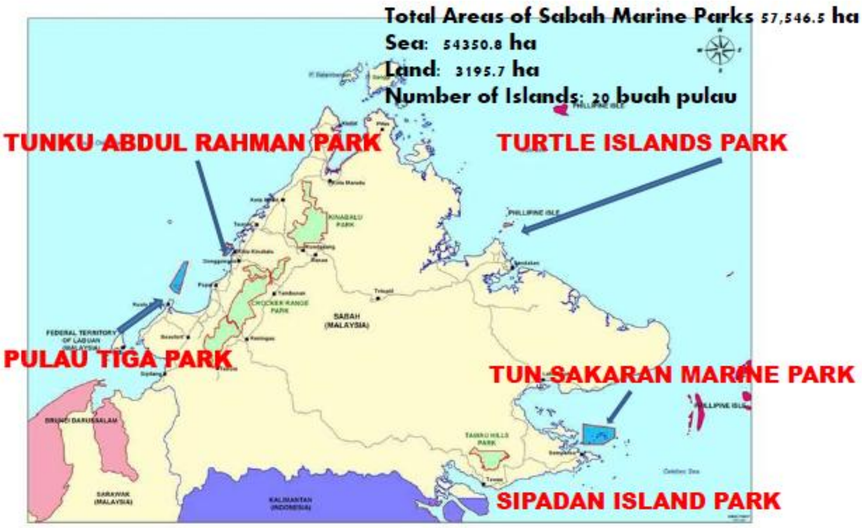
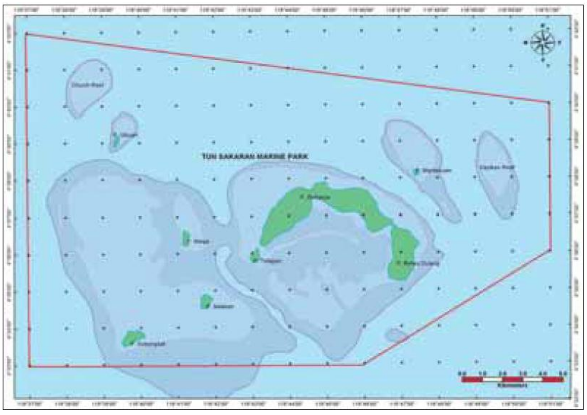


FIGURE 2-13: PROPOSED SABAH MARINE PROTECTED AREAS

FIGURE 2- 14: TUN SAKARAN MARINE PARK



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

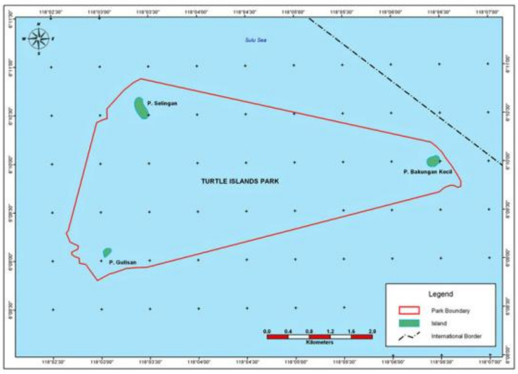
TURTLE ISLAND HERITAGE PROTECTED AREA (TIHPA)

The Turtle Islands Park (TIP) is unique and special in its location and the role it plays in conservation. The TIP is composed of three islands, namely, Pulau Selingaan, Pulau Bakungan Kechil, and Pulau Gulisaan. These islands, within Malaysian waters, are part of the cluster of islands collectively called the Turtle Islands.

The other islands are within the territory of the Philippines. The beaches of the Turtles Islands are nesting sites of migratory and endangered green and hawksbill turtles. Because of the role of these islands play in protecting these species, the Malaysian and Philippine Governments established the Turtle Islands Heritage Protected Area (TIHPA) in 1996. This is the first transboundary marine park in the world that protects endangered turtles. Sabah Parks (Malaysia) and the Pawikan (Turtle) Conservation Project (Department of Environment and Natural Resources, Philippines; World Wildlife Fund-Philippines) conduct the conservation activities within the TIHPA. On each of the Malaysian islands, Sabah Parks has established hatcheries to enhance the chances of eggs developing to hatchlings that are then released to the sea. A similar program is also carried out on Baguan Island in the Philippine territories.

Ecotourism is practised in Selingaan Island, where tourists are shown nesting turtles, replanting of eggs in the hatchery, and the release of hatchlings. The agencies won the J. Paul Getty Award for Wildlife Conservation in 1997 for their activities in conserving turtles (GCRMN).

FIGURE 2- 15: TURTLE ISLANDS PARK



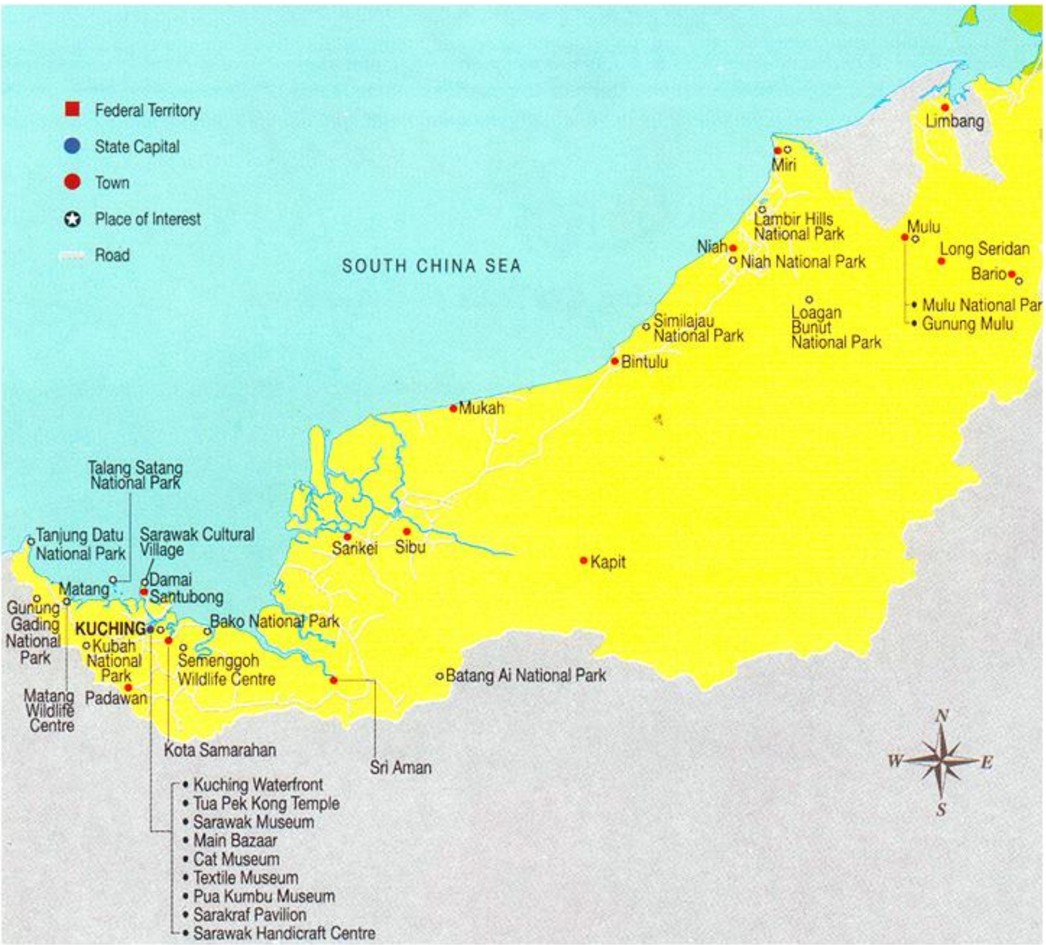
PICTURE 1: The largest of the three islands is the Bakkungan Kechil. This 8.5 hectares island is the neasrest to the Philippines border. The Island has a wide promontory to the southeast. In the centre of the island is a hill where mud volcanoes are still active and bubbling mud and water. The northern and western beaches are most favoured by the Green Turtles. Source: Sabah Parks

SARAWAK

There are three (3) marine parks gazetted under the National Parks and Nature Reserves Ordinance, 1998 in Sarawak. Pulau Talang-Talang and Pulau Satang-Satang were gazetted for turtle conservation while Miri-Sibuti Marine Park, the recent submerged marine park was gazetted for its significant coral reef biodiversity.

Most of Sarawak's Parks are terrestrial, and only three of the State Parks are on the coast Tanjung Datu, Bako, and Similajau). Of these, only Tanjung Datu encompasses coral reefs. Tanjung Datu is the newest and also the smallest park in state. It is strategically important as it lies at the western tip of Sarawak.

FIGURE 2-16: MARINE PROTECTED AREAS AND BOUNDARIES IN SARAWAK

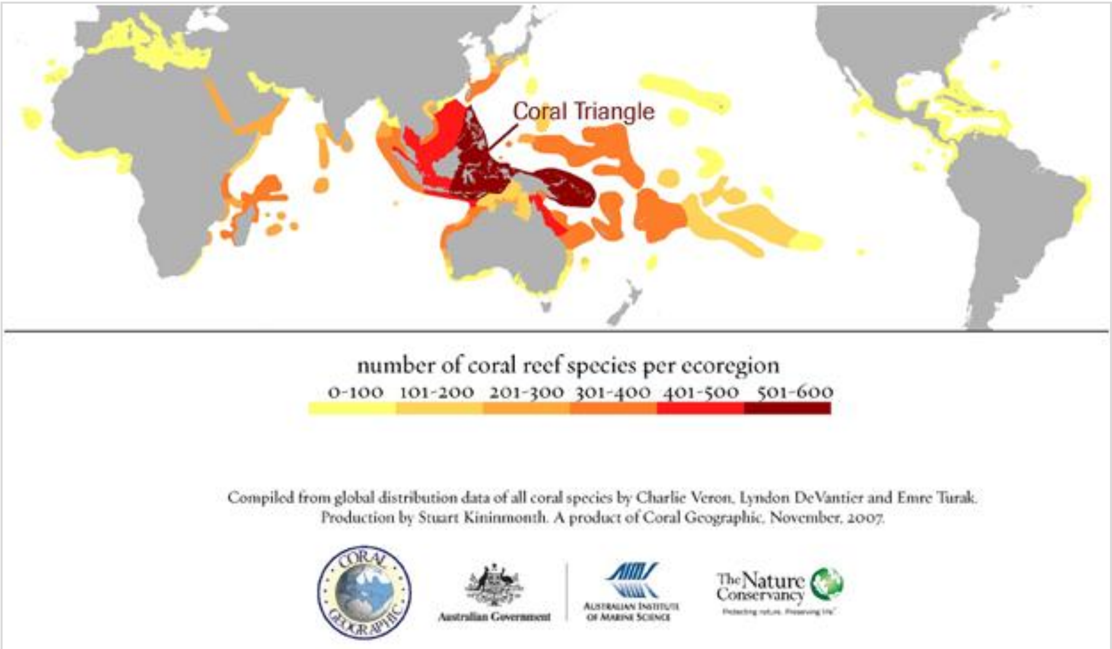


Coral Reefs

Introduction

The Coral Triangle region boasts one of the richest species of corals. In reference to Figure 2-17, the contours drawn indicates species richness pattern of up to 450 species in the area covering Borneo Island, Philippines and Indonesia, followed by 300 species in the area covering up to Timor-Leste, Papua New Guinea and Sumatera, Indonesia. The species shown in the contour map is the *scleractinian* species which is found mostly in the vicinity of these three (3) countries than anywhere else in the world.

FIGURE 2- 17: GLOBAL CORAL DIVERSITY MAP



source : http://ctatlas.reefbase.org/coraltriangle.aspx

Coral reefs in Malaysia is estimated to cover an approximate 4,000km^2 area. Most of the coral reefs are found in Sabah, Sarawak and the east coast of Peninsular Malaysia. Coral diversity is highest in East Malaysia, estimated at over 550 species. Coral reefs near the mainland of Sabah are located in Kudat (109km^2), Kota Belud (64km^2), Kota Kinabalu (54km^2) and Labuan (37km^2). However, coral reefs are limited in Sarawak where they are only found in the offshore islands north-east and south-east of Sarawak. Peninsular Malaysia has over 360 species of coral, however, coral reefs found in the Straits of Malacca, are in poor condition due to the muddy condition (Maritime Institute Malaysia, 2006). Coral reefs in Peninsular Malaysia are restricted only in the north-west and south-east of the Peninsular. Please refer to Figure 2-18 and 2-19 for illustration of coral reefs distribution.

Most of the islands within the state's coastal waters are gazetted as marine parks to protect these delicate ecosystems from facing further deterioration. Currently, a total of four (4) marine parks have been established in Sabah for the protection of coral reefs i.e. Pulau Tiga National Park, Tun Sakaran Marine Park, Tunku Abdul Rahman National Park, and Turtle Islands, with area coverage of 158km2, 101km^2, 49km^2 and 17km^2 respectively. The Swallow Reefs or better known as Pulau Layang-Layang located off Kota Kinabalu with a total coral area of less than 0.1km^2 is also under Sabah jurisdiction. In addition, two (2) other marine parks have been proposed for gazettement, i.e. the Tun Mustapha Marine Park and Pulau Sipadan Park. The proposed Tun Mustapha Marine Park with a total area of 11,000km^2 will be the largest protected areas for corals and marine species in Malaysia and is a well-known diving site for divers (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

TABLE 2- 4: MAJOR CORAL REEFS AREA LOCATED IN THE ISLANDS, ISLETS AND ROCKS IN STATES' WATER ADJACENT TO THE SOUTH CHINA SEA

State	Coral Reef Locations	Conservation Status
Terengganu	Pulau Redang	Marine Park[a]
	Pulau Paku Kecil	Marine Park[a]
	Pulau Paku Besar	Marine Park[a]
	Pulau Lima	Marine Park[a]
	Pulau Kerengga Besar	Marine Park[a]
	Pulau Kerengga Kechil	Marine Park[a]
	Pulau Ekor Tebu	Marine Park[a]
	Pulau Ling	Marine Park[a]
	Pulau Pinang	Marine Park[a]
	Pulau Susu Dara	Marine Park[a]
	Pulau Perhentian Kechil	Marine Park[a]
	Pulau Perhentian Besar	Marine Park[a]
	Pulau Bidong	Non-protected Area
	Pulau Gelok	Non-protected Area
	Pulau Yu	Non-protected Area
	Pulau Karah	Non-protected Area
	Pulau Nyireh	Marine Park
	Pulau Tenggol	Marine Park
	Pulau Kapas	Marine Park
	Pulau Gemia	Marine Park
Pahang	Pulau Tioman	Marine Park[c]
	Pulau Chebeh	Marine Park[c]
	Pulau Tulai	Marine Park[c]
	Pulau Sepoi	Marine Park[c]
	Pulau Labas	Marine Park[c]
	Pulau Tokong Bahara	Marine Park[c]
	Pulau Sri Buat	Marine Park[c]
	Pulau Sembilang	Marine Park[c]
	Pulau Gut	Marine Park[c]
	Pulau Tokong Burong	Non-protected Area
	Pulau Jahara	Non-protected Area
Johor	Pulau Pemanggil	Marine Park
	Pulau Aur	Marine Park
	Pulau Tinggi	Marine Park[d]
	Pulau Dayang	Marine Park[d]
	Pulau Mentinggi	Marine Park[d]
	Pulau Apil	Marine Park[d]
	Pulau Nanga Kechil	Marine Park[d]
	Pulau Nanga Besar	Marine Park[d]
	Pulau Simbang	Marine Park[d]
	Pulau Lanting	Marine Park[d]
	Pulau Ibol	Marine Park[d]
	Pulau Penyembang	Marine Park[d]
	Pulau Sibu	Marine Park[d]
	Pulau Sibu Tengah	Marine Park[d]
	Pulau Papan	Marine Park[d]
	Pulau Sibu Hujung	Marine Park[d]
	Pulau Besar	Marine Park[d]
	Pulau Tengah	Marine Park[d]
	Pulau Hujung	Marine Park[d]
	Pulau Rawa	Marine Park[d]
	Pulau Goal	Marine Park[d]
	Pulau Mensirip	Marine Park[d]
	Pulau Harimau	Marine Park[d]
	Pulau Lima	Non-protected Area
	Pulau Yu	Non-protected Area
Sarawak	Pulau Talang-Talang	Marine Park
	Pulau Satang	Marine Park
	Pulau Burong	Non-protected Area
	Sibuti reef	Non-protected Area
Sabah	Pulau Manukan	State Park[e]
	Pulau Sulug	State Park[e]
	Pulau Mamutik	State Park[e]
	Pulau Sapi	State Park[e]
	Pulau Gaya	State Park[e]
	Pulau Tiga	State Park[f]
	Pulau Kalampunian Damit	State Park[f]
	Pulau Kalampunian Besar	State Park[f]
	Pulau Balambangan	Non-protected Area[g]
	Pulau Banggi	Non-protected Area[g]

State	Coral Reef Locations	Conservation Status
	Pulau Mantanani	Non-protected Area
	Pulau Sapangar	Non-protected Area
	Pulau Layang	Non-protected Area
	Pulau Dinawan	Non-protected Area
	Pulau Mantukud	Non-protected Area
	Pulau Daat	Non-protected Area
	Batu Mandi	Non-protected Area
Labuan	Pulau Rusukan Besar	Marine Park[h]
	Pulau Rusukan Kechil	Marine Park[h]
	Pulau kuraman	Marine Park[h]

	Pulau Redang Group of Islands
	Pulau Perhentian Besar Group of Islands
	Pulau Tinggi Group of Islands
	Pulau Tioman Group of Islands
	Pulau Sibu Group of Islands
	Pulau Besar Group of Islands
	Tunku Abdul Rahman Park
	Pulau Tiga Group of Islands
	Tun Mustapha Marine Park
	Pulau Labuan Group of Islands

Note: [a] as Pulau Redang Marine Park, [b] as Pulau Tioman Marine Park, [c] as Johor National Park, [d] as Johor National Park, [e] as Tunku Abdul Rahman Park, [f] Pulau Tiga Park, [g] Tun Mustapha Marine Park and [h] Labuan Marine Park

Source: Maritime Institute Malaysia, 2006

However, it is important to note that there are also many shoals and ocean reefs in the South China Sea that are rich in corals but are not protected. These oceanic reefs and submerged mountain corals, such as in the Spratly Islands and Luconia Shoals (Beting Patinggi Ali) are located in the Continental Shelf and Exclusive Economic Zone (EEZ) and are yet to be explored and assessed (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Information about the health of coral reefs in Malaysia is somewhat limited. Survey data is fragmented and distributed among numerous institutions. There is no single data base of information from surveys, and much of the information is old (ReefCheck Malaysia, 2009).

ReefCheck Malaysia, together with many volunteers has been undertaking coral reef surveys since 2007 to develop baseline data on the status of coral reefs on Malaysia's East Coast. In its Annual Survey Report 2010, survey findings indicated that the reefs within the survey area[10] have a relatively high level of living hard coral, some 10% above the regional average. However, there are indications of low level of abundance of high-value fish species of fish such as groupers and shellfish (e.g. lobster, an indication of slow recovery from past overfishing and possible continuing problems with poaching within the marine protected areas. In some cases, high incidences of algae indicates that some reefs suffers from ecosystem imbalance due to elevated nutrient inputs, possibly from sewage and agriculture activities (particularly from plantations), coupled with low herbivory by fish and sea urchins (ReefCheck Malaysia, 2010).

[10] In Peninsular Malaysia, the surveys conducted at sites around the five main islands off the East coast (Aur, Perhentian, Redang, Tenggol and Tioman) were carried out as a continuation of the monitoring programme started in 2007. New sites on the islands of Kapas, Bidong and Yu were added into the survey programme this year as an extension of RCM's effort to cover more sites around Malaysia. In East Malaysia, a large percentage of the surveys were conducted together with a number of dive operators, notably in Lankayan, Mataking and Kapalai in Sabah as well as Miri, in Sarawak.

FIGURE 2- 18: DISTRIBUTION OF CORAL REEFS IN PENINSULAR MALAYSIA

Source: Spalding M.D., Ravilious C., Green E.P., 2001, World Atlas of Coral Reefs, Prepared at the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA

FIGURE 2- 19: DISTRIBUTION OF CORAL REEFS IN SABAH AND SARAWAK

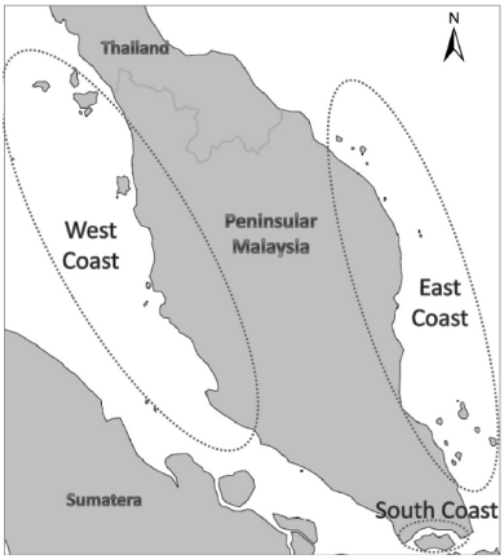
Source: Spalding M.D., Ravilious C., Green E.P., 2001, World Atlas of Coral Reefs, Prepared at the UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA

PENINSULAR MALAYSIA

This sub-section discusses the distribution of scleractinian[11] coral diversity based on three main areas – the south coast, west coast and east coast, as depicted in Figure 2-20 below.

The total number of scleractinian coral species in Peninsular Malaysia stands at 480 species. There are 245 species in the South Coast, 63 species in the West Coast and 431 species in the East Coast. It should be noted that the list is not final and requires confirmation. However, the species count can be considered as 'high' in the context of the Coral Triangle. Please refer to Appendix 2-1 for the list of scleractinian coral species of Peninsular Malaysia.

FIGURE 2-20: MAP OF PENINSULAR MALAYSIA INDICATING THE THREE MAIN STUDY AREAS: THE WEST COAST, THE EAST COAST AND SOUTH COAST



Source: Affendi, Y.A.; Faedzul, R.R., 2011

[11] Scleractinia, also called stony corals, are exclusively marine animals; they are very similar to sea anemones but generate a hard skeleton. Much of the framework of modern coral reefs is formed by scleractinians. There are two groups of Scleractinia - Compound corals live in colonies in clear, shallow tropical waters; they are the world's primary reef-builders. Solitary corals are found in all regions of the oceans and do not build reefs. In addition to living in tropical waters some solitary corals live in temperate, polar waters, or below the photic zone down to 6,000 metres (20,000 ft). Source: Wikipedia.

SOUTH COAST

In October 2008, a biological resource survey was completed at Middle Rocks, Johor (Yusuf et al., submitted 2009) and have found scleractinian coral diversity of 203 species. However, this findings have not been published. This and based on earlier research findings dating back to 1956 have recorded scleractinian coral diversity of 245 species within the South Coast of Peninsular Malaysia.

WEST COAST

During the 2nd Xarifa expedition of 1957-1958 coral samples were collected from the Straits of Malacca. Specifically, these samples were taken from Perak Island, Kepulauan Sembilan (Lalang, Saga & Rumbia Islands), and Jarak Island. The list was published in 1974. All 38 species of scleractinian corals specimens were placed in the Hessian State Museum at Darmstadt, West Germany. In a later survey in 1976 at Cape Rachado, Port Dickson, Negeri Sembilan, 34 species were recorded (excluding the 'fire coral' - *Millepora platyphylla).* Therefore with reference to both of these studies, scleractinian coral diversity for the West Coast of Peninsular Malaysia stands at 63 species (Affendi, Y.A.; Faedzul, R.R., 2011).

EAST COAST

In 1978, a team of researchers embarked on a survey of coral reef resources of the east coast of Peninsular Malaysia which includes sites at Pulau Tioman, Pulau Tulai, Pulau Tinggi/ Mentigi, Pulau Sembilang/Seri Buat, Pulau Besar, Pulau Tengah, Pulau Rawa, Pulau Gual/Harimau and Pulau Mensirip. A total of 156 scleractinian coral species excluding the 'blue coral', 3 species of 'fire coral', 4 species of unidentified *Porites* sp. and 7 other scleractinian corals which were not fully described have been recorded (Affendi, Y.A.; Faedzul, R.R., 2011).

One of the more extensive coral diversity studies was done in 2000 by the Coral Cay

Conservation Ltd (Harborne et al., 2000) which was commissioned by the Marine Park Department. They surveyed three Marine Park areas on the east coast of Peninsular Malaysia; Pulau Redang Marine Park (Teluk Mat Delah, Chagar Hutang, Pulau Ling, Pulau Lima, Pulau Lang Tengah & Terumbu Kili), Pulau Tioman Marine Park (Batu Malang, Teluk Juara, Pulau Gut, Pulau Tokong Bahara, Pulau Seri Buat, Teluk Kadar at Pulau Tulai & Pulau Renggis) and Pulau Tinggi Marine Park (Teluk Jawa at Pulau Dayang, Teluk Pontianak at Pulau Pemanggil, Pulau Simbang & Batu Tikus). This study recorded 202 scleractinian coral species excluding 14 species which were not fully described; one 'blue coral' and 4 species of 'fire coral'. Compared to earlier surveys done in 1974, additional 119 species have been added to the Peninsular Malaysia scleractinian list.

The Malaysia Coral Reef Conservation Project (MCRCP) in 2005 published a report on their study of Pulau Perhentian in 2003. This study was done by the Coral Cay Conservation Ltd for the Marine Park Department. They had a list of 88 scleractinian coral species excluding the 'blue coral' and 2 species of 'fire coral'.

In 2004, an extensive survey of the scleractinian corals took place at Teluk Tekek, Pulau Tioman (Affendi et al., 2005) and managed to document 221 species excluding 6 species not fully described, the 'blue coral' and 2 species of 'fire coral'. One key finding from the study was that 17 species of scleractinian corals found are considered rare by worldwide standard. Another survey at the same island was done along Kampung Paya through to Kampung Genting in 2007 (Affendi et al., 2007) in which 291 scleractinian coral species were documented, excluding the 'blue coral'. Therefore with regards to all the studies above, the scleractinian coral diversity for the East Coast of Peninsular Malaysia stands at 431 species.

Sabah

Sabah is home to 75% of Malaysian reefs (Burke et al., 2002). A total of 471 species, 79 genera and 21 families of hard corals (including 4 families of non-scleractinian corals) have been recorded in Sabah However, most studies in Sabah is work-in-progress and requires extensive reviews for verification. Table 2-5 below summarises previous studies that have been undertaken in Sabah. This table however, may not reflect all studies undertaken in Sabah as some may still be unpublished.

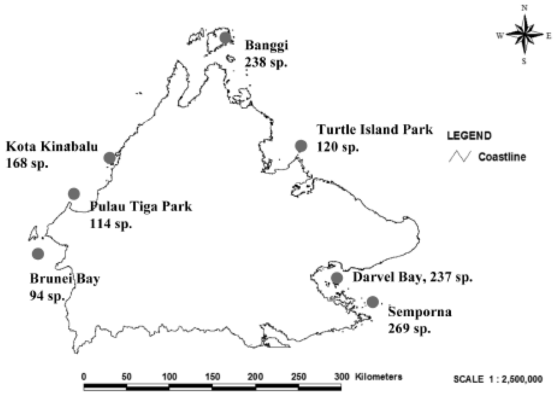
TABLE 2- 5: PREVIOUS STUDIES OF CORAL REEF ASPECTS IN SABAH

Location	Title	Research person/s or Team	Year
Semporna (islands within and surrounding the Tun Sakaran Marine Park, including P. Sipadan)	The coral reefs of the Bodgaya Islands (Sabah: Malaysia) and Pulau Sipadan	Wood, E.M and Tan, B.S.T	1987
	Hard corals of the Tunku Abdul Rahman Park, reefs off Semporna and Pulau Sipadan	Marsh, L.M.	1992
	Pulau Sipadan: Reef life and ecology	Wood, E.M	1994
	Kajian status alam sekitar dan keupayaan tampungan Pulau Sipadan	Universiti Malaysia Sabah and Sabah Parks	2005
Pulau Tiga Park (Pulau Tiga, P. Kalampunian Besar and P. Kalampunian Damit	Development and management plan: Pulau Tiga Park	Universiti Pertanian Malaysia, Universiti Malaysia Sabah, Jabatan Perhilitan and Sabah Parks	1996
Turtle Island Park (Pulau Selingan, P. Bakkungan Kechil and P. Gulisaan)	Development and management plan: Turtle Island Park	Universiti Pertanian Malaysia, Universiti Malaysia Sabah, Jabatan Perhilitan and Sabah Parks	1996
Darvel Bay (Pulau Sakar, P. Baik, Bagahak, Takon, P. Laila, P. Maganting, P. Bohayan, P. Tabawan, P. Silumpat	Hard corals of Darvel Bay (Ekspedisi Galaxea '98)	Ditlev, H., De Silva, M.W.R.N., Rahman, R.A., Toerring, D. Widt, S. and team	1998
Banggi group of islands	Reef Corals of Banggi Area Reefs, Sabah, Malaysia	Fenner, D.	2001
	Coral diversity in the Pulau Banggi Region, Sabah, at the western boundary of the Coral Triangle and the Sulu-Sulawesi Marine Ecoregion	Hoeksema, B. W., Waheed, Z. and Cabanban, A.S.	In prep.
	Status of coral reefs in southeast Malawali, Kudat, Sabah (Ekspedisi Perdana 2009)	Waheed, Z., Affendi, J., Irwanshah, M. and Brunt, H.	In prep.
Brunei Bay (Pulau Daat, P. Papan, P. Burung and islands within the Labuan Marine Park, which are P. Kuraman, P. Rusukan Besar and P. Rusukan Kecil)	Biological Resources in Coastal Environmental Profile of Brunei Bay	Waheed, Z and team	2006

Source: Affendi, Y.A.; Faedzul, R.R., 2011

The number of coral species was highest at the Semporna reef complex, followed by the Banggi group of islands and Darvel Bay with 269, 238 and 237 species, respectively. All three sites are located toward the east coast of Sabah (Figure 2-21).

FIGURE 2- 21: HARD CORAL SPECIES DISTRIBUTION IN SABAH



Source: Affendi, Y.A.; Faedzul, R.R., 2011

Functions and Importance

Coral reefs are divided into three (3) major types i.e. fringing, patch and atoll. In Malaysia, most of the coral reefs belong to the fringing type reefs, with the exception of Pulau Layang-Layang where they are categorized as an atoll. The UNEP World Atlas of Coral Reefs estimated at least 346 species of *scleratinian* corals may be found in Malaysian waters and an estimated 519 coral species can be found in South China Sea (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Moberg, F. and Folke, C. (1999) also cited that there is approximately ten (10) times more *sclerectinian* coral species in comparison to the highest reef community species diversity of the biogeographic regions- the Western Atlantic. Fish diversity is approximately four (4) times higher in the Indo-West Pacific than in Western Atlantic reefs. The mutualistic association, e.g. giant clam zooxanthellae and anemone fishes, are more diverse in the Indo-West Pacific compared with reefs in the Eastern Pacific and Atlantic oceans. (Moberg, F. & Folke, C., 1999)

The State of the Marine Environment Report (2011-2020) indicated that approximately 140 species with 58 genera and 17 families of hard corals are located on the outer reef slope with the genus *Acropora* representing at least 23 species. Coral species in the family *Acroporidae*, also known as the *acroporids* consists of 71 species of genus *Acropora*, 3 species of genus *Anacropora* and are commonly found in most of the islands in Malaysian waters and are dominant in the east coast of Peninsular Malaysia. Other coral species from the family *Poritidae*, *Mussidae* and *Faviidae* typically make-up coral reefs on the west coast of Peninsular Malaysia. A total of 252 species and 71 genera of hard corals have been recorded in Sabah and among the major genera found are *Acropora*, *Montipora*, *Fungia*, *Porites*, *Pavona*, *Leptoseris*, *Turbinaria*, *Astreopora* and *Lobophyllia*. The Layang-Layang reefs are largely dominated by hard corals (*Scleractinian*), with moderate diversity of soft corals present. Pulau Layang-Layang's hard corals grow at depths over 40m, which is remarkable considering the fact that most of the corals elsewhere are limited to shallow waters of less than 20m, probably due to the clear waters and an undisturbed environment that is suitable for optimal growth (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

TABLE 2- 6: LIST OF HARD CORALS AT PULAU LAYANG-LAYANG

Common Name	Family	Genera/Species
Table coral	Acroporidae	*Acropora hyacinthus*
Staghorn coral		*A. secale*
Starflower coral		*Astreopora sp.*
Basket coral		*Montipora sp.*
Encrusting coral	Agariciidae	*Leptoseris sp.*
Lettuce coral		*Pachyseris sp.*
Lettuce coral		*Pachyseris speciosa*
Cactus coral		*Pavona decussata*
Anchor coral	Caryophylliidae	*Euphyllia ancora*
Bubble coral		*Plerogyra sinuosa*

Common Name	Family	Genera/Species
Cup coral	Dendrophylliidae	*Turbinaria sp.*
Orange sun coral		*Tubastrea faulkneri*
Golfball coral	Faviidae	*Favia sp*
Brain coral		*Favites sp*
Brain coral		*Platygyra sp*
Encrusting coral		*Diploastrea sp*
Mushroom coral	Fungiidae	*Halomitra pileus*
Irregular Boomerang coral		*Sandalolitha robusta*
Disk coral		*Fungia danai*
Disk coral		*F.fungites*
Disk coral		*F.horrida*
Disk coral		*F.scabra*
Tongue coral		*Herpolitha limax*
Plate coral		*Cycloseris sp*
Bracket coral		*Podabacia sp*
Slipper coral		*Polyphyllia talpina*
Plate coral		*Zoopilus echinatus*
Plate coral		*Heliofungia actiniformis*
Horn coral	Merulinidae	*Hydnaphora sp*
Fire coral	Milleporidae	*Millepora sp*
Hard coral	Montiporidae	*Echinophora lamellose*
Brain coral	Mussidae	*Lobophyllia hemprichii*
Cauliflower coral	Pocilloporidae	*Pocillopora so*
Bird's Nest coral		*Seriatopora sp*
Cauliflower coral		*Stylophora sp*
Massive coral	Poritidae	*Porites sp*
Flowerpot coral		*Alveopora sp*
Flowerpot coral		*Goniopora sp*

Source: State of the Marine Environment Report (2011-2020)

TABLE 2- 7: LIST OF SOFT CORALS AT PULAU LAYANG-LAYANG

Common Name	Family	Genera/ Species
Fans		
Plexaurid gorgonian	Plexauridae	*Plexaurids* sp
Wire coral	Gorgoniidae	*Hicksonella* sp
Whips		
Red Whip coral	Ellisellidae	*Junceela* sp
Black coral	Antipathidae	*Cirripathes* sp
Others		
Soft coral	Alcyoniidae	*Sarcophyton* sp
Yellow soft coral	Nephtheidae	*Dendronephthya* sp
Nephtheid soft coral	Nephtheidae	*Scleronephthya* sp
Sea anemone	Stichodactylidae	*Stichodactyla* sp
Sea anemone	Stichodactylidae	*Heteractis aurora*
Sea anemone	Stichodactylidae	*H. magnifica*
Pulsating soft coral	Xeniidae	Xenia sp.

Source: State of the Marine Environment Report (2011-2020)

Coral reef ecosystem supports many fish species and of up to 600 coral reef fishes have been recorded at Pulau Layang-Layang. A higher number of fish species are found in pristine coral reefs as indicated in a research done in the 1980s that showed higher coral fish diversity in pristine area like Pulau Layang-Layang than any other place in Peninsular Malaysia. There are around seven (7) diverse families of coral fish i.e. the *scarids, serranids, chaetodontids, pomacanthids, labrids*, and *pomacentrids*. *Chaetodontids* are the most common indicator species found on the reefs (Maritime Institute Malaysia, 2006).

Picture 2: Layang-Layang Island

TABLE 2- 8: LIST OF REEF FISH RECORDED AT PULAU LAYANG-LAYANG

Family	**Species**	**Common name**
Acanthuridae	*Acanthurus lineatus*	Striped surgeon
A. triostegus		Convict surgeon
Antennariidae	*Antennarius pictus*	Painted frogfish
Apogonidae	*Apogon letacanthus*	Threadfin cardinalfish
Aulostomidae	*Aulostomus chinensis*	Trumpetfish
Corythoichthys heamatopterus		Reef pipefish
Balistidae	*Balistoides conspicillum*	Clown triggerfish
B. viridescens		Titan triggerfish
Pseudobalistes sp.		Yellow-margin triggerfish
Blennidae	*Aspidontus taeniatus*	Sawtooth blenny
Bothidae	*Bothus* sp.	Flounder
Carangidae	*Caranx sexfasciatus*	Big-eye trevally
C. melampygus		Blue fin trevally
Chaetodontidae	*Forcipiger longirostris*	Very-long-nosed butterfly
Hemitaurichthys polylepis		Pyramid butterflyfish
Chaetodon trifascialis		Chevron butterflyfish
C. auripes		Oriental butterflyfish
C. adiergastos		Eye-patch butterflyfish
Cirrhitidae	*Paracirrhites arcatus*	Ring-eyed hawkfish
Diodontidae	*Diodon hystrix*	Black spotted porcupinefish
Gobidae	*Priolepis cincta*	Banded reef goby
Isigobius sp.		Goby
Bryaninops loki		Whip-coral goby
Nemateleostris magnifica		Fire goby
Nemateleotris sp.		Dart goby
N. decora		Decorated fire goby
Haemulidae	*Plectorhinchus chaetodontoides*	Harlequin sweetlip
P. orientalis		Oriental sweetlip
Heterocongridae	*Heteroconger* sp.	Garden eel
Kyphosidae	*Kyphosus cinerascens*	Snubnose drum
Labridae	*Thalassoma* sp.	Sunset wrasse
Labroides dimidiatus		Cleaner wrasse
Cheilinus undulatus		Humphead Napoleon wrasse

Family	Species	Common name
Bodianus loxozonus		Eclipse hogfish
Lethrinidae	*Gnathodentex aurolineatus*	Gold lined sea bream
Microdesmidae	*Nemateleotris magnifica*	Red fire goby
Monacanthidae	*Aluterus scriptus*	Scribbled filefish
Oxymonacanthus sp.		Orange-spotted filefish
Muraenidae	*Gymnothorax meleagris*	White-mouth moray eel
G. javanicus		Giant moray
Plotosidae	*Plotosus lineatus*	Striped eel catfish
Pomacanthidae	*Pygoplites diacanthus*	Regal angelfish
Pomacanthus imperator		Emperor angelfish
Pomacentridae	*Plectroglyphydodon dickii*	Damselfish
Plectroglyphidon lacrimatus		Jewel damselfish
Dascyllus trimaculatus		Humbug damsel
D. reticulatus		
Amblyglyphidodon aureus		Golden damselfish
Amphiprion ocellaris		False clownfish
A. clarkii		Clark's anemonefish
A. frenatus		Clownfish
A. akallopisos		Skunk clownfish
A. sandaracinos		Orange anemonefish
Scaridae	*Scarus ghobban*	Blue-barred parrotfish
Bolbometopon muricatum		Bumphead parrotfish
Serranidae	*Cephalopholis sonnerati*	Grouper
C. miniata		Grouper
C. argus		Peacock grouper
Plectropomus laevis		Footballer grouper
Epinephelus coioides		Brown-spotted grouper
Pseudoanthias dispar		Redfin anthias
Scorpaenidae	*Scorpaenopsis venosa*	Raggy scorpionfish
Pterois volitans		Red lionfish
P. antennata		Spotfish lionfish
Cymbacephalus beauforti		Giant flathead
Solenostomidae	*Solenostomus paradoxus*	Harlequin ghost pipefish
Syngnathidae	*Corythoicthys* sp.	Pipefish
Synodontidae	*Oxymonacanthus longirostris*	Long-nose filefish
Synodus variegates		Lizard fish
Tetraodontidae	*Arothrodon nigropunctatus*	Pufferfish
A. hispidus		White-spotted pufferfish
Arothron stellatus		Starry pufferfish
Canthigaster valentine		Sharpnose puffer
Zanthidae	*Zanthus cornutus*	Moorish idol

Source: State of the Marine Environment Report (2011-2020)

In addition to reef fishes, there are other invertebrate organisms that thrives in the reef areas. Among which, seven (7) of the nine (9) clam species from the genera *Tridacna* and *Hippopus*, exist in waters surrounding the islands in Malaysia, and four (4) species in the east coast of Peninsular and seven (7) species in Sabah. In the east coast of Peninsular Malaysia, giant clams distribution in islands of Terengganu, Pahang and Johor consists of *T. squamosa, T. maxima, T. crocea*, and *H. hippopus* while Sipadan Island has all seven (7) species including *T. derasa*, *T. gigas* and *H. porcellanus* (Maritime Institute Malaysia, 2006). Other species that lives in the coral communities are of both of coral and non-coral associated species which are still under research, thus there are only a few publications which could be used to describe them better.

Commercial and pharmaceutical species such as the sea cucumber from the *Holothuridae* and *Stichopodidae* are used in traditional medicines. Approximately 44 species were recorded in Malaysia's marine parks (Maritime Institute Malaysia, 2006).

Coral reefs provides nurseries and breeding grounds for associated species and other marine life such as pelagic and migratory species; e.g. the yellow fin tuna (*Thunnus albacores*), groupers, parrot fishes, rabbit fishes, snappers and fusiliers. Besides a valuable ecosystem to marine lives, corals reefs are important to humans too. They are vital food sources and shelters to coral reef fishes and marine inhabitant which provides humans source of food and income. More importantly, it protects shores from erosion and maintains the health of mangroves and seagrasses. Coral reefs have great economic values as they are potential pharmaceutical products. Tourism industry have benefited from healthy coral reef ecosystem and stand to lose if these source of revenue are not well maintained. A report in 2003 estimated that Conservation Charges collected over for the entrance to Malaysia's Marine Parks amounted to RM1 million and revealed that marine parks attracted 778,482 foreign and 820,116 local tourists (Maritime Institute Malaysia, 2006). However, this number should be significantly higher as the collection of the charges / fees are not entirely enforced.

Coral reefs provide several valuable services to society – termed as *"Ecosystem Services"*[12], among which are in terms of food, fisheries, tourism, coastal protection, medicine and also in terms of aesthetic, spiritual and religious value. The break out of goods and ecological services of coral reef are as in Table 2-9.

THREATS

The Status of Coral Reefs of the World 2008 reported a general decline in most of the monitoring sites in Malaysia which was previously classified as "Very Good" and "Good" coral coverage.

According to a study "Reefs at Risk in Southeast Asia" coral reefs in the Southeast Asia region are the most threatened in the world. The Report identifies several key threats to coral reefs, for example, destructive fishing practices, overfishing, sedimentation and coastal developments. Please refer to Figure 2-22 for illustration of these threats.

Threats to coral reefs in Malaysia differ by location. Agriculture development on the Peninsular Malaysia contributes to increased sedimentation and nutrient run-offs. Some of the west coast reefs are now damaged by seasonal macroalgae blooms (ReefCheck Malaysia, 2009).

Destructive fishing practices such as cyanide fishing are more prevalent in East Malaysia, particularly in Sabah which is reported to have impacted on more than 68% of its reefs (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In addition, high priced fishes such as snappers, groupers and wrasses for the lucrative live fish trade industry are collected through cyanide fishing practices. This practice occurs in Kudat, extending out of Marudu Bay in the Northeast of Sabah to the Banggi Island as well as Labuan (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In Sarawak, river sedimentation is the main threat to reefs near the Miri River which have recorded 20-30% live coral cover and large amount of algal growth (ReefCheck Malaysia, 2009).

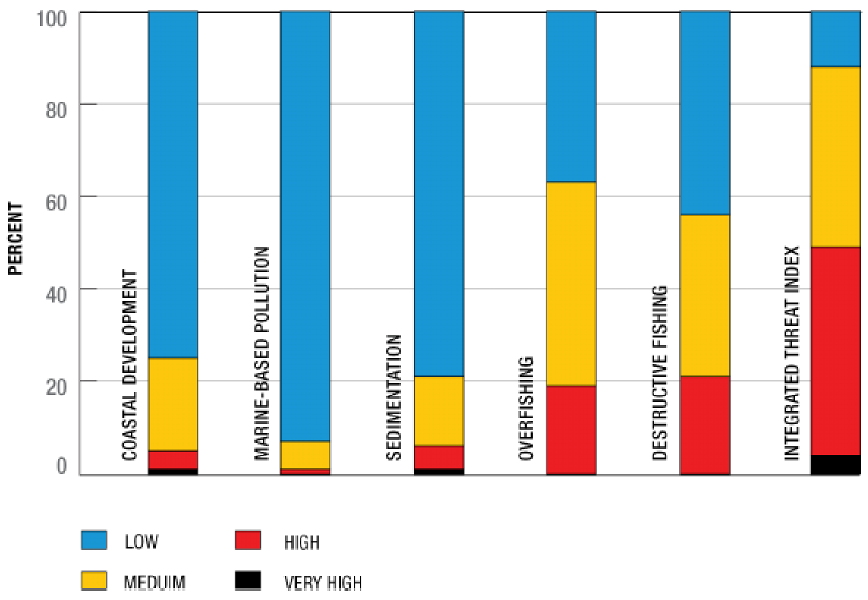
[12] Reef Check Malaysia Annual Survey Report 2010

TABLE 2- 9: GOODS AND ECOLOGICAL SERVICES OF CORAL REEF ECOSYSTEMS

Goods		Ecological services					
Renewable resources	**Mining of reefs**	**Physical structures**	**Biotic services**		**Biogeochemical services**	**Information services**	**Social and cultural services**
			Within ecosystems	**Between ecosystems**			
Seafood products	Coral blocks, rubble and sand used for building	Shoreline protection	Maintenance of habitats	Biological support through ‘mobile links’	Nitrogen fixation	Monitoring and pollution record	Support recreation
Raw materials for medicines from seaweeds, sponges, molluscs, corals, gorgonians and sea anemone	Raw materials for production of lime and cement	Build up of land	Maintenance of biodiversity and genetic library	Export of organic production, and plankton to pelagic food webs	Carbon dioxide (CO_2)and Calcium (Ca) budget control	Climate record	Aesthetic values and artistic inspiration
Other raw materials such as seaweed and algae	Mineral oil and gas	Promoting growth of mangroves and sea grass beds	Regulation of ecosystem processes and functions		Waste assimilation		Sustaining the livelihood of communities
Curio trade and jewellery or ornamental trade		Generation of coral sand	Biological maintenance of resilience				Support of cultural, religious and spiritual values
Live fish and coral for aquarium trade							

Source: redrawn after Moberg, F. & Folke, C. (1999)

FIGURE 2- 22: THREATS TO CORAL REEFS IS SOUTHEAST ASIA



Threats to coral reefs in Southeast Asia, which comprises a large part of the Coral Triangle. The eastern part of the Coral Triangle (Papua New Guinea and the Solomon Islands) are likely to have lower threat levels, especially in respect to pollution and coastal development. Only the threat of destructive fishing may be similar because of availability of World War II explosives.

Copied from Burke et al., 2002.

Fish bombing destroys sea life and corals in East Coast of Sabah

New Sabah Times
16th February, 2012

MORE than 80 per cent of the corals and other sea life in the waters of the East Coast of Sabah and its nearby islands have been destroyed due to fish bombing activities, says dive master and former fisherman, Hardy Habirah.

Besides deteriorating sea life, the fish bombing activities which have been going on for about 10 to 20 years are also slowly affecting the tourism industry not just within the East Coast of Sabah, but ultimately throughout the state. In a special interview with New Sabah Times, Hardy shared his experience on the devastation he has seen in the East Coast throughout his life as a fisherman, a boatman and his current job as dive master at The Reef Dive Resort in Mataking Island. “Of course we see places like Mataking and Sipadan Islands as highly sought-after holiday destinations and a tourism magnet for Sabah especially for divers, but what many people do not know is the devastation caused to the sea life due to fish bombing. “Many people know about or have heard about fish bombing, but what are not clearly seen by most people are the real damages caused by this method of fishing. Some people think only the fish will die from the bomb blast but that is not true. “Other sea life will also die like corals, turtles and all the other precious sea animals in the East Coast waters. It is truly heart-breaking to see,” he said. “There have been several instances when my tourists were happily diving away only to come out of the water asking me and the other divers if we heard any bomb blasts, they were both worried and scared,” he said. According to Hardy, when the tourists and other divers hear the blasts, they will get scared and would not want to make and visit. “So in our eyes, not only are the bomb blasts destroying the corals and other sea life, they are also hurting the tourism industry which flourishes in Sabah and is also the biggest income generator for the state,” he said.

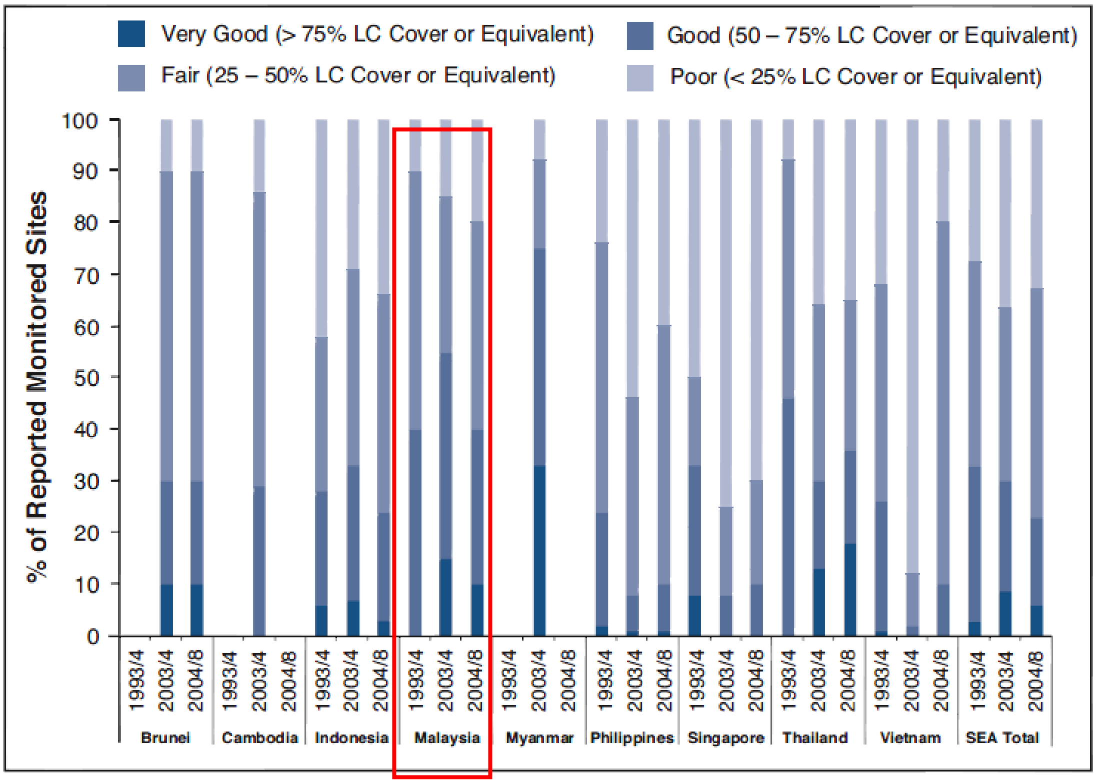
There are three areas in Sabah which are deemed Globally Significant Priority Conservation Areas within the Sulu-Sulawesi Marine Ecoregion (SSME) and these are the Kudat-Banggi Priority Conservation Area (PCA), Semporna PCA and Sandakan PCA. Malaysia’s two largest concentrations of coral reefs are found in Semporna PCA and Kudat-Bangi PCA. The reefs, mangroves and seagrass beds surrounding the Kudat-Banggi PCA, the fishand turtle populations in Sandakan and Turtle Islands and the reefs off Semporna and Sipadan are all making Sabah globally outstanding for its marine resources. Sabah is home to endangered dugongs and humphead wrasse and divers come from all over the world to experience the superlative marine life of Sipadan. The seas surrounding Sabah are some of the world’s richest. They provide fishing, tourism and other livelihoods to many thousands of Sabah’s people. However, they are threatened by overfishing, illegal use of fishing gear including fish bombing.

These threats, together with the lack of awareness, threaten livelihoods, food supply and ecological processes that sustain life. With greater and more efficient management and raised awareness, these marine resources can be utilised indefinitely.

Several bodies and organisations have started their own efforts in eradicating fish bombing activities including WWF, Sabah Parks and the Marine Conservation Society (MCS) UK will have a closed-door Regional Anti-Fish Bombing Symposium to be held in Kota Kinabalu later this month.

The objective of the Symposium is to make recommendations and to build partnerships with regards to anti-fish bombing patrolling and monitoring mechanisms in Sabah and the wider Coral Triangle area.
Participants of the symposium will include representatives from both governmental and non-governmental organisations, academicians, community representatives and law makers from Malaysia, Indonesia and Philippines.

FIGURE 2-23: STATUS OF CORAL HEALTH IN MALAYSIA AND OTHER SOUTHEAST ASIAN COUNTRIES



This graph shows the changes in live coral cover (as %) at reported monitoring sites in the Southeast Asian region between 1994 and 2008. There has been a general decline in those reefs previously with 'Very Good' and 'Good' coral cover, with a parallel increase in reefs with 'Fair' cover.

Source: Tun, K. et al., 2008

Figure 2-23 illustrates the changes in percentage of live coral cover at reported monitoring sites in the Southeast Asia region between 1994 and 2008. The survey results shows a general decline in those reefs previously with "Very Good" and "Good" coral coverage and a parallel increase in reefs with "Fair" cover (Tun, K. et al., 2008).

There has been a rapid growth in population across the region over the last 30 years thence a corresponding increase in coastal resources exploitation. Declining fish stocks in almost all Southeast Asia countries due to continuous unsustainable fishing practices and over-fishing forces many fishers to resort to destructive fishing practices such as bombing and cyanide fishing.

In Malaysia, over 85% of its coral reefs are threatened. A summary of the type of threats and its ranking are depicted in Table 2-10. Increased sedimentation and removal of coral reef substrate for coastal development destroys corals. The increasing demands for the utilization of coastal areas and construction of infrastructures are due to the growing population, expanding industrial economies and emerging tourism markets. Tourism activities within the marine protected areas of Malaysia further aggravates the issue of effluent discharge. Sewage, oil and grease as well as grey water are among the long-standing pollution problems affecting the corals (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

TABLE 2- 10: THREATS TO CORALS AND CORAL REEFS IN MALAYSIA

Threat	West Coast of Peninsular Malaysia	East Coast of Peninsular Malaysia	East Malaysia (Sabah and Sarawak)
Fishing Intensity	4	3	5
Fishing Damage	3	3	5
Fish Blasting	2	2	4
Gleaning	2	1	3
Boat Scouring	2	3	4
Population Pressure	4	3	4
Sedimentation	5	3	3
Domestic and Agriculture Pollution	3	2	4
Industrial Pollution	3	1	1
Oil Spill	2	1	2
Disease and Predation	2	4	3
Dredging	2	1	2
Coral Mining	1	1	3
Tourist Activities	1	2	2
Coral Bleaching	1	1	1

The Scale Values:
1= None to Rare
2= Very Low Concentration
3= Some Damage, Some Stress
4= Medium to High Damage
5= Very High, High Stress, Very Damaging

Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

The State of the Marine Environment Report, 2010 reveals several issues threatening coral reefs in Malaysia:

a. Survey of coral reef resources of both soft and hard are insufficient and not comprehensive in survey coverage area ;
b. Present marine parks coverage are not able to completely protect the biodiversity of coral reefs especially with limited manpower to enforce rules and regulations comprehensively;

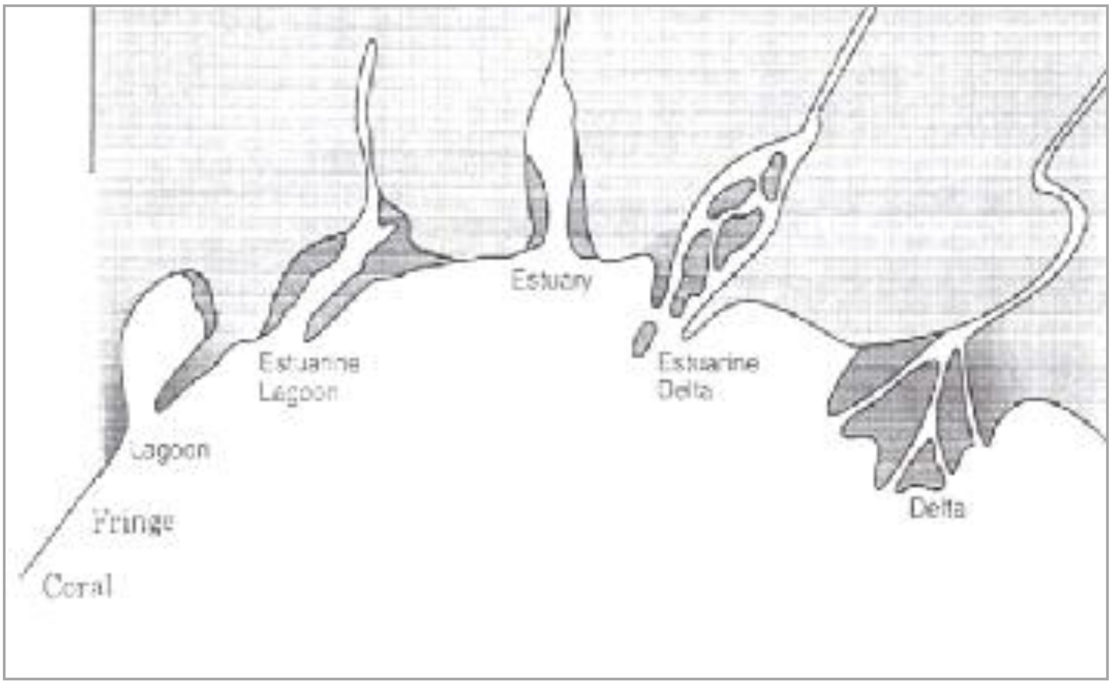
c. These marine parks are very limited to specific areas throughout the country and those outside the marine park are not monitored consistently. State Directorate of Lands and Mines or the Federal Directorate of Lands and Mines have no mandate or capacity to manage and protect the coral reefs and thus exposing them to unlimited exploitation and destruction;
d. Potential conflict of land based activities between various agencies only places coral reefs in the losing end;
e. Major threats to the corals of the west coast of Peninsular Malaysia includes land-based activities that increases sedimentation and turbidity, land-marine based pollutants, sewage and industrial nutrients, fisheries activities (trawling) and recreational activities;
f. Lack of treatment for sewage in east coast islands could not fully prevent the euthrophication of coastal waters due to excessive algae growth within the coral and leaking of oil and grease from boating activities; and
g. Global warming causes rise of sea temperature results in bleaching of corals affecting many coral areas in Malaysia as well as globally.

MANGROVES

INTRODUCTION

Mangroves forests are a form of ecosystem that has adapted to mudflats with roots that grows out of the ground, creating a unique sight of mudflats forest. Mangroves are tightly bounded to the coastal environments in which they occur and very much influenced by chemical and physical conditions and also create those conditions themselves. They are found in coastal settings like the deltas, estuarine areas with their own deltas, lagoons, and fringes of coral reefs as shown in Figure 2-24 (Kathiresan, K. & Qasim, S.Z., 2005).

FIGURE 2-24: TROPICAL COASTAL SETTINGS FOR SUCCESSFUL GROWTH OF MANGROVES



Source: Kathiresan, K. & Qasim, S.Z., 2005

There are generally six (6) functional types of mangrove forests namely, fringe, riverine, basin, overwash, scrub (dwarf) and hammock forests where the last three (3) types are the modified forms of the first three (3) types. The six types can be summarized as follows (Kathiresan, K. & Qasim, S.Z., 2005):

1. **Overwash mangrove forests:**
   These are small mangrove islands, frequently formed by tidal washings.
2. **Fringing mangrove forests:**
   These occur along the borders of protected shorelines and islands, influenced by daily tidal range. They are sensitive to erosion and long exposure to purely marine conditions with turbulent waves, and tides.
3. **Riverine mangrove forests**:
   These are luxuriant patches of mangroves existing along rivers and creeks, which get flooded daily by the tides. Such forests are influenced with the incursion of large amount of freshwater with fluvial nutrients and thus making the system highly productive with trees growing taller.
4. **Basin mangrove forests:**
   These are stunted mangroves located along the interior side of the swamps and in drainage depressions. Their positioning channels the terrestrial runoff to move towards the coast with a slow velocity of water flow.

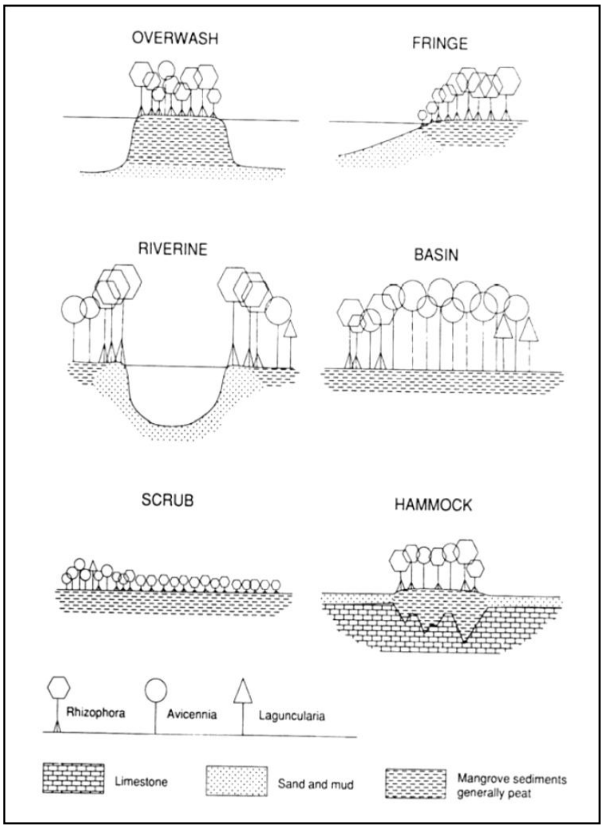
5. **Hammock mangrove forests:**
   These are similar to the basin type except that they occur in more elevated sites than the four types given above.

6. **Scrub mangrove forests:**
   These form dwarf mangrove settings along flat coastal fringes.

Generally, coasts with greater intertidal area and smooth slope of substrate encourage the growth of mangroves. However, changes on land that affect the direction and rate of flow of the water in the system will change the colonization of mangroves. Different species of mangroves respond differently to different tidal regimes (Kathiresan, K. and Qasim, S.Z., 2005). Mangroves are usually found in tropical conditions where the temperature ranges above 20°C and seasonal fluctuation does not exceed 5°C. However a very high temperature does not favour photosynthesis process, reducing the capacity, as their leaves are sensitive to changes in temperature. Any rise in temperature may change their reproductive cycle and alter their flowering and fall of rip seeds (Kathiresan, K. & Qasim, S.Z., 2005).

Mangroves grow in high salinity substrate and it influences the distribution of species, their productivity and growth. For example, *Rhizophora mucronata* seedlings do better in salinities of 30% O, but *R. apiculata* do better at 15% O. Changes in salinity are controlled by climate, hydrology, rainfall, topography and tidal flooding. A higher salinity environment causes them to spend more energy to maintain water balance and ion concentration instead of primary production and growth while low salinity contribute to reduction of cell turgidity and decreased respiration, which contributes to degradation of mangrove (Kathiresan, K. & Qasim, S.Z., 2005).

FIGURE 2-25: SIX TYPES OF MANGROVE FORESTS OF COMMON OCCURRENCE.



Source: Kathiresan, K. & Qasim, S.Z., 2005

Picture 3: Aerial view of river and mangrove forest in the Sarawak Mangrove Reserve

Peninsular Malaysia

In Malaysia, mangroves stretches along the coastline intermittently and develop very well in sheltered estuaries, deltas, lagoons and coral reef terrace. It is currently estimated that the total mangrove area in Malaysia is 575,000 ha. From the total mangrove area, 60% are found in Sabah, 23% in Sarawak and the remaining 17% in Peninsular Malaysia, which constitutes only 1.75% of the nation total land area (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Mangroves are one of the major ecosystems that forms Sabah coastline and has been identified as one of the most important life support system. In Peninsular Malaysia, most of the mangroves are found on the sheltered west coast from the state of Kedah, Perak, Selangor and Johor. Some grew on rocky shores such as in Pulau Langkawi, Kedah, Pulau Pangkor, Perak and in Port Dickson, Negeri Sembilan (Jusoff, K., 2008). Total area of mangrove recorded as at end of 2006 is estimated to be 107,802 ha, where 82,091 ha (76%) has been gazetted as Permanent Reserved Forests (PRFs). The total area of mangrove at 2010 has increased to 98,227ha (20% increase) mainly contributed by increase in area in the states of Johor and Selangor. Unfortunately, Penang has recorded a marked decrease in its mangrove forest reserves (26% decrease). Coverage of mangroves reserves are largest in Matang, Perak, followed by South Johor and Klang, Selangor (Jusoff, K., 2008).

Out of the total mangrove area, 85% have been gazetted as forest reserves (FR), wildlife sanctuaries, RAMSAR site Wetlands of International Importance, especially as Waterfowl Habitat, state and national parks. There are five (5) mangrove-based RAMSAR sites in Malaysia namely the Kukup Island, Tanjung Piai, Sungai Pulai, Kuching Wetlands and Kinabatangan. Degradation of mangrove area in Malaysia is significantly reduced from 800,000 ha in the early 1960s to about 695,000ha in 1973, and then to about 575,180 ha in 2005, representing a loss of about 28% in 50 years. Major mangrove losses in terms of land area are prominent in states of Selangor, Johor, Sarawak, Sabah, Negeri Sembilan, Kedah and Penang. Unfortunately, many mangrove reserves, which were gazetted during colonial period, have since been de-gazetted and converted for other unsustainable uses.

TABLE 2-11: EXTENT (HA) OF MANGROVE FORESTS (PRFS AND STATELAND) IN PENINSULAR MALAYSIA (2006)

State	Mangrove Forest Reserves	Stateland Mangroves	Total
Johor	16,127	13,561*	29,688
Kedah	6,202	1,916	8,118
Kelantan	-	744	744
Malacca	80	-	80
N. Sembilan	204	-	204
Pahang	2,387	1,813	4,200
Penang	376	494	870
Perak	40,466	1,885	42,351
Perlis	-	13	13
Selangor	14,897	4,650	19,547
Terengganu	1,295	692	1,987
Total	82,901	25,768	107,892

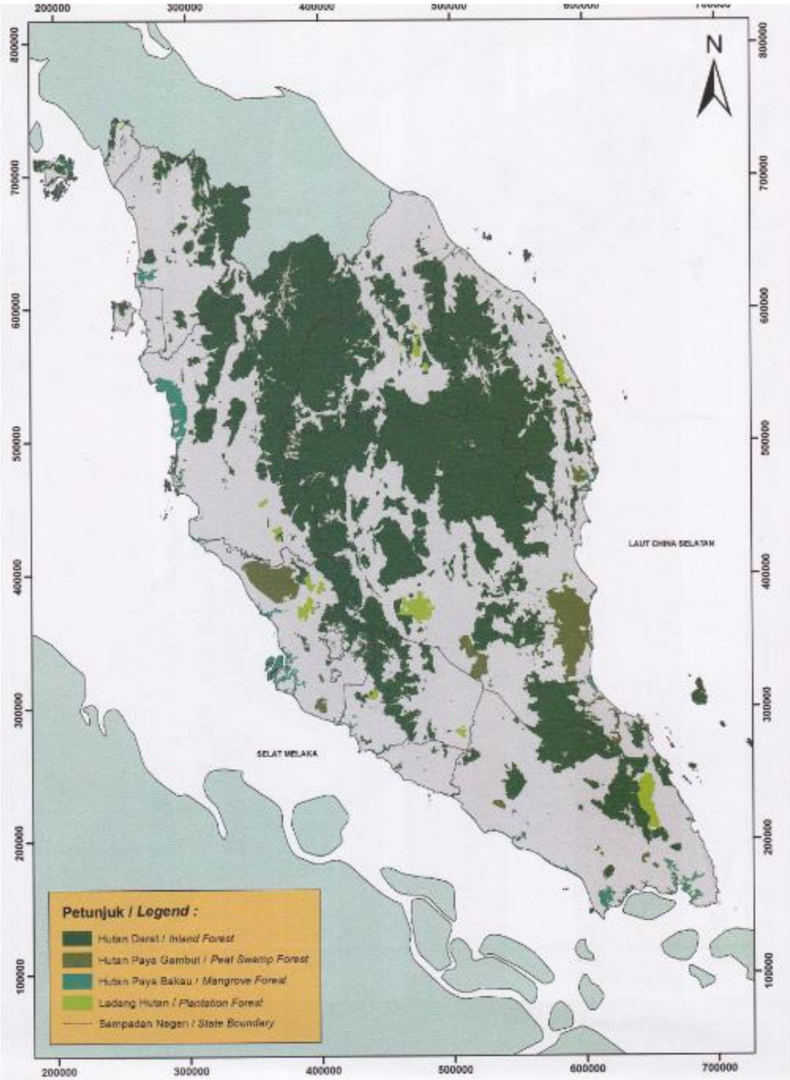
Source: Jusoff, K., 2008

TABLE 2-12: MANGROVE FOREST RESERVES IN PENINSULAR MALAYSIA (2006 / 2010)

State	Mangrove Forest Reserves		
	2006	2010	% change
Johor	16,127	27,343	70%
Kedah	6,202	6,201	0%
Kelantan	-	-	-
Malacca	80	80	0%
N. Sembilan	204	204	0%
Pahang	2,387	2,414	1%
Penang	376	279	-26%
Perak	40,466	41,617	3%
Perlis	-	-	-
Selangor	14,897	18,794	26%
Terengganu	1,295	1,295	0%
Total	**82,034**	**98,227**	

Source: Forestry Department Malaysian, 2010

FIGURE 2- 26: DISTRIBUTION OF MANGROVES AND OTHER FOREST TYPES IN PENINSULAR MALAYSIA



PICTURE 4: KUALA GULA BIRD SANCTUARY, MATANG MANGROVE FOREST

SABAH

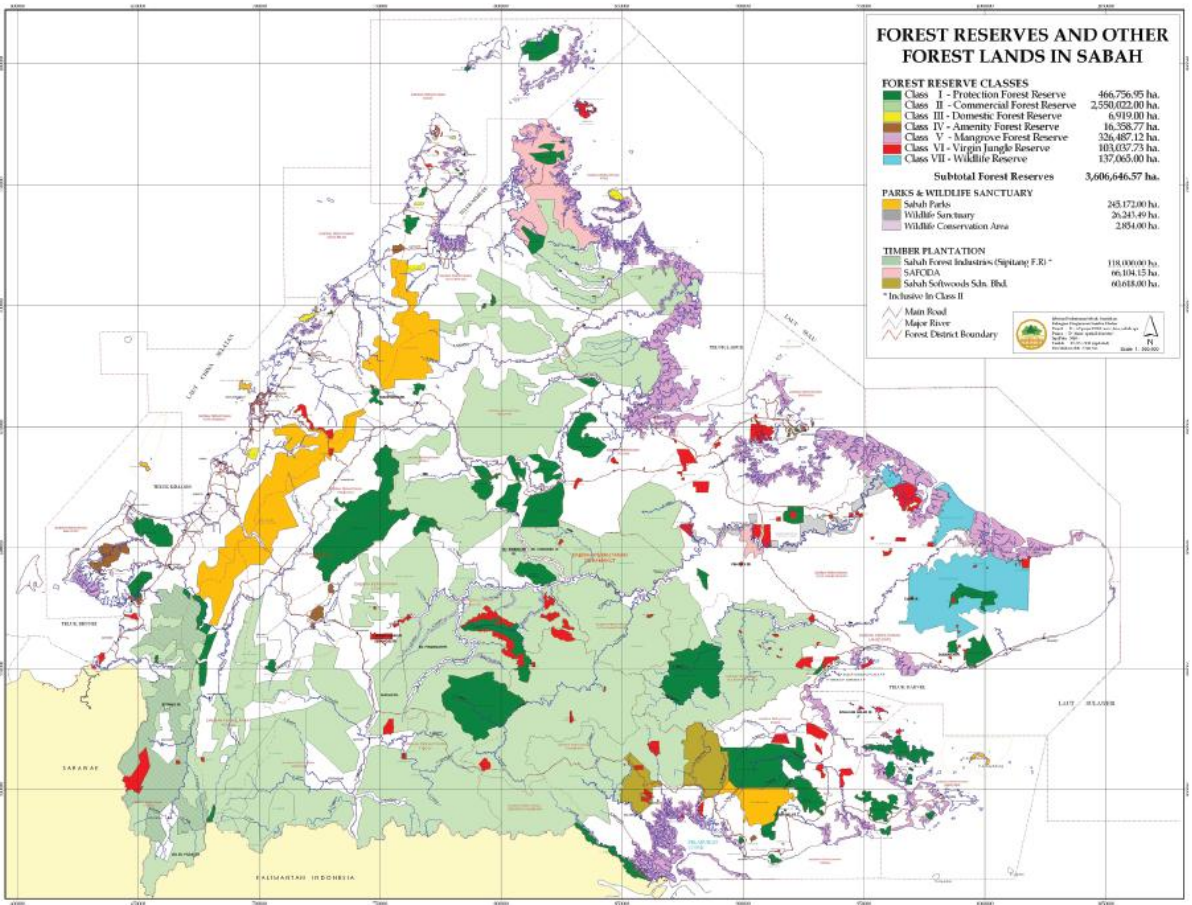
In 2010, the total area of forest reserves was 3,606,646.57 hectares (approx.) which comprises of 205 forest reserves. Nine forest reserves were excised and six re-classified. A total of 18 new forest reserves were declared in 2010 with a total area of 30,028.19ha (Sabah Forestry Department, 2010). Please refer to Table 2-14 for the list of new forest reserves.

TABLE 2-13: CLASSES AND FIGURES OF PERMANENT RESERVED FORESTS (PRF)

Class	Type of Forest Reserve	Approximate Area (Ha)	
		2009	2010
Class I	Protection Forest	364,794.17	466,756.95
Class II	Commercial Forest	2,665,886.00	2,550,022.00
Class III	Domestic Forest	7,355.00	6,919.00
Class IV	Amenity Forest	21,283.77	16,358.77
Class V	Mangrove Forest	320,521.56	326,487.12
Class VI	Virgin Jungle Reserve	92,400.70	103,037.73
Class VII	Wildlife Reserve	132,653.00	137,065.00
Grand Total		3,604,894.20	3,606,646.57

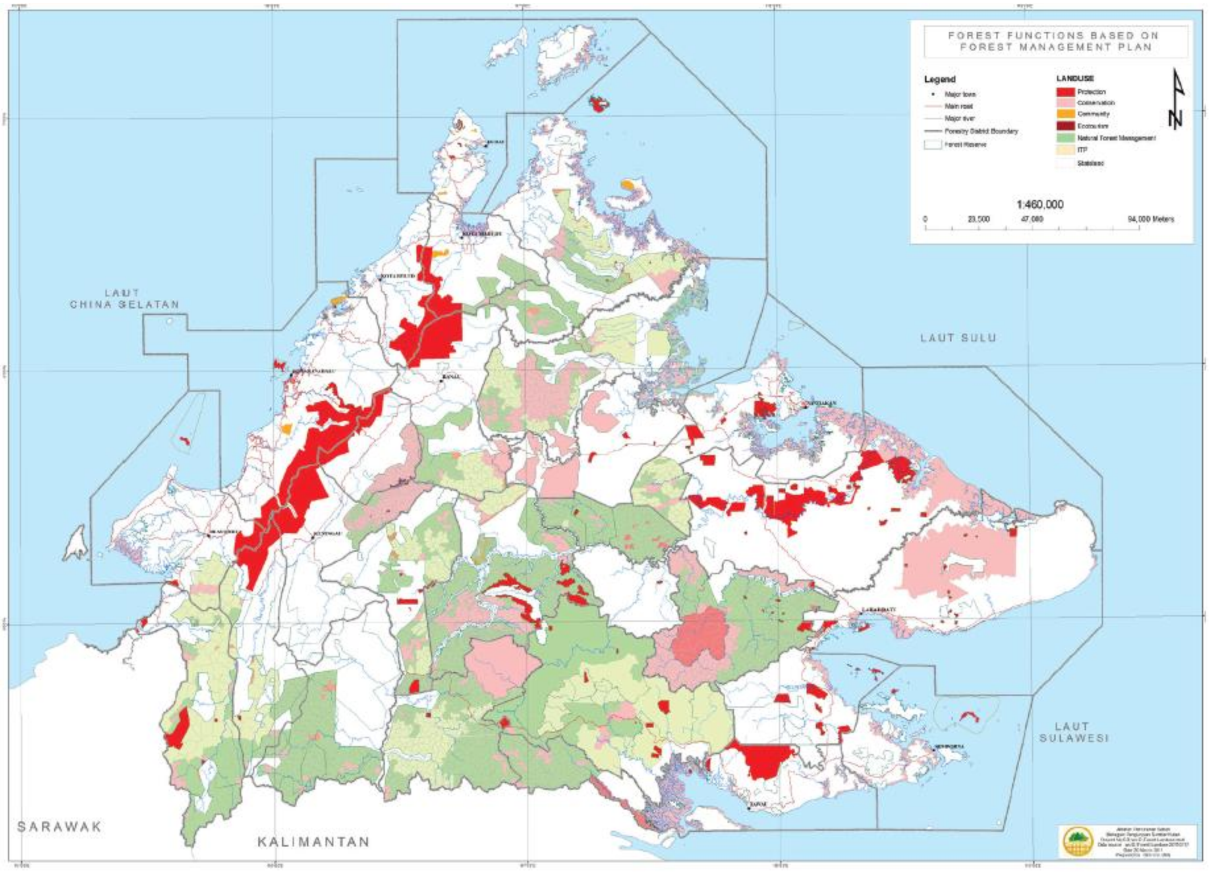
Source: Sabah Forestry Department, 2010

FIGURE 2- 27: DISTRIBUTION OF MANGROVES AND OTHER FOREST TYPES IN SABAH



Source: Sabah Forestry Department, 2010

FIGURE 2- 28: SABAH FOREST FUNCTIONS BASED ON FOREST MANAGEMENT PLAN



Source: Sabah Forestry Department, 2010

TABLE 2- 14: NEWLY GAZETTED FOREST RESERVES, 2010

No.	Name of Forest Reserve	Class	Approximate Area (Ha)
1.	Sungai Tongod	Class I	4,758.50
2.	Pulau Saga, Pulau Saddle & Pulau Laila	Class I	76.50
3.	Gana	Class I	884.00
4.	Sungai Kiluyu	Class I	1,068.00
5.	Pulau Batik Kulambu	Class IV	750.00
6.	Lahad Datu (Extension)	Class V	48.56
7.	Elopura (Extension)	Class V	78.00
8.	Sitompok	Class V	586.00
9.	Sungai Maruap	Class V	6,789.00
10.	Sempilor Malawali	Class VI	2,531.40
11.	Kabili Sepilok(Extension)	Class VI	14.00
12.	Mandahan	Class VI	0.40
13.	Sungai Siliawan (Extension)	Class VI	32.40
14.	Sungai Simpang (Extension)	Class VI	95.50
15.	Lungmanis (Extension)	Class VI	4.33
16.	Sungai Gologob	Class VI	7,900.00
17.	Kulamba (Extension)	Class VII	272.00
18.	Balat Damit	Class VII	4,140.00
Total			30,028.59

Source: Sabah Forestry Department, 2010

RAMSAR SITES

The Convention on Wetlands (Ramsar, Iran, 1971)- also known as the "Ramsar Convention" is an inter-governmental treaty that incorporates the commitment of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for sustainable use of all wetlands in their territories. The implementation of the Ramsar Convention is a continuing partnership among the current 160 Contracting Parties, the Standing Committee and the Convention Secretariat with the advice of the subsidiary expert body, the Scientific and Technical Review Panel (STRP), and the support of the International Organization Partners (IOPs). Conferences are held every three (3) years with attendance by representatives from Contracting Parties for policy-making decisions with regards to Resolutions and Recommendations as well as to administer work of the Convention in addition to improve implementation of its objectives in each member countries.

Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements (MEA) and work closely with other MEAs and is a full partner among the 'biodiversity-related cluster' of treaties and agreements. There are currently 160 Contracting parties and a total number of 1970 sites designated for the Ramsar list that covers 190,737,829 hectares.

Malaysia has ratified the Convention on Wetlands on 10th March 1995 and presently has 6 sites designated as Wetlands of International Importance with a surface area of 134,158 hectares. Of these 6 RAMSAR Sites, five (5) sites are related to coastal and marine environment namely Sungai Pulai, Tanjung Piai, Pulau Kukup, Kuching Wetlands National Park and Lower Kinabatangan-Segama Wetlands (National Coastal Resources and Marine Environment Profile of Malaysia, 2010). Table 2-15 represents a list of all RAMSAR Sites in Malaysia.

TABLE 2- 15: CHECKLIST OF RAMSAR SITES IN MALAYSIA

State	Name	Size (ha)	Date Gazetted
Pahang (1)	Tasek[13] Bera	38,446	10 November 1994
Johor (3)	Sungai Pulai	9,126	31 January 2003
	Pulau Kukup	647	31 January 2003
	Tanjung Piai	526	31 January 2003
Sabah (1)	Lower Kinabatangan-Segama Wetlands	78,803	28 October 2008
Sarawak (1)	Kuching Wetlands National Park	6,610	8 November 2005

Source: http://www.ramsar.org

[13] Tasek = Lake

Bird Sanctuaries and Wildlife Reserves

There are several islands and coastal areas in Malaysia that have been gazetted as wildlife reserves and bird sanctuaries under various wildlife and park legislations. These reserves are under the purview of respective State Wildlife Departments. Kuala Gula, a part of Matang Mangrove Reserve in Perak was gazetted as reserves for migratory and residential birds. Kuala Selangor Nature Park is a State Park managed by the Malaysian Nature Society, a non-governmental organisation (NGO). Sibuti and Samusam in Sarawak were gazetted as bird sanctuary and wildlife reserves respectively while wildlife reserves and bird sanctuaries in Sabah include Pulau Mantanani, Pulau Linkayan, Kota Belud Bird Sanctuaries and Kulamba Wildlife Reserves.

Functions and Importance

A mangrove ecosystem shelters many rare and endangered fauna and species in the ecosystem such as the proboscis monkey, dusky leaf monkeys, Malayan flying foxes, Malayan estuarine crocodile, dolphins, dugongs, turtles, and many resident and migratory birds (State of Marine Environment Report, 2011-2010). There are 41 true mangrove flora species belonging to 13 families recorded in Malaysia, representing two-third of the world true mangrove species.

This proves that Malaysia's mangroves are of global mangrove biodiversity significance. In addition, there are more than 100 associate or back mangrove species. Among the floral diversity recorded, no endemic species were recorded and most of the common species are widely distributed. The rare species such as *Sonneratia griffithii*, *Bruguiera hainessi*, *Aegiceras floridum*, *Osbornia octodonta*, *Algaia cucullata*, *Heritiera fornes* and *Heritiera globosa* have very restricted distribution. All of these species are at serious risk of extinction from localized threats (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Its ability to adapt to harsh environment deserves prioritised conservation and sustainable management efforts. These adaptations include physical adaptation of the mangrove roots and reproduction systems towards wave action, and physiological adaptations to saline condition and low level of oxygen. This ability provides a tool for humans to minimise damages in the event of climate change and sea level rise (State of Marine Environment Report, 2011-2010). Other important services provided by mangrove forests are (Jusoff, K., 2008):

a. Habitat of many endangered flora and fauna species
b. Valuable natural resources with distinctive diversity, high intrinsic natural productivity and unique habitat value
c. Invaluable goods and services in economics and environmental terms
d. Production of poles, charcoal and fuel wood
e. Coastline protection
f. Assimilation of waste
g. Source of food
h. Shelter and sanctuary for fauna
i. Spawning and breeding ground for marine life
j. Barrier to significantly reduce height and force of waves of tsunami
k. Consumable plants and medicinal herbs

There are more than 300,000 ha of mangroves concentrated on the east coast of Sabah that is associated with extended mudflats, and serves as important stopover and wintering site for birds in the East Asian-Australasian Flyway. These important stopovers include Kuala Gula (Perak), Kapar (Selangor), Parit Jawa (Johor), Benut (Johor), Pontian (Johor), Kukup (Johor), and Tanjung Piai (Johor). This area supports approximately 300 species of migratory and resident birds.

Malaysia also have extensive areas of tidal wetlands (mangroves and nipah) on the southern part of Klias Peninsular in Sabah while freshwater wetlands are found in coastal wetlands of the west coast especially at Beaufort, Paper and Kota Belud , also in Sabah (State of Marine Environment Report, 2011-2010).

The riverine area offers potential fishing site and the meandering rivers and rivulet. Fireflies, which are usually gathered at river estuaries is another major tourism attraction such as in Kampong Kuantan, Selangor; Kampong Yakyoh, Terengganu; Kelantan Delta; Sungai Lebam, Johor; and Kuala Linggi, Negeri Sembilan/Melaka (Jusoff, K., 2008). This provides a very unique platform for the development of niche ecotourism product in Malaysia to generate income for the local communities (State of Marine Environment Report, 2011-2010).

TABLE 2- 16: GOODS AND ECOLOGICAL SERVICES OF MANGROVES ECOSYSTEM

Goods		**Ecological services**			
Forestry products	**Raw materials**	**Physical structures**	**Biotic**	**Biogeochemical services**	**Social and cultural services**
Firewoord, charcoal, timber, honey, etc.	Shells of mangrove molluscs for manufacture lime	Screening the solar UV-B radiation	Trapping sediment and sinks suspended sediments	Nitrogen fixation	Support recreational activities
Wood with high content of tannin-timber	Attract honey bees and facilitate apiculture activities- provide employment	Reducing the 'Green House Effects'	Deepening the creeks – water circulation	Ammonium fixation	Aesthetic values and artistic inspiration
Pneumatophore-bottle stoppers, floats	Cheap nutritive feed for buffaloes, sheep, goats and camels	Minimizing the fury of cyclones or tsunami	Trapping and recycling of nutrients	Litter decomposition and nutrient enrichment	Sustaining the livelihood of communities
***Nypha* leaves to thatch roofs, mats and baskets**	Indigenous medicines	Protection of shoreline-controlling flood	Biomass and litter production – global carbon cycle		Support of cultural, religious and spiritual values
	Seeds for aquaculture industries	Prevent coastal erosion			

Source: Kathiresan, K. & Qasim, S.Z., 2005

THREATS

The degradation of mangrove areas is mainly as a result of increasing population and rapid economic developments in the coastal areas. Irresponsible and unsustainable practices in activities such as deforestation, land conversion/reclamation for agriculture, aquaculture, mining, industrial, port expansion, urbanization, tourism, infrastructure developments, coastal pollution from oil spills, domestic and industrial wastes exacerbates the situation (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Malaysia has lost approximately 36% of its mangrove forest area and 22% of mangrove forest reserves due to unsustainable human uses of mangrove and over-exploitation of natural resources. The State of Kedah lost 1,500 ha of mangrove land to make way for rice production whereas Selangor lost 7,500 ha (30%) of its mangrove area to coconut and oil palm plantation. More recently, mangrove forests have been cleared to provide space for coastal pond aquaculture of prawns (*Penaeus monodon* and *P. merguiensis*), siakap (*Lates calcarifer*) and snappers (*Lutjanus* spp.). This involves several areas in in Kedah and Selangor. Present ports such as Port Klang, North Port and West Port were built on reclaimed mangrove areas. The largest mangrove tracts that has been cleared for development was in Lumut Island with an estimated loss of up to 4,349 ha (State of Marine Environment Report, 2011-2010).

There has been an overall decline of 22% of water birds in Malaysia between 1983 and 1986. Data ranges from 2004-2006 recorded a serious rate of decline of up to 86% along the coast of Perak followed by Johor (40%) and Selangor (26%). Loss of mangrove areas affects its trophic dynamics and eventually the livelihood of traditional fishermen.

This is evidenced by a 2005 survey made in the southern State of Pahang (State of Marine Environment Report, 2011-2010).

Other threats include irresponsible industrial parks activities such the release of effluents into the river system predominantly in the states of Perak and Selangor. Unsustainable traditional fishing method such as the use of *empang*[14] in Johor and the motorized pushnet activity in Matang, Perak has serious impact on the juvenile population of fishes and prawn in the mangrove areas (State of Marine Environment Report, 2011-2010).

A summary of the impacts of mangrove clearing especially in Malaysia is described below (State of Marine Environment Report, 2011-2010):

a. Deterioration of marine water quality affects all marine environments with continuous loss of mangroves as these mangals[15] segregate much of the nutrients that flow down the river.
b. Removal of mangrove areas also means removing of nursery grounds for many commercially valuable fish species. Thence, affecting the recruitment to fisheries stocks and the marine food web.
c. Mangroves are proven to be good natural coastal barrier preventing them from erosion. Losses of mangroves will aggravate coastal and riverine erosion problems, which in turn would require large sum of investment for expensive mitigating infrastructures.

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[14] *Empang parit* is the traditional application of integrated aquaculture in the mangrove area. It usually consists of an unexcavated central platform that alternates between being flooded and exposed and a canal that runs along the pond dikes where fish, shrimp, and crabs are cultured. Tides are used to carry seed stock into the system and to exchange water. The forests are locally run and operated and self-managed by the community. Source: http://courses.washington.edu/larescue/pam/4-aquaculture.pdf

[15] *Mangals* are assemblages of woody plants known as mangroves, often several species dominate different zones with respect to distance from a marine shore

SEAGRASS

INTRODUCTION

Seagrass are the only group of flowering plants or angiosperms that lives in the coastal and marine environment of the temperate and tropical regions (Nurridan in Abdullah, 2004). They are a unique group of flowering plants that have adapted to exist fully submerged in the sea, thence influencing the physical, chemical, and biological environments in coastal waters (Orth, J.R., *et al*., 2006). They form meadows in nearshore brackish water or marine waters in temperate and tropical regions (Ho, N., Kassem, K. & Ng, S., 2011). These plants have developed unique ecological, physiological, and morphological adaptations to be fully submerged in the sea water, including having an internal gas transport, epidermal chloroplasts, submarine pollination, and marine dispersal.

FIGURE 2- 29: CONCEPTUAL DIAGRAMS FOR (A) TROPICAL AND (B) TEMPERATE SEAGRASS ECOSYSTEMS, DETAILING KEY ECOSYSTEM SERVICES AND MAJOR MECHANISMS OF SEAGRASS LOSS. (C) TEMPERATE AND TROPICAL SEAGRASS GENERA (AND FAMILY NAMES), FROM EPHEMERAL TO PERSISTENT.

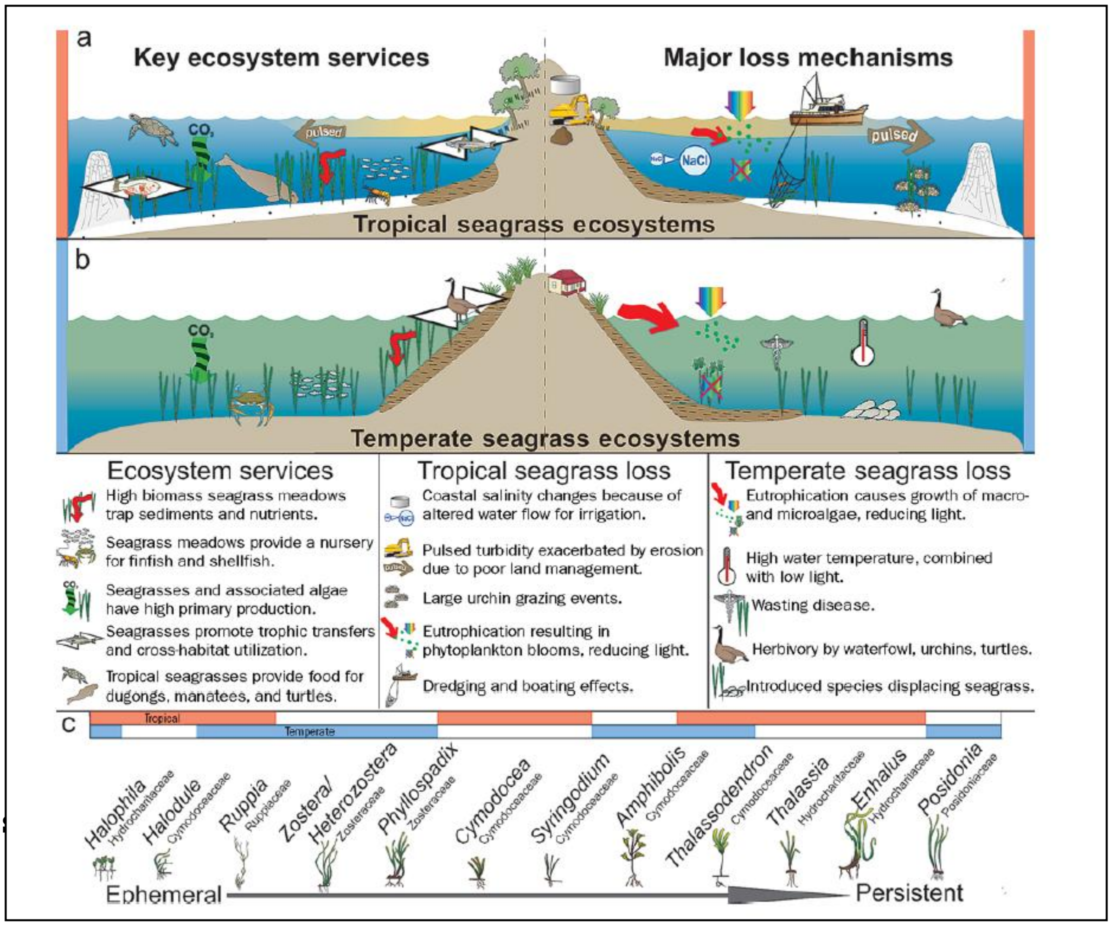


TABLE 2- 17: SEAGRASS SPECIES RECORDED IN MALAYSIA

Family	Species	Status/Remarks
Cymodoceae	*Cymodocea rotundata*	Common and widespread throughout Sabah, rare in Peninsular Malaysia.
	Cymodocea serrulata	Common and widespread throughout Sabah, rare in Peninsular Malaysia.
	Halodule pinifolia	Common and widespread throughout Malaysia, especially in the east coast of Peninsular Malaysia.
	Halodule uninervis	Common and widespread throughout Malaysia.
	Syringodium isoetifolium	Not common, restricted to a few sites in Malaysia.
	Thalassodendron ciliatum	Only recorded in Tanjung Kaitan, Sabah
Hydrocharitaceae	*Enhalus acoroides*	Common and widespread throughout Malaysia
	Halophila beccarii	Common and widespread throughout the east coast of Peninsular Malaysia. Presently not found in west coast of Peninsular Malaysia, Sarawak and Sabah.
	Halophila decipiens	Not common.
	Halophila minor	Some records previously recognized this species as *Halophila ovata*. Rare and restricted to a few sites in east coast of Peninsular Malaysia and Sabah.
	Halophila ovalis	Common and widespread throughout Malaysia.
	Halophila spinulosa	Rather rare and restricted to a few sites in southern and east coast of Peninsular Malaysia and Sabah.
	Thalassia hemprichii	Common in Sabah.
Potamogetonaceae	*Ruppia maritime*	Very rare and only recorded in Seberang Prai, Penang

Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

Globally, there are 60 species of seagrasses within 12 genera, 4 families and 2 orders, most of which are found in the Indo-Pacific region. Malaysia ranked third in the world with a total of 14 species of sea grass found in its coastal area (Ho, N., Kassem, K. & Ng, S., 2011).

The 14 species recorded in the coasts of Malaysia are: *Enhalus acoroides*, *Halophila beccarii*, *H. decipiens*, *H. ovalis*, *H. minor*, *H. spinulosa*, *H. pinifolia*, *H. uninervis*, *Cymodocea rotundata*, *C. serrulata*, *Thalassia hemprichii*, *Syringodium isoetifolium*, *Ruppia maritima* and *Thalassodendron ciliatum* (Ho, N., Kassem, K. & Ng, S., 2011).

Majority of seagrasses in Malaysia are restricted to sheltered areas in the shallow intertidal associated ecosystems, semi-enclosed lagoons and sub-tidal zones, between mangrove and coral reef ecosystems (Japar and Mutaharah, 2003). Some are also found around offshore islands with fringing reefs (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

FIGURE 2- 30: DISTRIBUTION OF SEAGRASSES IN PENINSULAR MALAYSIA

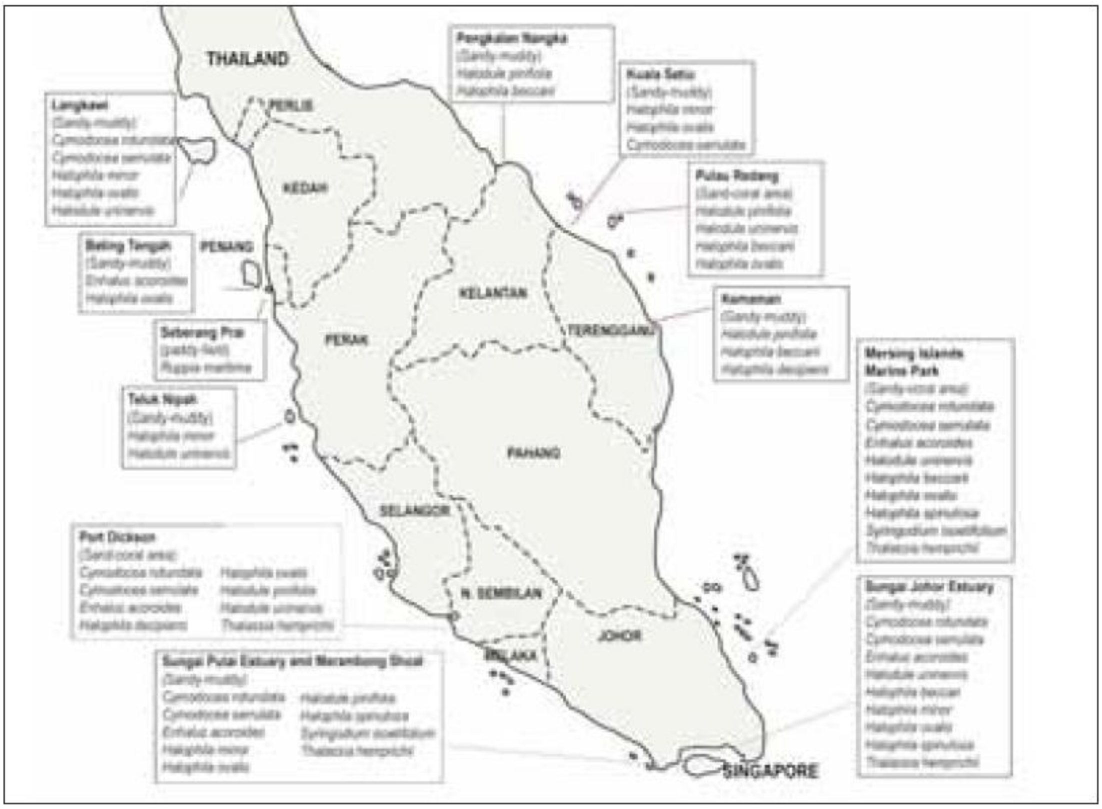
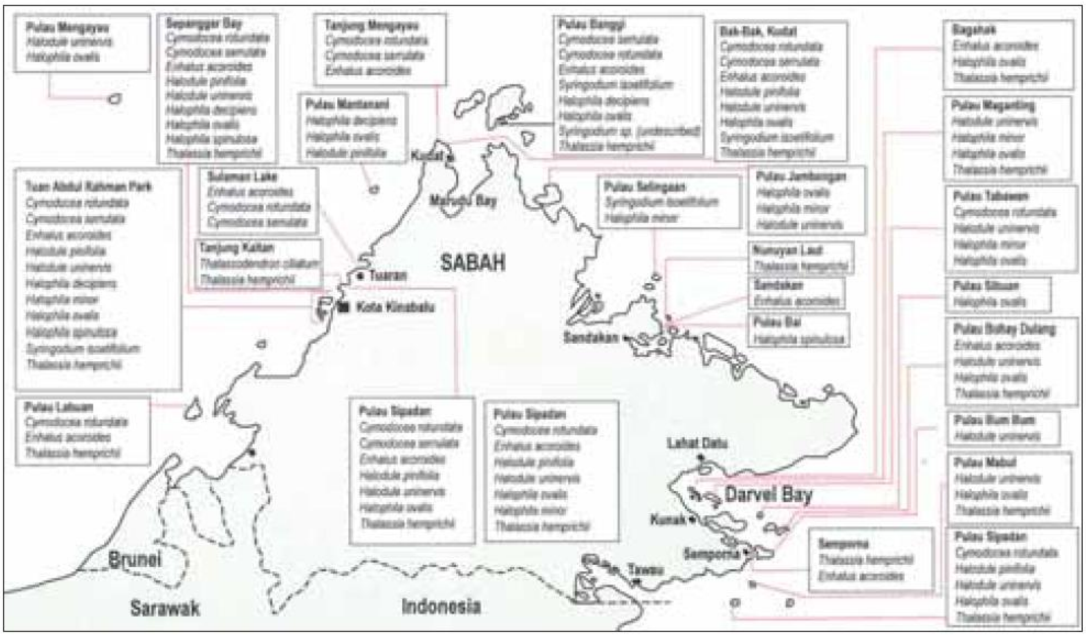
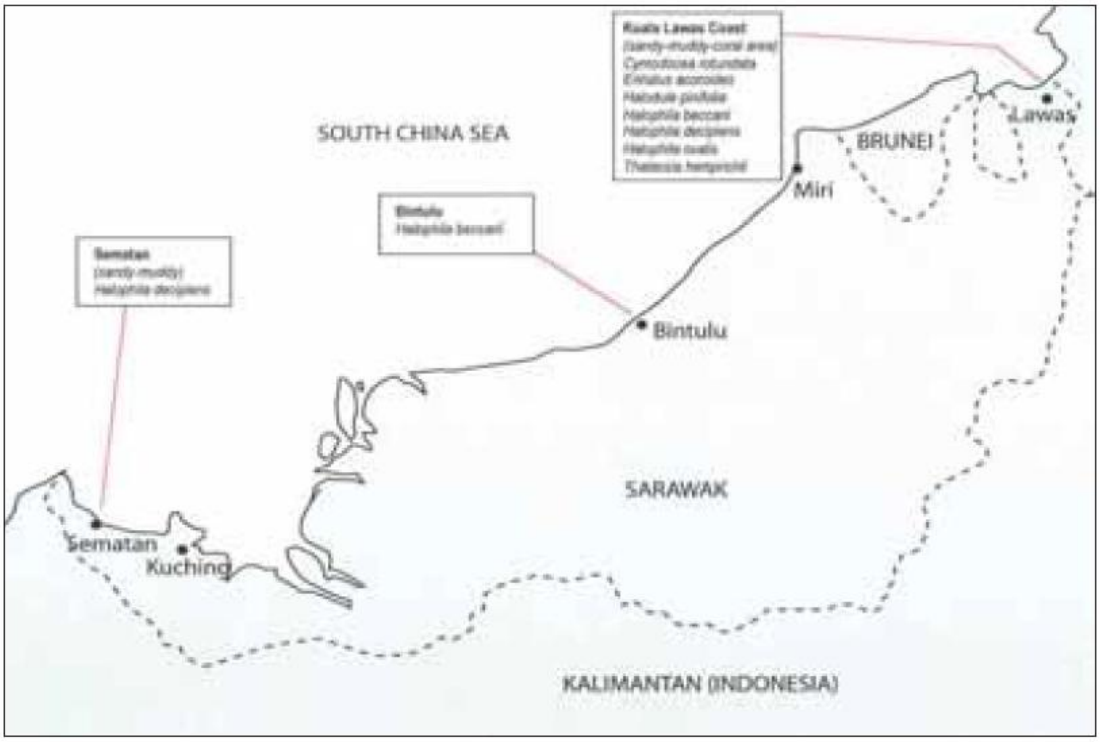


FIGURE 2- 31: DISTRIBUTION OF SEAGRASSES IN SABAH



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2010

FIGURE 2- 32: DISTRIBUTION OF SEAGRASSES IN SARAWAK



Places in the south, east coasts of Peninsular Malaysia, Sabah and Sarawak, where urbanisation is minimal encourages diversity and development of seagrass communities.

In Peninsular Malaysia, seagrass beds can be found in the islands of Langkawi, Penang Strait of Penang, Pangkor Island, Port Dickson, Sungai Pulai estuary, Tanjung Adang, Sungai Pulai, Johor River, Mersing Islands Marine Park, Kemaman, Paka, Merhang, Setiu Lagoon, Redang Island, Pengkalan Nangka and Pantai Baru (Kelantan) (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

In Sabah, seagrass of mixed species exist in the intertidal zone down to a depth of 2.5m on the west and south-eastern casts of Sabah. These seagrasses grow on substrates ranging from sand, muddy-sand to coral rubble. Most of the seagrasses in general, are found in Tunku Abdul Rahman Park, Sepangar Bay, Tanjung Kaitan, Karambunai, Sungai Salut, Sungai Mekabong, Tanjung Mengayau, Bak-bak, Pulau Mantanani, Pulau Banggi, Pulau Balambangan, Pulau Jambongan, Sandakan, Darvel Bay, Pulau Sipadan, Pulau Labuan and Pulau Layang-layang. As for the inter-tidal zone, mixed associations of seagrass are found in four (4) areas namely the Bak-Bak, Tanjung Mengayau, Sepangar Bay and Pulau Gaya. Sub-tidal seagrass that grows on coral rubble are found in four isolated off-shore islands of Pulau Manganting, Pulau Tabawan, Pulau Bohay Dulang and Pulau Sipadan along the south-eastern coasts. In Sarawak, seagrasses are confined to Kuala Lawas and Talang-talang Islands (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Based on various publications, unpublished data, field observation and discussion with seagrass experts, there are currently 18 species of seagrasses recorded in Malaysia, including 4 new *Halophila* species (Table 2-18). All the seagrass species are placed into three families (Japar *et al.* 2003).

TABLE 2- 18: SEAGRASS SPECIES RECORDED IN MALAYSIA

Family	Species	Status / Remarks
Cymodoceae	*Cymodocea rotundata*	Common and widespread throughout Sabah, rare in Peninsular Malaysia.
	Cymodocea serrulata	Common and widespread throughout Sabah, rare in Peninsular Malaysia.
	Halodule pinifolia	Common and widespread throughout Malaysia, especially in the east coast of Peninsular Malaysia
	Halodule uninervis	Common and widespread throughout Malaysia.
	Syringodium isoetifolium	Not common, restricted to a few sites in Malaysia.
	Thalassodendron ciliatum	Only recorded in Tanjung Kaitan (Sabah) by Phang (2000).
Hydrocharitaceae	*Enhalus acoroides*	Common and widespread throughout Malaysia.
	Halophila beccarii	Common and widespread throughout the east coast of Peninsular Malaysia. Presently not found in west coast of Peninsular Malaysia, Sarawak and Sabah.
	Halophila decipiens	Not common, restricted to a few sites in Malaysia.
	Halophila minor	Some records previously recognised as *Halophila ovata*. Rare and restricted to a few sites in east coast of Peninsular Malaysia and Sabah.
	Halophila ovalis (Figure7)	Common and widespread throughout Malaysia.
	Halophila spinulosa	Rather rare and restricted to a few sites in southern and east coast of Peninsular Malaysia and Sabah.
	Halophila sp. 1	Recorded from east coast of Sabah (Japar *et al.* 2004).
	Halophila sp. 2	Refer to Field Guide to the Identification of East Asian Seagrasses (in press); recorded in east coast of Sabah and the location is not revealed in this report as the researcher is currently preparing a journal article on this species.
	Halophila sp. 3	Recorded from east coast of Sabah (Japar *et al.* 2004).
	Halophila sp. 4	Recorded from east coast of Sabah (Japar *et al.* 2004).
	Thalassia hemprichii	Common in Sabah.
Potamogetonaceae	*Ruppia maritime*	Very rare. Only recorded in Seberang Prai by Burkill (1935); no recent survey to re-confirm the occurrence of this species.

source: UNEP, 2008

Functions and Importance

Seagrass beds have important ecological roles in the coastal ecosystem and provide high value ecosystem services, just like the coral reefs community (Orth, J.R., *et al*., 2006):

a. Primary production from sea grass beds and their associated epiphytes exceeds that of many cultivated terrestrial ecosystems;
b. Carbon source provider to the deep sea where supply of organic matter is scarce in an extremely food-limited environment;
c. Act as carbon sink in the sediment of the sea grass beds;
d. Act as nutrient filter to the coastal ocean with their structural components of sea grass leaves, rhizomes, and roots that could modify currents and waves, traps and stores both sediments and nutrients;
e. Nursery ground to economically important species of finfish and shellfish;
f. The proximity of sea grass adjacent to other critical habitats such as the mangroves and coral reefs enable trophic transfers and cross-habitat utilization by fishes and invertebrates. Thence subsidize essential energy to

maintain abundance of coral reef fish species;

g. Act as biological sentinels or "coastal canaries" where changes in sea grass distribution and signals relevant water quality attributes, such as chlorophyll and turbidity that affect the light reaching to their leaves; and
h. Act as biological indicator that measures environmental impacts over definable timescales and other factors that contribute to the pollution of the sea grass area due to their need to intense sunlight.

The complex ecosystem of sea grass is an important food source for megaherbivores such as the green sea turtles, dugongs and manatees (Orth, J.R., *et al*., 2006). Seagrass beds also provide food, home and nursery grounds for a variety of invertebrates such as fishes and turtles (Ho, N., Kassem, K. & Ng, S., 2011).

Seagrass beds are rich with seashells, shrimps and crabs and often these are collected during low tide for own consumption and / or for additional source of income (National Coastal Resources and Marine Environment Profile of Malaysia, 2010). Marine fishing communities in Semporna Priority Conservation Area (PCA) are highly dependent on sea grass habitats for gleaning[16] activities (Ho, N., Kassem, K. & Ng, S., 2011).

One unique use of the seagrass is that the *Enhalus* fruits or seeds are made edible and are still eaten by the coastal communities of Sungai Pulai, Johor. *Enhalus acoroides* has nutritional value that is comparable to that of wheat and rice flour in terms of carbohydrate and protein content but higher in calcium, iron and phosphorus content (UNEP, 2008)

PICTURE 5: RUPPIA MARITIME – VERY RARE. ONLY RECORDED IN SEBERANG PRAI, PENANG

PICTURE 6: THALASSIA HEMPRICHII – COMMON IN SABAH

[16] A fishing activity carried out by women and children of coastal families during low tide by walking on sea grass beds or shallow reefs with a basin and a small hoe to collect edible marine resources such as shellfish, spider conch (*Lambis sp.*), sea urchin, clam, sea cucumber, stingray, eel and fish.

TABLE 2- 19: CHECKLIST OF SEAGRASSES DISTRIBUTION IN MALAYSIA

Region	West coast of Peninsular Malaysia			Southern coast of Peninsular Malaysia	East coast of Peninsular Malaysia								Sarawak		West coast of Sabah							East coast of Sabah
Species / Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Cymodocea rotundata	+				+									+		+	+	+	+		+	+
Cymodocea serrulata	+			+	+												+	+	+		+	
Halodule pinifolia		+		+		+	+	+		+	+	+		+			+	+	+	+		
Halodule uninervis	+	+		+	+										+		+	+	+			+
Syringodium isoetifolium				+	+												+		+		+	+
Thalassodendron ciliatum																		+				
Enhalus acoroides		+		+	+											+	+	+	+		+	
Halophila beccarii					+	+	+		+		+	+										
Halophila decipiens		+				+					+		+				+	+		+	+	
Halophila minor	+										+						+	+				+
Halophila ovalis	+	+		+	+						+			+			+	+	+	+	+	+
Halophila spinulosa				+	+										+		+	+				
† *Halophila sp. 1*																					+	
* *Halophila sp. 2*																						
† *Halophila sp. 3*																						
† *Halophila sp. 4*																						
Thalassia hemprichii				+	+									+		+	+	+	+		+	+
Ruppia maritime			+																			
Total	5	5	1	8	9	3	2	1	1	1	5	2	1	4	2	3	11	11	8		8	6

Note: Location: 1 – Langkawi Islands (Kedah); 2 – Seberang Prai (Penang); 3 – Port Dickson (Negri Sembilan); 4 – Sungai Pulai estuary, Tanjung Adang & Merambong shoal (Johor); 5 – Mersing Islands National Park (Johor); 6 – Kemaman (Terengganu); 7 – Paka (Terengganu); 8 – Merchang (Terengganu); 9 – Sungai Terengganu (Terengganu); 10 – Setiu Lagoon (Terengganu); 11 – Pulau Redang (Terengganu); 12 – Pengkalan Nangka (Kelantan); 13 – Sematan (Sarawak); 14 – Kuala Lawas (Sarawak); 15 – Pulau Layang-layang; 16 – Pulau Labuan; 17 – Tunku Abdul Rahman Park (Sabah); 18 – Sepangar Bay, Tanjung Kaitan, Karambunai, Sungai Salut & Sungai Mekabong (Sabah) ; 19 – Tanjung Mengayau & Bak-bak (Sabah); 20 – Pulau Mantanani (Sabah); 21 – Pulau Banggi and Pulau Balambangan (Sabah); and 22 – Darvel Bay (Sabah).

** Refer to Field Guide to the Identification of East Asian Seagrasses (in press); recorded in east coast of Sabah and the location is not revealed in this report as the researcher is currently preparing a journal article on this species.*
† Recorded from the east coast of Sabah (Japar et al. 2004).

Source: (Japar, 1994; Moh Kushairi, 1992; Gan, 2003; Gumpil, 1997; Gumpil 2002; Japar, 1994; Japar et al. 1997a; Japar et al. 1997b; Japar et al. 1999a; Japar et al. 1999b; Japar et al. 2000; Japar et al. 2001a; Japar et al. 2001b; Japar and Muta Harah, 2003; Japar et al. 2003; Japar et al. 2004; Muta Harah et al. 1999; Muta Harah et al. 2003a; Muta Harah et al. 2003b; Muta Harah et al. 2004; Norhadi, 1993; Orosco and Amir Sharifudeen, 2004; Phang, 2000; Sasekumar et al. 1990; Wong et al. 2003).

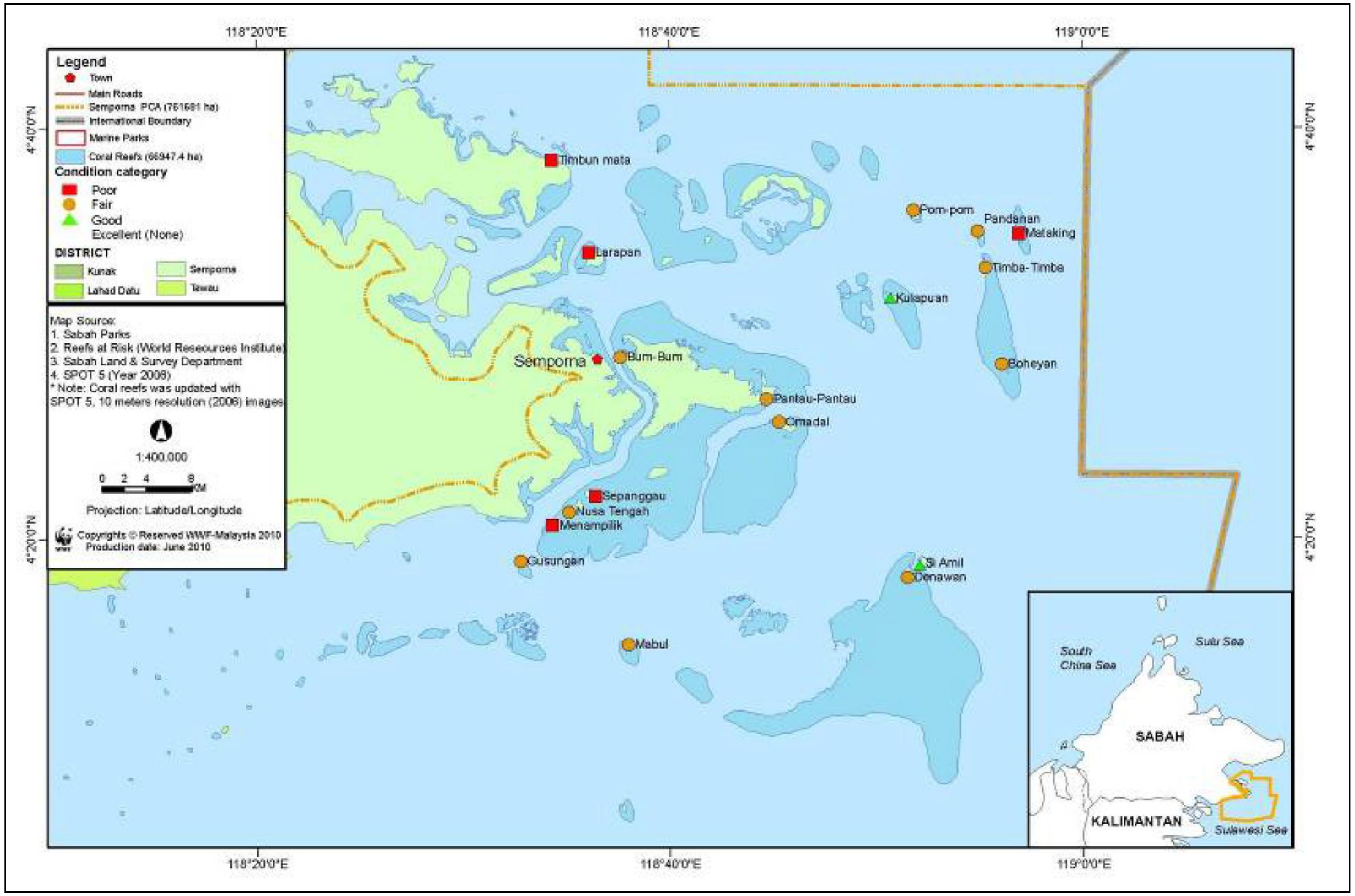
TABLE 2- 20: SEAGRASS SPECIES DISTRIBUTION AND RECORD FROM SURVEYS IN SEMPORNA PCA

Family / Species	Northern Reefs											Southern Reefs						
	Larapan	Timbun Mata	Bum-bum 1	Bum-bum 2	Kulapuan	Pom-pom	Pandanan	Mataking	Timba-timba	Boheyan	Omadal	Seppangau	Si Amil	Denawan	Mabul	Gusungan	Nusa Tengah	Menampilik
Hydrocharitaceae																		
Enhalus acoroides	+ D		+ D	+ R						+ R	+ C	+ D		+ R		+ D	+ D	+ D
Thalassia hemprichii	+ D	+ R	+ C	+ D	+ D	+ D	+ D	+ D	+ D	+ D	+ D	+ C	+ D	+ D	+ C	+ C	+ C	+ C
Halophila beccarii																		
Halophila decipiens																		
Halophila minor																		
Halophila ovalis	+ C	+ R		+ R		+ R	+ R	+ C			+ C	+ R	+ R	+ R	+ R		+ R	+ R
Halophila spinulosa																		
Cymodoceaceae																		
Cymodocea rotundata		+ R		+ R		+ C			+ C	+ C	+ C				+ C	+ C		+ R
Cymodocea serrulata	+ R				+ R		+ R	+ C		+ C			+ C	+ D	+ R			
Halodule pinifolia										+ R								
Halodule uninervis		+ C		+ R					+ C		+ R		+ C	+ R	+ D			
Syringodium isoetifolium				+ C							+ C		+ D	+ R	+ C	+ R		
TOTAL	4	4	2	6	2	3	3	3	3	5	6	3	3	6	6	4	3	4

Table 1: Seagrass species distribution and record from surveys in Semporna PCA.
Species distribution indicator: D = Dominant; C = Common;
R = Rare (Applicable only to seagrass found in the quadrats)

Source: Ho, N., Kassem, K. & Ng, S., 2011

FIGURE 2- 33: STATUS OF SEAGRASS COVERAGE IN SEMPORNA PCA



Source: Ho, N., Kassem, K. & Ng, S., 2011

THREATS

Seagrasses are fragile ecosystems when threatened by anthropogenic activities, may affect associated ecosystems, fauna and flora such as those found in mangroves and coral reefs.

Natural catastrophes such as typhoons, storm surges and coastal erosion can damage sea grass beds. Typhoons and storms may be rare in Malaysia, however when Hurricane Greg struck Kota Kinabalu and Tunku Abdul Rahman Marine Park (Sabah) in December 1996, it causes significant change of the surrounding coral reefs and seagrasses and of adjacent areas such as Sepangar Bay and Menggatal. Islands in the east-coast of Peninsular Malaysia are also susceptible to the wrath of the northeast monsoon (within the months of November to March) which often caused severe coastal erosion (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Typical activities that have affected the health of seagrass habitats in Malaysia are: sediment run-off from coastal development activities, nutrient enrichment through direct discharge of untreated domestic and industrial wastewaters, fertilizer and pesticide runoff from agriculture activities, sand mining, port development and expansion, illegal encroachment of trawlers to the coastal areas, destructive fishing methods, traditional harvesting of fisheries resources, boat and shipping traffic, and marine pollution (National Coastal Resources and Marine Environment Profile of Malaysia, 2010). Please refer to Table 2-22 for a list of human activities related threats to selected seagrass beds in Malaysia.

Some of the more pressing issues that have caused detrimental effects on seagrass in Malaysia are (amongst others) (National Coastal Resources and Marine Environment Profile of Malaysia, 2010):

a. Lack of comprehensive survey of seagrass meadow resources throughout the recent years and location of seagrass in Sabah is not known;

b. Threats along the Straits of Malacca - Sedimentation, sand mining, oil pollution, tourism, land reclamation and marine transport (boat and ships), mangrove removal and aquaculture, illegal trawling and pushnet activities, uncontrolled collection of fishery resources by coastal inhabitants within the habitat;

c. Threats along the east-coast of Peninsular Malaysia - Natural causes such as strong sea currents and strong waves shifts sand during the northeast monsoon bring about serious coastal erosion problems. Other anthropogenic activities includes sand mining and dredging for shoreline stabilization and flood control, land based development, fishing methods (trawl and push nets), digging activity for polychaetes and bivalves (Hiatula solida, Meretric meretrix) and other harvesting of fisheries resources, transportation (propeller's oil, grease, anchors), illegal fishing, ecotourism, wastewater discharge (industrial, sewage), fertilizer and pesticide run off, and reclamation projects; and

d. Present legislation governing seagrass meadows is disjointed and fragmented with potential conflicts between the Land and Mines Directorate and the marine protected areas authorities. Respective state enactments in Sabah and Sarawak however are not comprehensive enough and many seagrass areas are not protected nor managed under any rules, regulations or enactments. Hence exposing these seagrass beds to overexploitation of artisanal, commercial and recreational fishermen operating in and around the area.

TABLE 2- 21: THREATS BY HUMAN ACTIVITIES TO SELECTED SEAGRASS BEDS IN MALAYSIA

State	Location of seagrass beds	Conservation status	Threats
Kedah	Pulau Langkawi (Tanjung Rhu and Teluk Ewa)	None	• Land reclamation for tourism facilities • Pollution from cement industry • Impacts from boating and recreational activities
Negri Sembilan	Port Dickson	None	• Reclamation for tourism facilities • Sand/coral mining • Pollution from solid wastes and sewage • Uncontrolled tourism and recreational activities
Johor	Sungai Pulai estuary, Tanjung Adang and Merambong shoal	Mangrove Forest Reserves and RAMSAR site	• Land reclamation for port development and expansion (Tanjung Pelepas Port), and industrial parks. • Massive ship navigation / movement • Ship-based pollution • Potential pollution from petrochemical industries • Heat water and wastes from Tanjung Bin power plant (coal) • Clearing of mangroves • Impacts from harvesting of fisheries resources
	Sungai Johor estuary and adjacent areas (Straits of Johor, Pulau Tekong and Pulau Ubin, Singapore)	Mangrove Forest Reserves	• Land reclamation (Pulau Tekong, Pulau Ubin and Changi area) • Sand mining • Industrial wastes from Pasir Gudang, Tebrau and Woodlands (Singapore) Industrial Parks • Massive ship navigation/movement • Ship-based pollution • Domestic wastes and sewage
	Pulau Sibu, Pulau Tinggi, Pulau Besar, Pulau Rawa and adjacent islands	Johor Marine Parks and Mersing Islands National Park	• Sedimentation from the impacts of illegal trawling at marine park • Impacts from boating and recreational activities • Untreated wastes
Terangganu	Sungai Paka estuary and Paka Shoal	Mangrove Reserve	• Sand mining • Impacts from harvesting of fisheries resources
Sarawak	Kuala Lawas	Mangrove Reserve	• Impacts from harvesting of fisheries resources
Sabah	Tunku Abdul Rahman Park	National Park	• Land reclamation at Kota Kinabalu and adjacent areas • Destructive fishing (cyanide and fish bombing) • Direct discharge of wastes from illegal settlement from Pulau Gaya and mainland of Kota Kinabalu • Impacts from boating and recreational activities • Ship-based pollution
	Karambunai, Sepangar Bay, Sungai Salut and Sungai Mekabong	None	• Land clearing for Kota Kinabalu Industrial Park, naval base and settlements (Figure 3) • Destructive fishing (cyanide and fish bombing) • Impacts from boating and recreational activities pollution from petrochemical industries • Ship-based pollution (Sepangar and Kota Kinabalu Ports)
	Sulaman Lake		• Impacts from boating and recreational activities • Aquaculture development • Illegal cutting of mangroves
	Pulau Banggi and Pulau Balambangan	To be gazetted as Tun Mustapha Marine Park and Mangrove reserves	• Sand and coral mining • Destructive fishing (cyanide and fish bombing) • Illegal trawling activities • Illegal clearing of mangroves • Impacts from harvesting of fisheries resources
	Darvel Bay	Mangrove reserves (Lahad Datu, Kunak and Semporna) and some islands proposed as Tun Sakaran Marine Park	• Sand and coral mining • Destructive fishing (cyanide and fish bombing) • Illegal trawling activities • Illegal clearing of mangroves • Impacts from harvesting of fisheries resources

Source: UNEP, 2008

Interactions between Coral Reef, Mangroves and Seagrass Ecosystems

The endosymbiotic[17] relationship between *zooxanthellae*[18] and *anthozoans* is probably one of the more important examples of symbiosis in any marine benthic community. The mutual interaction provides a nutritional basis for coral growth and thus food for coral consumers and physical structure to the habitat. The symbiont *zooxanthellae* provide oxygen, sugars, lipids, and amino acids for growth, repair and reproduction of the coral in addition to improve the rate of calcification or known as skeleton deposition process. *Zooxanthellae* accelerate skeletal formation in reef-building corals through a poorly understood phenomenon called "light enhanced calcification". The symbiont helps in the removal of chemical wastes (ammonium) from animal metabolism and recycles it back to the host as alanine. They also receive chemicals that absorb damaging ultraviolet (UV) light.

The coral communities play hosts to a variety of predator-prey relationships. One of the common phenomenons in coral communities is corallivory herbivores such as the crown of thorn starfish, *Acanthaster planci*, the asteroids, *Culcita sp*., the gastropod, *Drupella spp*. and the echinoid *Eucidaris thouarsii*. These species are important in the formation of the coral communities (Moberg, F. & Folke, C., 1999).

Predator species such as the triggerfish and pufferfish helps to control the abundance of herbivores such as crown of thorn, sea urchins, *Drupella spp*. (Moberg, F. & Folke, C., 1999). Predation and grazing by fishes and invertebrates in coral communities also influence the fundamental processes such as energy flow, fisheries production, larval settlement and metamorphosis, bioerosion, and the evolution of chemical defences. Interaction between the consumers and resources determines the stability of coral communities.

Mangroves have close relationship with coral reef and seagrass ecosystems. Their interaction plays an important role in conserving biodiversity. The intricate relationship of these ecosystems is linked by physical and nutrient interactions, fish migrations and human impacts. A recent study concluded that existence of mangrove ecosystem enhances the fish biodiversity in the coral ecosystems in terms of fish migration. Another study also showed that the coral reef fish were twice as abundant on reefs adjacent to mangrove forests compared to reefs that were not (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

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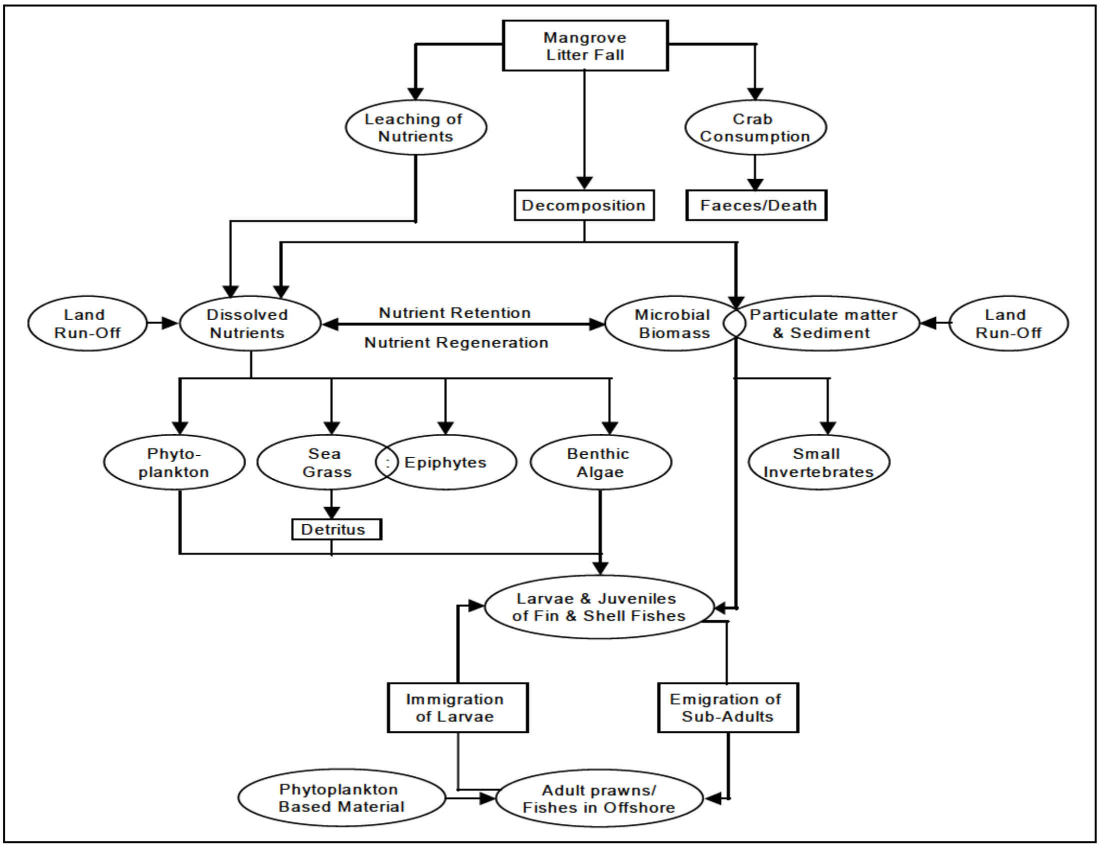
[17] Taxonomy and phylogeny (the ways in which living things are connected, categorized, and named) ultimately boil down to questions of origins: who begat whom, and who originally begat the begetters, and so on. Some of the begetting is fairly straightforward, involving gradual adaptations to gradually changing conditions. Other times, dramatic changes in conditions seem to drive sudden and significant evolutionary change. And sometimes, a fortuitous event simply makes a big splash in the evolutionary pond. The origin of eukaryotes appears to have included a big splash in the form of endosymbiosis, a condition in which different organisms live together, one inside the other. Source: http://www.dummies.com/how-to/content/endosymbiotic-theory.html

[18] Zooxanthellae are unicellular yellow-brown dinoflagellate which live symbiotically in the gastrodermis of reef-building corals and were one thought to be the same species of *Symbiodium microadriaticum.*

FIGURE 2- 34: AN EXAMPLE FOOD WEB IN A MANGROVE SYSTEM



Source: Kathiresan, K. & Qasim, S.Z., 2005

Mangals contribute to complex food webs and important energy transfers (Figure 2-34). Mangrove forests produce an estimated of 40% excess photosynthetic carbon of net primary production. Large amount could be potentially transported offshore depending on local condition while some simply accumulates in the sediments.

Mangroves contribution in food webs commence with feeding on mangrove detritus by sediment meiofauna and these community composition changes during the process of litter decay. These meiofaunal communities respond to chemical changes in the leaves and contribute only little to the larger food web (Kathiresan, K. & Qasim, S.Z., 2005).

Mangroves may have a stronger trophic linkage with epibenthic invertebrates and fish from the ecosystem or from adjacent habitats. Mangrove detritus serves more importance as substrate for microbial activities and nutrient regeneration than it is as direct food source for detrivores. Examples cited from Kathiresan, K. and Qasim, S.Z. (2005) concluded a significant contribution to estuarine carbon budget from mangroves through analysis of energy and nutrient fluxes between mangroves and estuarine waters, this represent a role of nutrient and carbon sink rather than a source to adjacent habitats (Kathiresan, K. & Qasim, S.Z., 2005).

Mangroves provide protection to the land as well as to other adjacent marine ecosystems. It has roots that hold the soil particles firmly thus preventing soil erosion. This enable a flow of clean and nutrient-rich water supplied to associated ecosystems such as coral reefs, seaweeds and seagrass beds. These support system, if removed will cause the sediment to become loose and be deposited into associated ecosystems thence destroying them.

FIGURE 2- 35: INFLUENCE OF MANGROVES AND DEFORESTATION ON SEAWEED, CORAL REEFS AND SEA GRASS ECOSYSTEMS.

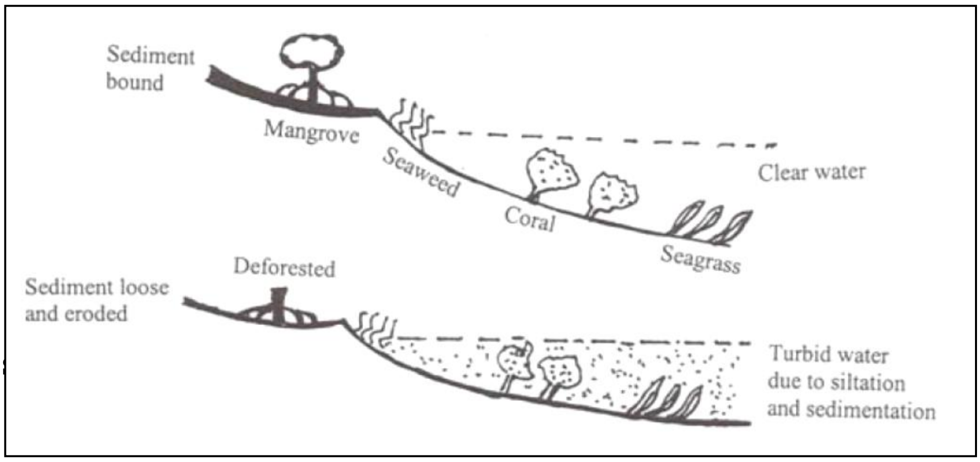


FIGURE 2- 36: INTERACTIONS IN THE TROPICAL SEASCAPE, SHOWING THE CONNECTIONS BETWEEN MANGROVES, SEA GRASS BEDS AND CORAL REEFS

Mangrove	Seagrass Bed	Coral Reef
Prevents erosion	**Binds sediment**	**Buffering of waves and currents**
Absorbs nutrients*	**Absorbs nutrient***	**Export of fish and invertebrate larvae**
Interrupts freshwater discharge	**Export of maturing fish**	**Migration of adult fish and invertebrate larvae (influencing productivity of sea grass bed through grazing and nutrient export)**
Export of fish and crustaceans		**Export of organic material, and nutrients supporting the pelagic food web**

*Mangroves and sea grass beds sometimes export nutrients (especially organic nutrients)

Source: Moberg, F. & Folke, C., 1999

Figure 2-36 illustrates the interactions between mangroves, seagrass beds and coral reefs. All three (3) ecosystems are closely linked with subsequent consequences that affect them with losses of any of the ecosystem. Coral reefs act as waves and currents buffer before they reaches the fragile ecosystem of seagrass beds. Stronger waves and currents are buffered by large patch of seagrass meadows while strong mangrove forests protects shoreline from extreme erosion. Coral reefs are usually the first and final destination of fish and invertebrate larvae prior to entering into the adjacent seagrass beds or mangrove areas upon reaching adult stage. Fish and crustaceans in mangrove areas also migrate into adjacent seagrass beds in certain stage of their life cycle. Mangroves and seagrass beds near to the shore absorbs nutrients and occasionally export organic nutrients into the coral reefs where coral reefs continue to disperse them further in the pelagic food web.

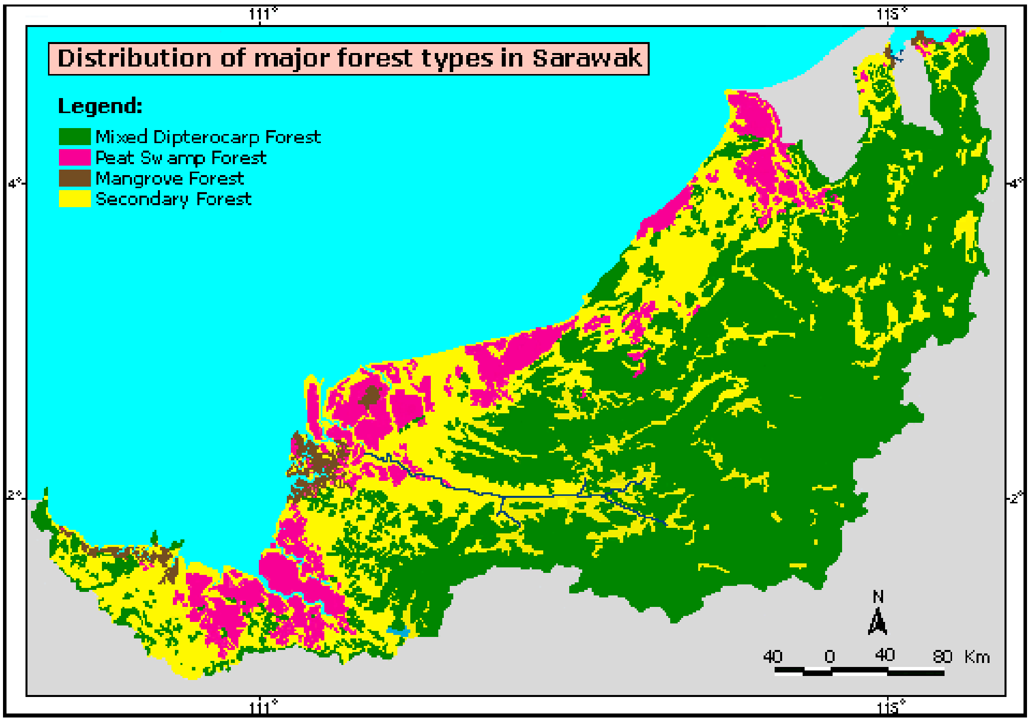
Coastal Peat Swamps and Melaleuca Forests

Introduction

Peat swamp and melaleuca forests used to grow extensively along the west coast of Malaysia. Unfortunately, the area have been largely converted for agriculture activities and human settlement thus marking this type of forest as an endangered coastal wetlands.

Peat swamp forest is a waterlogged forests in peat soil and constitutes a significant component of forest cover in Malaysia with an estimated 1.54 million ha still remaining. An estimated 70% or more of these forests can be found in Sarawak, less than 20% in Peninsular Malaysia and the remainder in Sabah (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

FIGURE 2- 37: DISTRIBUTION OF MANGROVES AND OTHER FOREST TYPES IN SARAWAK



In Peninsular Malaysia, a total area of 82,890ha of peat swamp forests can be found in Raja Musa and Sungai Karang Forest Reserves in Selangor and 140,830ha in Pekan and Nenasi in Pahang. Small patchy forests can be found in Perak, Melaka, Terengganu and Johor (Forestry Department Malaysia, 2010).

The Melaleuca forests is a flood resistant freshwater forest that can be found behind sandy dunes or lagoons with connection to rivers and mangrove belts. In Peninsular Malaysia, it is commonly found along the coasts but this has been reduced to very small or patchy areas due to extensive coastal development and conversion to other land uses. Significant cover area of Melaleuca forests can still be found along the coastal road of Marang to Kemaman in Terengganu while small areas of degraded Melaleuca forests can be found in Kelantan, Johor, Melaka and Negeri Sembilan (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

TABLE 2-22: PERMANENT RESERVED FOREST IN PENINSULAR MALAYSIA BY FOREST TYPE (HA)

Tahun *Year*	Jenis Hutan / *Forest Type*				Jumlah *Total*
	Darat *Inland*	Paya Gambut *Peat Swamp*	Paya Laut *Mangrove*	Ladang *Plantation*	
2001	4,498,137	181,713	86,454	74,127	4,840,431
2002	4,350,085	191,319	86,497	73,957	4,701,858
2003	4,343,847	190,757	85,800	75,807	4,696,211
2004	4,333,775	191,233	83,442	75,055	4,683,505
2005	4,351,607	185,860	102,514	71,283	4,711,264
2006	4,344,585	198,091	100,042	83,464	4,726,182
2007	4,250,087	237,745	103,257	104,541	4,695,630
2008[1]	4,481,698	241,474	100,824	101,069	4,925,065
2009[1]	4,478,543	241,474	101,800	108,752	4,930,569
2010	**4,469,893**	**242,906**	**98,229**	**108,657**	**4,919,685**

[1] Data kajian semula / *Revised data*

Source: Forestry Department Malaysian, 2010

FUNCTIONS AND IMPORTANCE

The peat swamp and Melaleuca forests provides in the form of forestry and fishery products, flood mitigation, water supply for agriculture and groundwater discharge. In addition, these forests provide many commercially valuable tree species and contain home to many flora and fauna (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

Malaysia's waterlogged forests are home to several globally endangered threatened species such as Orang Utan, Proboscis Monkey, Sumatran Rhinoceros, Storm's Stork, Wrinkled Hornbill, and the dipterocarp tree. The forest also provide many unique blackwater (acidic) fishes which are commercially important for the aquarium industry in addition to the commercial food fish. Unfortunately, many of the peat swamp forests have been logged extensively for its timber and fell victim to unscrupulous wildlife trade (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

THREATS

Peat swamp and melaleuca forests provides valuable timber products as well as homes to a variety of habitats. However, agricultural development- mainly conversion to oil palm plantation, tin mining, and conversion to residential development are threatening its existence. Over-exploitation of timber products and illegal harvest of wildlife resources from peat swamp forests is also an issue of concern (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

ECONOMIC VALUE OF ECOSYSTEMS AND BENEFICIAL USES OF INDICATOR SPECIES

REVIEW OF ECONOMIC VALUE OF CORAL TRIANGLE ECOSYSTEM

Malaysia has undergone a shift from an agricultural based country to a newly industrialized country and is proven by an impressive track record of rapid growth and income distribution. Rubber and tin was the focus in the early years of independence and thence Malaysia has moved to large scale planting with diversification into palm oil and rubber. Agriculture continues to be the main contributor to the national economy for almost three (3) decades post-independence. In the mid-1980's, Malaysia steered forward rapidly towards industrialization and in 2005, the Growth Domestic Product (GDP) for each sectors was 9.7% for agriculture, 44.6% on industry and 45.7% on services (Department of Statistic Malaysia, 2007 in National Coastal Resources and Marine Environment Profile of Malaysia, 2010) .

Internationally known amongst loyal divers community, Sabah offers an amazing diversity of coral reefs that supports an abundance of marine flora and fauna. It also supports the coastal communities who depends solely on the health of these reefs. Uniquely located within the "Coral Triangle", this part of the world's oceans have the highest concentration of marine biodiversity.

Coral reefs covers some 4,000km^2 around the country, including fringing reefs and offshore islands, and are representative of an economically important ecosystem and are the forms a significant percentage of the country's tourist industry (National Coastal Resources and Marine Environment Profile of Malaysia, 2010).

The intricacy of the economic, social and biological systems surrounding the use of coral reefs makes it difficult to estimate a value. However, there are three (3) estimates that may serve to represent the monetary values of coral reefs (Reef Check Malaysia Annual Survey Report, 2010):

a. The Global Coral Reef Monitoring Network report in "Status of the Coral Reefs of the World: 2004" suggests that the potential economic value of well managed coral reefs in South East Asia is estimated as USD 12.7 billion (~MYR 39.83 billion) per annum.
b. Coral reefs provide economic goods and ecosystem services worth approximately USD 375 billion (~ MYR 1,176.37 billion) each year that benefits hundreds of millions of people.
c. The World Resources Institute report in "Reefs at Risk in South East Asia (2002) indicated that sustainable coral reefs fisheries alone are worth some USD 2.4 billion (~MYR 7.5 billion) per year in the region. The coral reefs of Indonesia and Philippines provide annual economic benefits estimated at USD 1.6 billion (~MYR 5 billion) and USD 1.1 billion (~MYR 3.45 billion) per year, respectively.

Economic Valuation Method Assessment

In Malaysia, there are minimal studies and research done on total economic evaluation of corals and coral reefs resources. Evaluation of the economic value of the coral is often not always able to be directly measured in monetary value. The Maritime Institute Malaysia (2006) has recommended several methodologies based on their in-house research works:

i) Total Economic Value (TEV)

The concept include a range of environmental benefits offered by natural resources and has been used by various authors in their research. The method of calculation is illustrated in Figure 2-37.

Values of coral reefs in terms of recreational benefits are calculated by the willingness to pay using the **Contingent Valuation Method (CVM).** CVM collects information directly using survey and questionnaires on willingness to pay for various environmental goods and services and/or the willingness to accept their loss/degradation, after which a statistical analysis is being carried out and economic benefits of marine parks are 'priced' by attaching monetary values to their attribute.

ii) Travel Costs (TC)

In this method, travel time or costs are used as an indicator of the total 'entrance fee'; and thence, a person's willingness to pay for visiting a park.

iii) Replacement Costs (RC)

This approach is to evaluate the ecosystem services of coastal protection. Costs of replacing the coral reef with protective constructions such as revetments and underwater wave breakers are taken into account.

iv) Effect of Production (EoP)

The method is also known as 'change in productivity', where difference in output (production) is used as the basis for valuing the reef services. The method also includes estimation of difference in production in fisheries and tourism before and after an impact of a threat.

v) Damage Costs (DC)

The value of the expected loss of the 'stock at risk' is used as a straightforward proxy for the value of the coastal protection service.

Several economic models in Table 2-24 below may demonstrate the most uninformed individuals the total monetary benefits associated with coral reefs around the region. Each products and services of corals and coral reefs related tourism activities are evaluated with different method of assessment. For example, in Pulau Payar, Malaysia, using the Contingent Valuation Method (CVM), an estimation of USD 390,000 conservation fee could be collected from visitors. While in the Great Barrier Reef, approximately USD 107 million of value is estimated for travel costs of tourists to the coral region.

FIGURE 2- 38: SUBDIVISION OF THE TOTAL ECONOMIC VALUE OF CORAL REEFS.

Total Economic Value (TEV)

Use Value

Direct Use Value

Outputs/services that can be consumed directly

- Extractive (Capture fisheries, mariculture, aquarium trade, pharmaceutical)
- Non-Extractive (tourism/recreation, research/education, aesthetic)

Indirect Use Value

Functional benefits enjoyed indirectly

- Biological support to sea birds, turtle, fisheries
- Physical protection to other coastal, ecosystems, coastline, navigation
- Global life support in terms of carbon storage

Non-use Value

Bequest, option and existence values

Functions that value either the future use, expected new information and based on moral convictions

- Endangered and charismatic species
- Threatened reef habitats
- Aesthetic reef scapes
- 'Way of life' linked to traditional use

The Maritime Institute Malaysia (2006) cited Lauretta *et al.*, 2002[19] in another methodology to break down the economic contributions of coral reefs to the overall economy in Southeast Asia. Please refer to Table 2-23.

In reference to the valuation based on the Total Economic Value (TEV) method, a study was done to estimate the value based on use-value and taking into consideration of both direct and indirect use variables. Sustainable fisheries in local consumptions and live reef fish export contributes to approximately USD 17,500- 41,000 per year. If the amount is to also taken into account of the effort to protect coastal shore from erosion, the potential benefits adds up to USD20,000-151,000 per year. Healthy coral ecosystem encourages growth of tourism activities and provides as a source of additional income for local communities. Tourism activities of a coral ecosystem is able to generate about USD700 – 110,000 for every 100-1000 person. For every 600-2000 persons who are willing to pay to conserve the beauty and biodiversity of coral reefs, a value of USD2,400 – 8,000 per year could be achieved. This sums up the potential economic contribution from coral reefs from US$23,000 – 271,000 per year (please refer to Table 2-24 below).

[19] Based on Matthew, 2004

TABLE 2-23: ECONOMIC VALUE PLACED ON PRODUCTS AND SERVICES OF CORALS AND CORAL REEF ECOSYSTEMS/ CORAL REEFS RELATED TOURISM ACTIVITIES

Place and Country	Year	Product/Service [Method used]	Value (USD/yr)	References
Pulau Payar, Kedah (Malaysia)	1998	Willingness to pay conservation fee by visitors to access the marine park in order to assist with the maintenance and protection of the park [CVM]	390,000	Yeo (1998) in Mahfuzuddin, *et al.* (2004)
Phi Phi Islands (Thailand)	2001	Annual benefits from recreational services [TC]	205.14 million / 6,243 per hectare	Udomsak (2001) in Mahfuzuddin, *et al.* (2004)
	2001	Overal annual benefits from use and non-use values of coral reefs [TC and CVM]	497.38 million / 15118 per hectare	Udomsak (2001)
Hon Mun Islands (Vietnam)	2004	Annual recreational value of the islands [TC]	17.9 million	Pham and Tran (2004) in Mahfuzuddin, *et al.* (2004)
Philippines	1988	Fisheries loss value [EoP]	80,000	McAllister (1988)
	Not stated	Overall contribution of marine tourism/ total asset value of reefs [TC]	1.1 billion	Cesar, *et al.* (2002)
Sumilon Island (Philippines)	1990	A decline value of total yield of reef fishes after the breakdown of protective management [EoP]	54,000	Alcala and Russ (1990)
Bali (Indonesia)	For several years	Coastal protection expenditures covering a 500m of coastline protection [RC]	1 million	Cesar (1996) in Mahfuzuddin, *et al.* (2004)
One of the hotel in West Lombok (Indonesia)	Over a period of 7 years	Costs to restore their beach stretch of around 250m, which was damaged by past coral mining [RC]	880,000	Riopelle (1995) in Mahfuzuddin, *et al.* (2004)
Sri Lanka	1998	Replacement costs following years of coral mining [RC]	246,000/km	Berg *et al.* (1998)
Tarawa Atoll (Kiribati)	1992	Coastal defenses cost to prevent coastal erosion [RC]	90,720	Spurgeon (1992)
Great Barrier Reef (Australia)	1987	Tourism sector by estimating tourists' travel costs [TC]	107 million	Hundloe, *et al.* (1987) in Mahfuzuddin *et al.* (2004)
Bonaire Marine Park	1995	Tourism sector by estimating tourists' travel costs [TC]	19.2 million	Pendleton (1995)
Caribbean reefs	2004	Value of coral reef-related tourism in the Caribbean [Based on current statistics and market surveys for fisheries, tourism, and shoreline protection services]	2,100	Lauretta, *et al.* (2004)
Jamaica	1997	Tourism sector by estimating tourists' travel costs [TC]	1.3 billion	Mahfuzuddin, *et al.* (2004)
Yukon artificial reef site (Southern California)	August 2002- August 2003	Diving activity in Yukon's ship based artificial reefs [CVM]	Between 600,000 to 2 million	Pendleton (2004)
Hawaii	2002	Marine tourism [Based on reef-related tourism and fisheries activities]	360 million	Charissa (2002)
South Florida's Coral reef ecosystem	2002	Reef-based tourism [Non-market economic value for coral reefs]	228 million	Asch, *et al.* (2002)

Source: Maritime Institute Malaysia, 2006

TABLE 2- 24: POTENTIAL SUSTAINABLE ANNUAL ECONOMIC NET BENEFITS OF HEALTHY CORAL REEFS IN SOUTHEAST ASIA (PER SQ/KM)

Resource use (direct and indirect)	Production range	Potential benefits (USD/yr)
Sustainable fisheries (Local consumptions)	10 - 30 tons	12,000 - 36,000
Sustainable fisheries (Live fish export)	0.5 - 1 ton	2,500 – 5,000
Coastal protection (Erosion prevention)		5,500 – 110,000
Tourism and recreation	100 – 1000 persons	700 – 110,000
Aesthetic/ Biodiversity (willingness to pay)	600-2000 persons	2,400 – 8,000
Total: **(Fisheries and coastal protection only)**		**20,000 – 151,000**
(Including tourism and aesthetic value)		**23,000 – 271,000**

Source: Maritime Institute Malaysia, 2006

Table 2-25 illustrates researches done in several countries in an effort to evaluate the economic contribution of the mangroves. Table 2-27 indicates the economic value of mangroves along the West Coast of Peninsular Malaysia. Its indirect value was derived from intangible services such as nursery roles, carbon sequestration potential and protection from erosion. It also include the non-use value where it represents an economic value for 'just knowing that the mangroves exist'.

TABLE 2- 25: THE MANGROVE ECOSYSTEM VALUES TO SOCIETY ESTIMATED AROUND THE WORLD.

Country	Item of value	Cost (US$/ha/year)	Author, year
Indonesia	Traditional use	3,000 (half income among the poorest households)	Ruitenbeek, 1992
Thailand	Traditional use	230-1,200	Christensen, 1982; Sathirathai, 1998
Southern parts of Thailand	Traditional use	1,500 per household (a quarter of per capita GDP)	Sathirathai, 1998
	Coastline protection and stabilization services	3,000	Sathirathai, 1998
	Carbon sequestration	100	Sathirathai, 1998
Koh Kong Province in Cambodia	Local level uses and indirect values	500-1,600	Bann, 1997
Rekawa, Sri Lanka	Coastal protection from storm and fisheries value	1,000	Gunawardena and Rowan, 2005
Sri Lanka	Storm protection	8,000,00	Batagoda, 2003
Irian Jaya	Erosion control service	600 per household per year	Ruitenbeek, 1992
South of Vietnam	Protection against extreme weather events	5,000,00	Tri et al., 1998
South east Thailand	Ecosystem function	10,000	Panapitukkul et al., l998
Global mangroves	Forestry and fisheries benefits	500- 2,500	Dixon, 1989
	Disturbance regulation	1839	Costanza *et al.*, l997
	Waste treatment	6696	Costanza *et al.*, l997
	Habitat/refugee	169	Costanza *et al.*, l997
	Food production	466	Costanza *et al.*, l997
	Raw materials	162	Costanza *et al.*, l997
	Recreation	658	Costanza *et al.*, l997
	Total benefits	3294	Costanza et al., l997

Source : Kathiresan, K. & Qasim, S.Z., 2005

TABLE 2- 26: ECONOMIC VALUE OF MAGROVES ALONG WEST COAST OF PENINSULAR MALAYSIA

ECONOMIC VALUE OF MANGROVES ALONG PENINSULAR MALAYSIA'S WEST COAST

	Gross value (RM)
Use values	**2,475,741,981**
Direct use:	233,721,896
Charcoal and Poles	91,365,205
Fish and prawns	16,266,907
Mud crabs	13,476,857
Tourism	112,612,927
Indirect use:	2,238,036,135
Nursery role	1,094,871,841
Carbon sequestration	480,729,717
Protection from erosion	662,434,577
Option value:	3,983,950
Biodiversity value	3,983,950
Non-use values	**2,932,185,680**
Existence value *(the value we attach to 'just knowing that the mangroves exist')*	2,932,185,680
Use and non-use values	**5,407,927,661**

Source: MPP-EAS, Chong et al, 1999

Source: GEF/UNDP/IMO, 1999

Table 2-27 lists the number of countries that are involved in the collection and supply of marine ornamental fish (Wood, E.M., 2001). Malaysia has a relatively small sized ornamental fishery industry compared to the other major exporting countries. In 2000, up to 50,000 fish were exported annually at export value of than USD 100,000. Quantities and value of the industry for domestic market unknown.

TABLE 2- 27: COUNTRIES INVOLVED IN COLLECTION AND SUPPLY OF MARINE ORNAMENTAL FISH.

Country in South-East Asia –Australia Area	Relative Size of Fishery[20]: Year 2000	Domestic Use [D] or Export [E]	Summary Profile of Fishery
Cocos Keeling	Small	E	Total allowable catch of 2,000 aquarium fish per annum
Thailand	Large	E	Export had begun at least by the 1970s. From 1987-1990 exports from Phuket (one of the main collecting areas) were worth about 28-52 thousand US$ annually. Many fish are sent to Singapore for re-export or domestic use. Singapore imported 285,600 marine ornamental fish from Thailand in 1998.
Vietnam	Large	E	Export probably began in the 1980s. A significant amount of stock probably goes to neighbouring countries for re-export. There are currently 100 full-time and 200 part-time collectors. Possibly about a million fish are collected annually.
Taiwan	Small	D & E	Collecting is partly seasonal. Certain species are also cultured here
Hong Kong	N/A	D & E	There is no collecting in Hong Kong waters. Marine fish are imported from neighbouring countries and used locally or re-exported.
Philippines	Very large	E	Exports began in 1957 and export value peaked in 1988 at about US$ 8 million. From 1990-1994 exports averaged US$ 6.76 million. In the early 1990s there were an estimated 2,500 collectors, and there are currently 34-37 companies actively exporting. It is estimated that about 6 million aquarium fish were exported in 1996. The fishery uses 386 species of coral reef fish belonging to79 families.
Malaysia	Small	D	Malaysia used to export marine aquarium fish, mainly via neighbouring countries for re-export, but export is no longer permitted. The quantities caught for the domestic market are unknown.
Singapore	N/A	D & E	There is no collecting in Singapore waters. Marine fish are imported from neighbouring countries and used locally or re-exported.
Indonesia	Very large	E	Export was established at least by the early 1970s and possibly earlier. It is now one of the major suppliers. Export value of marine ornamental fish in 1993 was US$ 5.5 million with stocks going mainly to USA and the Far East, also to Europe.
Australia	Large	D & E	Commercial collection began in the 1970s. The number of collecting permits peaked at 160 in 1990 but had fallen to 63 in 1998, allowing about 180 collectors to operate. About 170,000 fish were collected in 1997, involving 150 species.

Source: Wood, E.M., 2001

[20] Relative size of fishery: Small: up to 50,000 fish exported annually, or export value less than US$100,000; Medium: 50,000 – 100,000 fish exported or export value up to about US150,000; Large: 100,000 – 200,000 fish exported, or export value up to about US$300,000; Very large: 200,000 + fish exported annually, or value over US$300,000

The economic benefits associated with tropical coastal and marine ecosystems

Recreation activities / industry has been identified as one of the major direct economic activities that can be derived from coral reefs followed by products for human consumptions, construction, pharmaceutical and/or for ornamental purposes, research and education. Whilst for mangroves, waste assimilation are one of the potential economic value generator. Seagrass ecosystem generally provides benefits for research and further studies into their unique ecosystem. In terms of indirect uses, coastal defence, existence value and intrinsic value of coral ecosystem could potentially provide significant economic value followed with biological support which may improve significant benefits in mangrove and seagrass ecosystem. All three (3) ecosystems shares similar average benefits in other indirect uses namely global life support, option value and quasi-option value. In terms of magnitude, the total economic value of coral reef and mangrove ecosystems are significantly more than seagrass ecosystem. Please refer to Table 2-29

It is not very often that monetary values of environmental services and functions that are not accounted in marketplace are estimated. However, it is important for decision makers, including government agencies, business managers, local landowners and donor communities to have a good understanding in order to make sound policy and investments decisions that takes into account wise resource management and at the same time improve the economic value of these resources to society.

TABLE 2- 28: RELATIVE MAGNITUDE OF ECONOMIC BENEFITS ASSOCIATED WITH TROPICAL COASTAL AND MARINE ECOSYSTEMS

Benefits	Coral reefs	Mangroves	Seagrasses
Direct uses:			
Products			
Edible	√√	√√	√√
Construction	√√	√√	-
Pharmaceutical	√√	√√	?
Ornamental	√√	√	√
Recreation	√√√	√√	√
Waste assimilation	-	√√√	√
Research	√√	√√	√√
Education	√√	√√	√√
Indirect uses:			
Biological support	√√	√√√	√√√
Coastal defense	√√√	√√√	√√
Global life support	√√	√√	√
Option value	√√	√√	√√
Quasi-option value	√√	√√	√√
Existence value	√√√	√√√	√√√
Intrinsic value	√√√	√√√	√√√
Symbol	**Benefit**	**Description**	
-	None	Provides no benefit	
√	Low	Provides minor economic benefits only	
√√	Medium	Provides benefit between low and high	
√√√	High	Potentially provides significant economic value	
?	Not Known	Could potentially provide large benefits in the future	

A rapid appraisal of the economic value of the Semporna Priority Conservation Area (PCA), located on the east coast of Sabah was completed in February 2011 by WWF-Malaysia. Semporna PCA has a coral coverage of 66,947 ha and covers 170km^2 of mangrove forest. This research is important as Semporna PCA is part of the Sulu-Sulawesi Marine Ecoregion (SSME) and is located within the highest marine biodiversity region- the Coral Triangle. This rapid appraisal based on Total Economic Value framework provides a concept weighing on the dependency of local communities on the resource, national and global stakeholders, and those who benefit from Semporna PCA directly and indirectly. A summary from the preliminary appraisal are as shown in Table 2-29.

TABLE 2- 29: PRELIMINARY APPRAISALS OF ESTIMATED GROSS AND NET VALUE OF GOODS AND SERVICES IN SEMPORNA PCA

Goods / Services	Gross Value, RM (million)	Net value, RM (million)	Notes
Production Services			
Fisheries			
Marine capture (2007)	39.3	29.4	o.e., possible double counting of catch data
Live reef fish trade	4.6	2.3	N.A
Subsistence fishing	-	-	N.A
Recreational fishing	-	-	N.A
Illegal, unregulated and unreported (IUU) fishing	-	-	
Forestry			
Mangrove harvesting		-	N.A
Non-timber products		-	N.A
Seaweed	21.9	19.7	
Sea cucumber	0.76		
Giant clams	-	-	Not commercially produced
Non-extractive services			
Leisure and recreation (tourism)	85.8	34.3	u.e.
Consumer surplus from tourism	2.3	2.3	u.e., b.t.
Revenue received from Sipadan permits	1.75	1.75	-
Benefits from sea transportation	0.27	0.54	u.e.
Education and research	-	-	N.A

Goods / Services	Gross Value, RM (million)	Net value, RM (million)	Notes
Regatta Lepa	-	-	N.A
Indirect use and support services			
Nutrients recycling	-	-	N.A
Biological support for fisheries and species	-	-	N.A
Coastal protection	26.63	26.63	b.t.
Carbon store	-	-	N.A
Calcium store	-	-	N.A
Option value			
Option use value	-	-	N.A
Non-use value			
Bequest value (future)	-	-	N.A
Existence value	2	2	u.e.
TOTAL	**185.31**	**118.92**	

NOTES

o.e	Over estimate
u.e	Under estimate
n.e	Not estimated
N.A	Data not available
B.T	Benefit transfer (value transferred from another study)

The rapid economic assessment found that the Semporna PCA is capable and has the potential to generate over RM185million (gross value) and a net value of over RM118million. The assessment has attempted to provide estimations where data is readily available. Missing figures may be due to several factors such as no / lack of secondary research done on the components and also perhaps lack of resources to conduct primary research to attain the figures necessary to complete the assessment. Hence, it should be stressed that the preliminary estimates are grossly undervalued especially for a high value conservation are such as the Semporna PCA. Values from existing studies and researches from other similar areas have been applied (e.g. coastal protection) to provide an estimate of the actual values.

Some of the findings lead to some policy recommendations:

- The potential economic value of the Semporna PCA justifies the political will, commitment and investments that are urgently needed at the local, national, regional and global levels for longer term conservation efforts of the area. This is to minimize future economic costs / opportunity cost and at the same time to avoid irreversible degradation of the high value conservation area which represents a natural heritage to the state of Sabah and the country. It is important that future planning, development and management of the Semporna PCA should consider the ecological capacity of the area to avoid further degradation. This could mean adopting Ecosystem Based Management (EBM) as a management model to sustain the important economic values of the area.

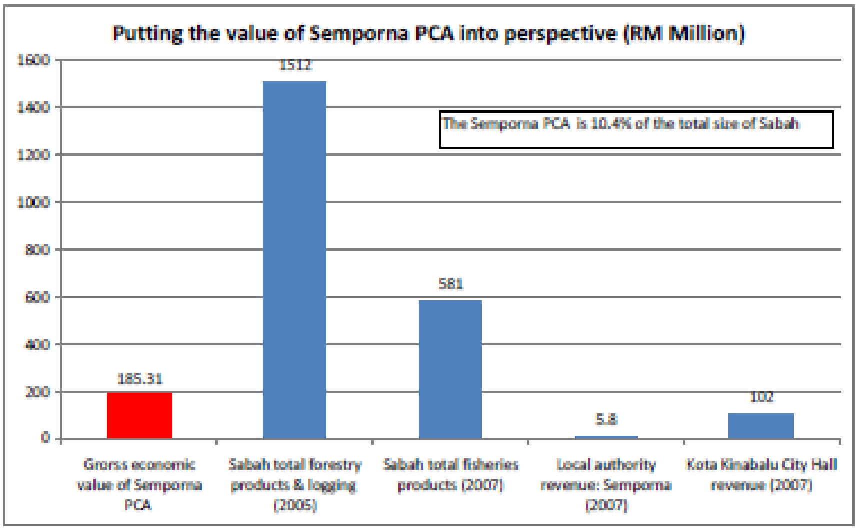
- There is an urgent need to factor in these economic values into public and private policies and decision making processes that have influence on the development patterns of the Semporna PCA. Values generated from the assessment provides an example on how this information may be used in decision making when considering applications for development projects within the environmentally sensitive areas. Conscious efforts are urgently required to be incorporate these economic values into decision making processes and planning tools such as ***environmental impact assessments*** (***EIAs***). As an example, the Department of Environment Malaysia has developed a guideline on Economic Valuation of Environmental Impacts for EIA Projects in June 2008. Detailed EIA reports are required to incorporate economic values of the environment providing a step into the right direction, although this is only a guideline and not enforceable.

- The preliminary estimates of the economic values demonstrated that the Semporna PCA is able to contribute at a minimum of RM185 million per annum. However investments that goes back into the sustainable management of the Semporna ecosystem to reduce threats to the area (as contributed by Sabah Parks for areas that had been gazetted as marine parks) and sustain the values is inadequate. If this inadequacy of management and conservation funding are given its due attention, the tourism sector stand to gain the most (48%), followed by the fisheries sector (24%), coastal protection (14%) and seaweed production (12%). The remaining 2% were based on the proxy for existence values.

- There is an urgent need to streamline the mandates of the different stakeholders within the Semporna PCA towards greater participation and commitment towards the management of the area. Particularly, local communities and the private sector present at Semporna have critical roles to play as they benefit most from conservation activities, apart from government agencies and NGOs. Increasing participation from communities and private sectors in conserving marine areas has been proven to be successful based on certain conditions. In view of this, it is important to investigate how each stakeholder could play a role in supporting conservation measures for the Semporna PCA and to educate them on the importance of their contributions.

- The magnitude of the preliminary value estimated for the Semporna PCA compared to associated production and revenues are reflected in Figure 2-38. The preliminary value indicate the economic value of the Semporna marine ecosystem makes up around 32% of the total fisheries value for Sabah, approximately 12% of total forestry products and logging while it surpasses the revenue of the Kota Kinabalu City Hall by almost double and the Local Authority of Semporna by a factor of around 32 times.

FIGURE 2- 39: MAGNITUDE OF THE PRELIMINARY VALUE OF THE SEMPORNA PCA AGAINST OTHER INDICATORS



source: Hong, Y.B., 2011. Rapid Appraisal of the Economic Values of the Semporna Priority Conservation Area, WWF-Malaysia, Malaysia

Beneficial Uses of Indicator Species

Coral Reefs Indicator Species

a) *Butterfly fish (Chaetodon melapterus) and short-spine sea urchin (Echinometra mathaei)*

It is important to know that a suitable bio-indicator would be able to reflect the changes that occur in the environment targeting to the group/types/species of flora that are to be monitored. Inappropriate bio-indicators will not only fail to reflect changes but also lead to poor management and finally continuous degradation of the ecosystem (Valavi. H., et al., 2010). In a study carried out by Valavi, H. et al. (2010), they found out that butterfly fish (*Chaetodon melapterus*) and short-spine sea urchin (*Echinometra mathaei*) are a more common group found in the coral reef ecosystem and much widespread, thus making the quantifying exercise a lot easier in order to determine changes in the ecosystem.

Groupers, grunts and snappers on the other hand, maybe useful for long term monitoring of overfishing in the coral reefs ecosystem although they may not be reliable indicators for short term monitoring of overfishing. An increase in the usual catch and removal of finfishes increases short-spine sea urchin (*Echinometra mathaei*) population thence causes high bio-erosion which further degrade the coral reef ecosystems and decrease the population of corallivore butterfly fishes (*Chaetodon melapterus*) (Valavi. H., et al., 2010).

b) *Drupella* sp.

Drupella are marine snail predating on reef-building corals widespread on Indo-Pacific coral reefs. *Drupella* has been one of the best indicator species as population outbreaks of these marine snails have been associated with considerable death of corals. Cumming, R.L (2009) cited the first reports of coral destruction by *Drupella* began in 1972 by Moyer et al. (1972) in Japan followed by high densities of *Drupella* at Ningaloo Reefs, Western Australia by Ayling & Ayling (1987) (Cumming, R.L., 2009) .

Cumming, R.L (2009) listed a few scenarios that may indicate a rise of densities in *Drupella* populations caused by unsustainable or abnormal factors in coral community (Cumming, R.L., 2009):

- *Drupella* occupying a high proportion of coral colonies. High densities of these marine snails will lead to an increase in population and increase of colonies being occupied and damaged by *Drupella*.
- *Drupella* assembles on corals that are bleached or diseased. Reefs under such pressure sustain a considerable density of *Drupella*, raises question of ability of these marine snails to transmit disease.

c) *Crown-of-thorns (COT), Acanthaster planci*

Corallivorous crown-of-thorns seastar, *Acanthaster planci* can create significant biological disturbances on a tropical reef during outbreaks. Outbreaks of these sea stars can destroy coral reefs, change coral community structure, promote algal colonization and affect fish population dynamics altogether. This coral-eating sea star could severely affect the economics of an island when coral reef tourism could generate a potential million-dollar industry (Timmers, M.A et al., 2011)

Mangrove Indicator Species

Telescopium telescopium

Mollusc is key component of the mangrove's food chain and plays a vital role in the abundance of waders, and of some sea birds. Abundance and diversity of mollusc have been used as indicator of ecosystem health and local biodiversity in mangrove over the history (Ghasemi, S., Zakaria, M., & Hoveizeh , N.M, 2011).

One of the common inhabitant of mangrove forests are gastropods and *Telescopium telescopium* are one of them (Amin, B. et al., 2005). A high abundance of gastropods of low species richness could relate to low degree of environmental favorable in mangrove habitats. Lower species richness shows only few species could attain high levels of primary productivity under changes of environmental condition (Ghasemi, S., Zakaria, M., & Hoveizeh , N.M, 2011).

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Telescopium telescopium are large snail shaped of an ice-cream cone and often seen in mangroves and mud area. The snail's diet is detritus and algae sucked up by their proboscis during low tide. Thus, making them a suitable organism for monitoring environmental contamination and metal bioavailability studies. On par with development around Malaysia, increased population and fast-paced economic and industrial growth poses several ecological problems to marine and coastal areas (Amin, B. et al., 2005).

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APPENDIX 2-1: LIST OF SCLERACTINIAN CORAL SPECIES OF PENINSULAR MALAYSIA

No.	Species Name	West	South	East
1	*Acanthastrea echinata*		x	x
2	*Acanthastrea faviaformis*			x
3	*Acanthastrea hemprichii*		x	x
4	*Acanthastrea ishigakiensis*		x	
5	*Acanthastrea lordhowensis*		x	x
6	*Acanthastrea regularis*			x
7	*Acanthastrea rotundoflora*		x	
8	*Acropora abrolhosensis*			x
9	*Acropora abrotanoides*			x
10	*Acropora aculeus*		x	x
11	*Acropora akajimensis*			x
12	*Acropora anthocercis*			x
13	*Acropora appressa*			x
14	*Acropora aspera*		x	x
15	*Acropora austera*			x
16	*Acropora awi*			x
17	*Acropora brueggemanni*		x	x
18	*Acropora cerealis*		x	x
19	*Acropora clathrata*			x
20	*Acropora concinna*	x	x	
21	*Acropora convexa*		x	x
22	*Acropora copiosa*		x	
23	*Acropora crateriformis*		x	x
24	*Acropora cuneata*		x	x
25	*Acropora cytherea*			x
26	*Acropora dendrum*			x
27	*Acropora digitifera*		x	x
28	*Acropora divaricata*		x	x
29	*Acropora elseyi*		x	x
30	*Acropora florida*	x	x	x
31	*Acropora formosa*	x	x	x
32	*Acropora gemmifera*			x
33	*Acropora globiceps*			x
34	*Acropora grandis*		x	x
35	*Acropora hemprichii*			x
36	*Acropora hoeksemai*			x
37	*Acropora horrida*			x
38	*Acropora humilis*			x
39	*Acropora hyacinthus*		x	x
40	*Acropora insignis*		x	x
41	*Acropora irregularis*		x	x
42	*Acropora kirstyae*			x
43	*Acropora latistella*			x
44	*Acropora listeri*		x	x
45	*Acropora loripes*		x	x
46	*Acropora lutkeni*			x
47	*Acropora macrostoma*		x	
48	*Acropora microclados*		x	x
49	*Acropora microphthalma*			x
50	*Acropora millepora*		x	x
51	*Acropora monticulosa*			x
52	*Acropora nana*			x
53	*Acropora nasuta*		x	x
54	*Acropora nobilis*	x	x	x
55	*Acropora palifera*			x
56	*Acropora palmerae*			x
57	*Acropora papillare*			x
58	*Acropora pectinatus*			x
59	*Acropora pinguis*			x
60	*Acropora prolixa*			x
61	*Acropora prostrata*		x	x
62	*Acropora proximalis*			x
63	*Acropora pruinosa*		x	x
64	*Acropora pulchra*		x	x
65	*Acropora retusa*			x
66	*Acropora robusta*		x	x
67	*Acropora rosaria*		x	x
68	*Acropora samoensis*			x

69	*Acropora secale*			x
70	*Acropora sekiseiensis*			x
71	*Acropora selago*			x
72	*Acropora solitaryensis*		x	x
73	*Acropora speciosa*			x
74	*Acropora spicifera*		x	x
75	*Acropora stoddarti*			x
76	*Acropora subulata*		x	x
77	*Acropora tenuis*			x
78	*Acropora togianensis*			x
79	*Acropora tubicinaria*	x	x	
80	*Acropora tumida*		x	x
81	*Acropora valenciennesi*			x
82	*Acropora valida*		x	x
83	*Acropora variabilis*		x	x
84	*Acropora vaughani*			x
85	*Acropora vermiculata*			x
86	*Acropora wallaceae*			x
87	*Acropora yongei*			x
88	*Alveopora allingi*		x	
89	*Alveopora daedalea*			x
90	*Alveopora excelsa*	x	x	x
91	*Alveopora marionensis*		x	
92	*Alveopora minuta*			x
93	*Alveopora spongiosa*			x
94	*Anacropora forbesi*			x
95	*Anacropora matthai*			x
96	*Anacropora reticulata*			x
97	*Astreopora gracilis*		x	x
98	*Astreopora listeri*		x	x
99	*Astreopora myriophthalma*	x	x	x
100	*Astreopora ocellata*			x
101	*Australogyra zelli*			x
102	*Balanophyllia cumingii*		x	
103	*Balanophyllia imperialis*		x	
104	*Balanophyllia stokesiana*		x	
105	*Barabattoia amicorum*			x
106	*Blastomussa merleti*		x	
107	*Blastomussa wellsi*			x
108	*Catalaphyllia jardenei*			x
109	*Caulastrea tumida*			x
110	*Coscinaraea columna*		x	x
111	*Coscinaraea exesa*		x	x
112	*Coscinaraea hahazimaensis*			x
113	*Ctenactis albitentaculata*			x
114	*Ctenactis crassa*			x
115	*Ctenactis echinata*			x
116	*Culicia rubeola*	x		
117	*Cycloseris colini*			x
118	*Cycloseris costulata*			x
119	*Cycloseris curvata*			x
120	*Cycloseris cyclolites*			x
121	*Cycloseris erosa*			x
122	*Cycloseris patelliformis*			x
123	*Cycloseris somervillei*			x
124	*Cycloseris tenuis*			x
125	*Cycloseris vaughani*			x
126	*Cynarina lacrimalis*			x
127	*Cyphastrea agassizi*			x
128	*Cyphastrea chalcidicum*	x	x	x
129	*Cyphastrea japonica*		x	x
130	*Cyphastrea microphthalma*		x	x
131	*Cyphastrea ocellina*			x
132	*Cyphastrea serailia*		1	x
133	*Dendrophyllia arbuscula*	x		
134	*Dendrophyllia micranthus*			x
135	*Dendrophyllia nigrescens*		x	
136	*Diaseris distorta*			x
137	*Diaseris fragilis*			x
138	*Diploastrea heliopora*	x	x	x
139	*Distichopora violacea*		x	x
140	*Echinophyllia aspera*		x	x
141	*Echinophyllia echinata*			x
142	*Echinophyllia orpheensis*			x
143	*Echinopora gemmacea*		x	x
144	*Echinopora horrida*			x
145	*Echinopora lamellosa*		x	x
146	*Echinopora mammiformis*			x
147	*Echinopora pacificus*			x
148	*Euphyllia ancora*		x	x
149	*Euphyllia divisa*		x	x
150	*Euphyllia fimbriata*		x	x
151	*Euphyllia glabrescens*		x	x
152	*Euphyllia paradivisa*			x
153	*Euphyllia paraglabrescens*			x
154	*Euphyllia yaeyamaensis*			x
155	*Favia albidus*			x
156	*Favia amicorum*			x
157	*Favia danae*		x	x
158	*Favia favus*		x	x
159	*Favia helianthoides*		x	x
160	*Favia laxa*		x	
161	*Favia lizardensis*		x	x
162	*Favia maritima*		x	x
163	*Favia marshae*			x
164	*Favia matthaii*		x	x
165	*Favia maxima*		x	x
166	*Favia pallida*			x
167	*Favia rosaria*			x
168	*Favia rotumana*		x	x
169	*Favia rotundata*		x	x
170	*Favia speciosa*	x	x	x
171	*Favia stelligera*			x
172	*Favia truncatus*		x	x
173	*Favia veroni*		x	x
174	*Favia vietnamensis*			x
175	*Favites abdita*	x	x	x
176	*Favites acuticollis*		x	x
177	*Favites bestae*		x	x
178	*Favites chinensis*		x	x
179	*Favites complanata*		x	x
180	*Favites flexuosa*		x	x
181	*Favites halicora*		x	x
182	*Favites melicerum*			x
183	*Favites micropentagona*		x	x
184	*Favites paraflexuosa*		x	x
185	*Favites pentagona*		x	x
186	*Favites russelli*		x	x

187	*Favites spinosa*			x
188	*Favites stylifera*			x
189	*Flabellum stokesi*		x	
190	*Fungia actiniformis*		x	x
191	*Fungia concinna*		x	x
192	*Fungia danai*			x
193	*Fungia echinata*		x	x
194	*Fungia fralinae*			x
195	*Fungia fungites*	x	x	x
196	*Fungia granulosa*			x
197	*Fungia klunzingeri*			x
198	*Fungia moluccensis*			x
199	*Fungia paumotensis*			x
200	*Fungia repanda*		x	x
201	*Fungia scabra*		x	x
202	*Fungia scruposa*			x
203	*Fungia scutaria*			x
204	*Fungia somerville*			x
205	*Fungia spinifer*			x
206	*Galaxea astreata*		x	x
207	*Galaxea clavus*			x
208	*Galaxea explanata*			x
209	*Galaxea fascicularis*	x	x	x
210	*Galaxea horrescens*			x
211	*Galaxea paucisepta*		x	
212	*Gardineroseris planulata*		x	x
213	*Gardineroseris ponderosa*			x
214	*Goniastrea retiformis*			x
215	*Goniastrea aspera*		x	x
216	*Goniastrea australensis*		x	x
217	*Goniastrea benhami*	x	x	
218	*Goniastrea edwardsi*		x	x
219	*Goniastrea favulus*		x	x
220	*Goniastrea minuta*		x	x
221	*Goniastrea palauensis*		x	x
222	*Goniastrea pectinata*	x	x	x
223	*Goniastrea retiformis*	x	x	x
224	*Goniopora ciliatus*		x	
225	*Goniopora columna*		x	x
226	*Goniopora djiboutiensis*			x
227	*Goniopora eclipsensis*		x	
228	*Goniopora fruticosa*		x	x
229	*Goniopora lobata*	x	x	x
230	*Goniopora malaccensis*	x	x	
231	*Goniopora minor*		x	x
232	*Goniopora norfolkensis*			x
233	*Goniopora pendulus*		x	
234	*Goniopora planulata*		x	x
235	*Goniopora savignyi*			x
236	*Goniopora somaliensis*			x
237	*Goniopora stokesi*		x	x
238	*Goniopora stutchburyi*		x	
239	*Goniopora tenella*	x		
240	*Goniopora tenuidens*			x
241	*Goniopora fruticosa*		x	x
242	*Goniopora palmensis*		x	
243	*Halomitra pileus*			x
244	*Heliofungia actiniformis*			x
245	*Herpolitha limax*		x	x
246	*Herpolitha weberi*			x
247	*Hydnophora exesa*		x	x
248	*Hydnophora grandis*		x	x
249	*Hydnophora microconos*	x	x	x
250	*Hydnophora rigida*	x	x	x
251	*Leptastrea aequalis*			x
252	*Leptastrea pruinosa*			x
253	*Leptastrea purpurea*		x	x
254	*Leptastrea transversa*	x	x	x
255	*Leptoria phrygia*		x	x
256	*Leptoseris explanata*		x	x
257	*Leptoseris foliosa*			x
258	*Leptoseris gardineri*			x
259	*Leptoseris hawaiiensis*			x
260	*Leptoseris incrustans*			x
261	*Leptoseris mycetoseroides*		x	x
262	*Leptoseris papyracea*			x
263	*Leptoseris scabra*			x
264	*Leptoseris striata*		x	
265	*Leptoseris tubulifera*			x
266	*Leptoseris yabei*		x	x
267	*Lithophyllon lobata*		x	x
268	*Lithophyllon undulatum*		x	x
269	*Lobophyllia corymbosa*		x	x
270	*Lobophyllia dentatus*		x	
271	*Lobophyllia diminuta*			x
272	*Lobophyllia flabelliformis*		x	x
273	*Lobophyllia hataii*			x
274	*Lobophyllia hemprichii*	x	x	x
275	*Lobophyllia pachysepta*			x
276	*Lobophyllia robusta*		x	x
277	*Lobophyllia hataii*		x	x
278	*Madracis kirbyi*			x
279	*Madrepora tenuispicata*	x		
280	*Merulina ampliata*	x	x	x
281	*Merulina scabricula*		x	x
282	*Montastrea annularis*			x
283	*Montastrea annuligera*			x
284	*Montastrea colemani*		x	x
285	*Montastrea curta*		x	x
286	*Montastrea magnistellata*		x	x
287	*Montastrea multipunctata*			x
288	*Montastrea salebrosa*			x
289	*Montastrea valenciennesi*		x	x
290	*Montipora aequituberculata*			x
291	*Montipora altasepta*			x
292	*Montipora alveopora*			x
293	*Montipora cactus*		x	x
294	*Montipora calcarea*			x
295	*Montipora caliculata*			x
296	*Montipora capricornis*			x
297	*Montipora cebuensis*			x
298	*Montipora cocosensis*			x
299	*Montipora composita*	x		x
300	*Montipora confusa*		x	x
301	*Montipora corbettensis*		x	
302	*Montipora crassituberculata*			x
303	*Montipora danae*	x	x	x
304	*Montipora delicatula*			x

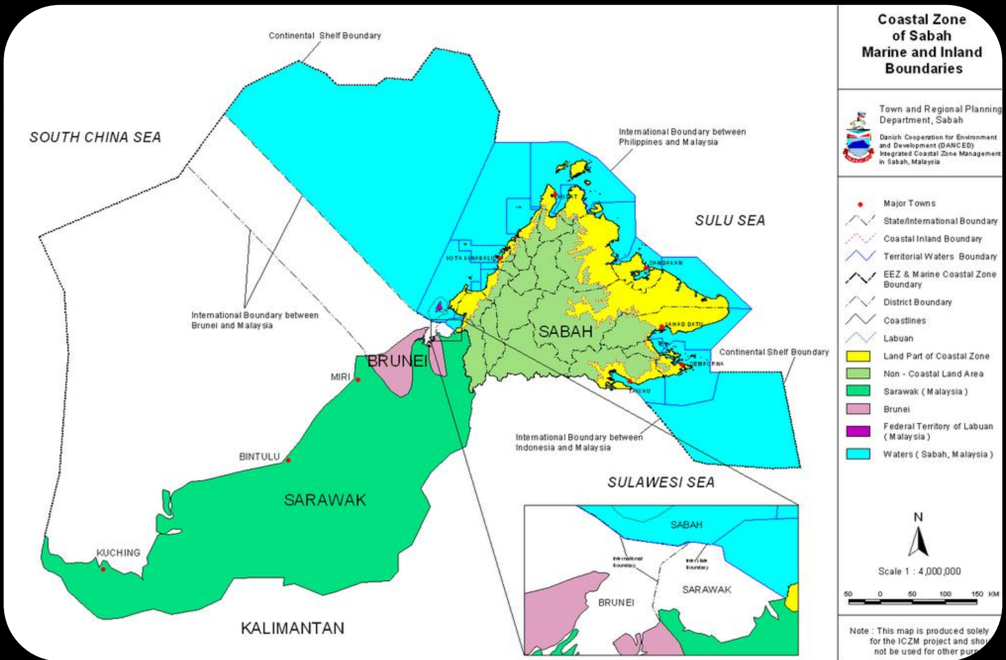
305	*Montipora digitata*		x	x
306	*Montipora efflorescens*		x	
307	*Montipora effusa*		x	x
308	*Montipora elschneri*			x
309	*Montipora florida*			x
310	*Montipora foliosa*	x	x	x
311	*Montipora fossae*			x
312	*Montipora foveolata*			x
313	*Montipora friabilis*			x
314	*Montipora frondens*			x
315	*Montipora fruticosa*		x	x
316	*Montipora gaimardi*		x	x
317	*Montipora granulosa*			x
318	*Montipora grisea*		x	x
319	*Montipora hirsuta*			x
320	*Montipora hispida*	x	x	x
321	*Montipora incrassata*		x	
322	*Montipora informis*	x	x	x
323	*Montipora levis*	x	x	x
324	*Montipora malampaya*			x
325	*Montipora marshallensis*			x
326	*Montipora meandrina*			x
327	*Montipora millepora*			x
328	*Montipora minuta*			x
329	*Montipora mollis*			x
330	*Montipora monasteriata*		x	x
331	*Montipora nodosa*			x
332	*Montipora palawanensis*			x
333	*Montipora papillosa*			x
334	*Montipora peltiformis*			x
335	*Montipora ramosa*			x
336	*Montipora solanderi*	x	x	x
337	*Montipora spumosa*	x		x
338	*Montipora stellata*			x
339	*Montipora striata*		x	
340	*Montipora sulcata*			x
341	*Montipora tuberculosa*		x	x
342	*Montipora turtlensis*		x	
343	*Montipora undata*		x	x
344	*Montipora venosa*	x		x
345	*Montipora verrucosa*		x	x
346	*Montipora verruculosus*			x
347	*Montipora vietnamensis*		x	
348	*Mycedium elephantotus*	x	x	x
349	*Mycedium robokaki*		x	
350	*Oulastrea crispata*		x	x
351	*Oulophyllia bennettae*		x	x
352	*Oulophyllia crispa*		x	x
353	*Oulophyllia levis*		x	
354	*Oxypora crassispinosa*			x
355	*Oxypora glabra*		x	x
356	*Oxypora lacera*		x	x
357	*Pachyseris carinata*			x
358	*Pachyseris foliosa*			x
359	*Pachyseris gemmae*		x	x
360	*Pachyseris rugosa*		x	x
361	*Pachyseris speciosa*	x	x	x
362	*Palauastrea ramosa*			x
363	*Paracyathus stokesi*		x	

364	*Parahalomitra robusta*			x
365	*Parasimplastrea sheppardi*			x
366	*Pavona bipartita*			x
367	*Pavona cactus*			x
368	*Pavona clavus*			x
369	*Pavona danai*		x	x
370	*Pavona decussata*		x	x
371	*Pavona divaricata*	x		
372	*Pavona duerdeni*	x		x
373	*Pavona explanulata*	x	x	x
374	*Pavona frondifera*	x	x	x
375	*Pavona gigantea*			x
376	*Pavona lata*	x	x	x
377	*Pavona maldivensis*			x
378	*Pavona varians*	x	x	x
379	*Pavona venosa*		x	x
380	*Pectinia alcicornis*		x	x
381	*Pectinia lactuca*	x	x	x
382	*Pectinia maxima*			x
383	*Pectinia paeonia*		x	x
384	*Pectinia symphylloides*			x
385	*Physogyra lichtensteini*			x
386	*Platygyra acuta*		x	x
387	*Platygyra carnosus*			x
388	*Platygyra crosslandi*			x
389	*Platygyra daedalea*		x	x
390	*Platygyra lamellina*	x	x	x
391	*Platygyra pini*		x	x
392	*Platygyra ryukyuensis*		x	
393	*Platygyra sinensis*		x	x
394	*Platygyra verweyi*			x
395	*Platygyra yaeyamaensis*		x	x
396	*Plerogyra sinuosa*	x	x	x
397	*Plesiastrea versipora*		x	x
398	*Pocillopora damicornis*	x	x	x
399	*Pocillopora danae*			x
400	*Pocillopora eydouxi*	x		x
401	*Pocillopora meandrina*		x	x
402	*Pocillopora solida*	x		
403	*Pocillopora verrucosa*	x	x	x
404	*Podabacia crustacea*	x	x	x
405	*Podabacia motuporensis*			x
406	*Polyphyllia talpina*		x	x
407	*Porites andrewsi*			x
408	*Porites annae*			x
409	*Porites aranetai*			x
410	*Porites attenuata*			x
411	*Porites australiensis*			x
412	*Porites cocosensis*		x	x
413	*Porites compressa*	x		
414	*Porites cumulatus*			x
415	*Porites cylindrica*			x
416	*Porites densa*		x	x
417	*Porites echinulata*			x
418	*Porites eridani*	x		
419	*Porites evermanni*		x	x
420	*Porites horizontalata*			x
421	*Porites iwayamaensis*	x		x
422	*Porites latistella*			x

423	*Porites lichen*			x
424	*Porites lobata*		x	x
425	*Porites lutea*	x	x	x
426	*Porites mayeri*			x
427	*Porites monticulosa*			x
428	*Porites murrayensis*			x
429	*Porites negrosensis*			x
430	*Porites nigrescens*	x	x	x
431	*Porites rus*		x	x
432	*Porites solida*		x	x
433	*Porites superfusa*	x		
434	*Porites tenuis*	x		x
435	*Psammocora contigua*	x	x	x
436	*Psammocora digitata*		x	x
437	*Psammocora explanulata*			x
438	*Psammocora haimeana*			x
439	*Psammocora nierstraszi*		x	x
440	*Psammocora profundacella*		x	x
441	*Psammocora superficialis*		x	x
442	*Pseudosiderastrea tayami*		x	x
443	*Rhizopsammia verrilli*			x
444	*Sandalolitha dentata*			x
445	*Sandalolitha robusta*			x
446	*Scapophyllia cylindrica*		x	x
447	*Scolymia australis*			x
448	*Scolymia vitiensis*			x
449	*Seriatopora hystrix*		x	x
450	*Stylaraea punctata*			x
451	*Stylocoeniella armata*			x
452	*Stylocoeniella cocosensis*			x
453	*Stylocoeniella guentheri*			x
454	*Stylophora mordax*		x	
455	*Stylophora pistillata*			x
456	*Stylophora subseriata*			x
457	*Symphyllia agaricia*		x	x
458	*Symphyllia radians*			x
459	*Symphyllia recta*	x	x	x
460	*Symphyllia hassi*		x	x
461	*Symphyllia valenciennesii*		x	x
462	*Trachyphyllia geoffroyi*		x	x
463	*Tubastrea aurea*	x	x	
464	*Tubastrea coccinea*			x
465	*Tubastrea diaphana*		x	x
466	*Tubastrea faulkneri*		x	x
467	*Tubastrea micrantha*		x	x
468	*Tubastrea micranthus*			x
469	*Turbinara peltata*		x	
470	*Turbinaria bifrons*			x
471	*Turbinaria crater*		x	x
472	*Turbinaria frondens*			x
473	*Turbinaria irregularis*			x
474	*Turbinaria mesenterina*		x	x
475	*Turbinaria mollis*		x	x
476	*Turbinaria patula*		x	
477	*Turbinaria peltata*	x	x	x
478	*Turbinaria radicalis*		x	
479	*Turbinaria reniformis*		x	x
480	*Turbinaria stellulata*		x	x
	TOTAL	**63**	**245**	**431**

Chapter III: Governance

This chapter broadly describes and lists the various national legislations, policies, plans and institutional arrangements in relation to marine resources and biodiversity management. Additionally, it describes several challenges within the legal system and policy related issues. A dedicated sub-section is dedicated to the State of Sabah where possible on the overview of the various legislations, policies and institutional arrangements within the State of Sabah in relation to its marine resources and biodiversity management. In addition, a brief description of the various international treaties that Malaysia is a party to and those pertaining to transboundary issues can be found in this Chapter.



Sabah Coastal Zone Map: Marine Boundary, Sabah Coastal Zone Profile 1998,
source: http://www.townplanning.sabah.gov.my/iczm/reports/Coastal%20Profile%20Sabah/Index.html

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LEGISLATIONS

FEDERAL LEGISLATIONS

The Malaysian Constitution came into force in 27th August 1957. It governs the delicate relationship between the Federal and State Governments. It has 188 articles and applies to all of the thirteen States that forms the country. In Schedule 9 of the Constitution, there are three (3) lists providing for areas in which the Federal government can make laws (Federal List); where the State government can make laws (State List); and where they can make laws concurrently (Concurrent List). In addition to these, the states of Sabah and Sarawak are given additional lists (List IIIA), which is supplemental to the Concurrent List. However, there are no specific references to the management of the environment and biodiversity. Nevertheless, all natural land resources (including forests and freshwaters and the animals that live in them) are under the respective states' jurisdiction.

There are four (4) articles from the Federal, State and Concurrent List that have direct impact on the conservation of marine biodiversity (UNEP, 2008):

a) Article 9(c) of the Federal List which gives the Federal Government jurisdiction over marine fishing and fisheries, except for turtles;
b) Articles 2 and 3 of the State List which gives the States jurisdiction over land and land use matters, including forestry and agriculture;
c) Article 12 of the State List which gives control over turtles and riverine fishing to the States; and
d) Article 3 of the Concurrent List, which provides for joint responsibility for the conservation of wildlife and the establishment of National Parks.

MARITIME ESTATE JURISDICTION

The separation of jurisdiction between Federal and State governments is a sensitive state of affairs in the management and enforcement of laws over the use of the marine and coastal resources. Section 5 of the National Land Code, 1965, describes "State land" as all land in the State including so much of the bed of any river, and of the foreshore[1] and bed of the sea, as is within the territories of the State or the limits of territorial waters other than -

a. alienated land;
b. reserved land;
c. mining land;
d. any land, which under the provisions of any law relating to forests (whether passed before or after the commencement of this Act) is, for the time being, reserved forest.

Whereas, the Federal Government has jurisdiction over the marine estate of up to 200 nautical miles out to the sea, State governments have authority over land matters up to three nautical miles seaward measured from the low-water mark (DFR, 2010). Please refer to Appendix 3-1 for a list of Federal Legislations that influences the use and management of the ocean in Malaysia.

FISHERIES ACT 1985 (AMENDED 1993)

Schedule 9 of the Constitution provides jurisdictional powers over maritime and estuarine fishing and fisheries to the Federal Government. Following this, the main legislation that governs these area and activities is the Fisheries Act 1985 (Amended 1993). In matters relating to turtles, the Federal Government are only responsible for the conservation and management of turtles in waters within the Federal Territory of Kuala Lumpur and Labuan; and areas outside the jurisdiction of any State in Malaysia.

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[1] The National Land Code defines "shore line" to mean the high water mark of ordinary spring tides.

Coral reefs fall in a grey area. Physically located on the seabed, they can be regarded as State subjects. However, as all living resources are regarded as "*fish*" (except for any species of otters, turtles or their eggs), they can be defined as Federal subjects. The Constitution does not provide for a clear management or ownership rights on marine resources. Marine parks are established under a subsidiary legislation of the Fisheries Act i.e. the Establishment of Marine Parks Malaysia Order 1994. Currently, it has no Act of its own.

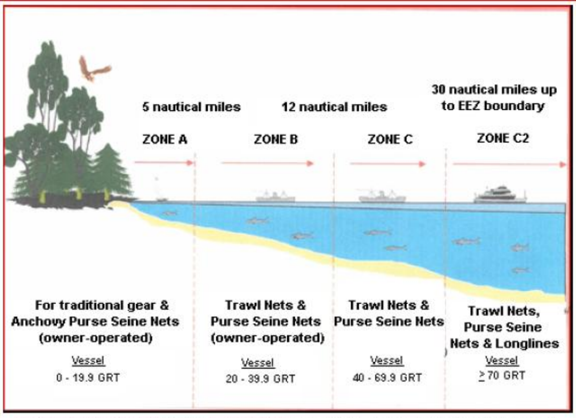
Overall, the Act governs all fisheries activities including the *"conservation, management and development of maritime and estuarine fishing and fisheries in Malaysian Fisheries Waters (MFW)*[2]*, and to turtles and riverine fishing in States in Malaysia and to matters connected these with and incidental thereto".* Turtles and riverine fishing are matters listed in Item 12 of the State List. This aspect of the law can only come into force in the State until a law made by the concerned State legislature has adopted it.

Although it is clear that 'fisheries' (an economic activity) is under Federal jurisdiction, the Constitution is not clear on whether 'fish' and other marine aquatic animals or plants found in 'state waters' are under whose jurisdiction – Federal or State. As an example, most corals (which are living animals) in Malaysia are found in the 'foreshore' or near coast areas (which are actually under State Govt. jurisdiction), but the Federal Government in Peninsular Malaysia had legislated regulations under the Fisheries Act 1963 (a Federal Act) to govern the management and protection of corals (under the care of the Marine Parks Department, which is a Federal Department). Corals, outside the Marine Parks area, are not protected in Peninsular Malaysia under the Fisheries Act 1983. In Sabah State, corals species are also not protected if they are found outside the Sabah Parks gazetted areas. However, in the State of Sarawak, all hard and soft corals are categorised as *'totally protected animals'* under the Wildlife Protection Ordinance, 1998 which carries a penalty of two years imprisonment and a fine of twenty five thousand ringgit if proven to hunt, kill and capture those animals.

[2] The MFW area includes internal water to 200 nautical miles from the territorial sea baselines.

Marine capture fishery activities are regulated through vessel licensing system and are under the responsibility of the Licensing and Resource Management Division, Department of Fisheries (DOF). Licenses issued includes licenses for vessels (incl. deep-sea vessels) and equipment for various zones; i.e. Zones A, B, C, C2 and C3 (please refer to Figure 3-1) below.

FIGURE 3- 1: FISHING ZONES IN MALAYSIA



>> *Vessels are not prohibited from fishing in zones further than their designated zones. For example, a Zone A vessel may fish in Zone B, C or C2. [NOTE: Reversely, vessels, however, are restricted from fishing in zones landward to their designated zones].*

Source: UM, 2010

AQUACULTURE

The Act uses the term *"fishery"* to mean any one or more stocks of fish, which can be treated as a unit for the purposes of their conservation, management and development and includes fishing for any such stocks, and includes aquaculture. Therefore, "*fishery*" also includes the conservation, management and development of aquaculture (SOMER, 2010). Section 2 of the Act recognises "*aquaculture*" to mean the propagation of fish seed or the raising of fish throughout husbandry during the whole or part of its life cycle. "*Culture system*" means any establishment; structure or facility employed in aquaculture and includes on-bottom culture, cage culture, hanging-net culture, pen culture, pond culture, pole or stick culture, raceway culture, raft culture, rope culture and hatchery. The meanings of the above cultures are not given in the Act, but defined in associated regulations. Whilst the Department of Fisheries issue licenses for marine capture fisheries and may issue licenses for '*marine culture systems'*, few precedents are available as benchmarks for legal implications on the operation and management of aquaculture in Malaysia - whether inland or offshore (SOMER, 2010). For aquaculture (in maritime waters[3] also sometimes referred to marine cage aquaculture or mariculture or marine culture system), the Minister is free to legislate on matters related to rules and procedures on (i) licensing of marine culture system; (ii) prescribe fish feed standards; (iii) promote and regulate aquaculture in maritime waters; and (iv) prescribe measures for the control of fish diseases. A subsidiary legislation on aquaculture is stated under Section 61 for *Fisheries (Marine Culture System) Regulations, 1990*.

Under the Tenth Malaysia Plan (2011-2015), commercial fisheries are identified as High Value Agriculture is eligible for pioneer status under the Promotion of Investment Act 1986. Commercial fisheries activities that qualifies for the pioneer status includes:

- Agriculture production, which includes spawning, breeding and culturing of aquatic products and offshore fishing;
- Integrated aquaculture, which includes cultivation and processing of aquatic products; and
- Processing of agricultural produce, which includes aquatic products and aquaculture feeds.

Part VI of the Act lists several activities as 'offences' – some of these are:

- Foreign fishing vessel / foreign national contravening the Act;
- Using or attempting to use, or carrying or possessing explosives, poisons or pollutant, or any apparatus utilising an electric current or any prohibited gear for the purpose of killing, stunning, disabling or catching fish or rendering such fish more easily caught;
- Knowing or having reasonable cause to believe any fish is a prohibited species or has been taken, received or is found in possession of such fish;
- Disturbing, harassing, catching or taking any aquatic mammal or turtle found beyond the jurisdiction of any State in Malaysia;
- Wilfully damaging fishing vessels, fishing stakes, fishing appliances, fish-aggregation devices or marine culture systems; and
- Destroying incriminating evidences.

Relationship between the Fisheries Act 1985 and State Enactments

Several State enactments have adopted the provisions of the Fisheries Act, 1985 for matters relating to turtles and riverine fishing. Research findings from the Malaysia Ocean Policy project has confirmed that the current gaps in the management of marine living resources are attributable to the distribution of powers between the Federal and State governments (DFR, 2010).

- Neither the Fisheries Act nor state enactments provide for the management of marine and coastal biological diversity. Protection of commercially exploitable and non-exploitable fish including sedentary species and their dependent ecosystem is not adequately covered in the Fisheries Act.

[3] "Maritime waters" means areas of the sea adjacent to Malaysia, both within and outside Malaysian fisheries waters and includes estuarine waters, and any reference to marine culture system, fishing or fisheries shall be constructed as referring to the conduct of any of these activities in maritime waters

- State governments are better at establishing and gazetting *'coastal protection areas*', which are within their scope of jurisdiction.
- State enactments rarely adopt inland water ecosystem approach that integrates conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits of inland waters.

Environmental Quality Act 1974

The Environmental Quality Act, 1974 is the main law for environmental protection in Malaysia and is enforced by the Department of Environment (DOE). It relates to the prevention, abatement, and control of pollution and enhancement of the environment, and for purposes connected to it. Specifically, it deters marine pollution and pollution of inland waters through the prohibition of the discharge of oil and wastes into Malaysian territorial waters unless licensed by the DOE or within acceptable conditions of discharge. In essence, the EQA regulates industrial pollution and mitigates environmental impacts of infrastructure development through its many regulations that forms the regulatory framework of the Act. The EQA is basically a pollution prevention law focussed on industrial pollution management through licensing and order for Environmental Impact Assessment (EIA) for development activities (Section 34A). There is a fine not exceeding RM500,000 or not exceeding 5 years imprisonment or both for polluting Malaysian waters.

In marine parks, the requirements for EIAs are more stringent for all tourism development projects. However, concerns have been raised as to the effectiveness of the monitoring of these development activities particularly where compliance and mitigation measures are concerned. In addition, operations of facilities such as hotels and chalets or infrastructures such as jetties are not subject to continuous monitoring.

Water Quality

The Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979 [Regulations 8(1), 8(2), 8(3)] outlines 23 parameters and their associated effluent standards for industrial and development projects. It specifies one set of values for projects within catchments (areas upstream of surface or above ground water supply intakes, for the purpose of human consumption including drinking); and one for all other areas. Project proponents may exceed the emission or effluent standards subject to being granted a license from the Department of Environment to do so.

As of November 2010, the Department of Environment has published the Malaysian Marine Water Quality Criteria and Standard to replace its Interim Marine Water Quality Standard (Please refer to Chapter V for more detail). However, there are no published guidelines on quality assurance for sampling, sample transportation, documentation, or laboratory analysis (PR, 2011). With regard to laboratory testing, consistency is assisted by sending all samples only to Government laboratories. Marine water quality monitoring near islands has been outsourced to the private sector.

National Forestry Act, 1984

Forestry management is under the jurisdiction of State governments. Federal authority only extends to the provision of advice, technical assistance, training and research. However, in order to facilitate the adoption of a coordinated and common approach to forestry, umbrella legislation, the National Forestry Act, 1984, was passed under which each State is provided a common framework for passing their individual state enactments. In Sarawak and Sabah, the administration and management of mangroves as forest reserves is governed by Forest Ordinance 1954 and Forest Enactment 1968, respectively.

Wildlife Protection Act, 2010

The Wildlife Protection Act 2010 replaced the older Act (Wildlife Protection Act, 1972) on 28 December 2010. It has a wider scope and jurisdiction in the protection of more wildlife species and activities related to wildlife. The Act provides for better control on all wildlife species, wildlife derivatives, hybrid species and invasive alien species. It provides for a more stringent penalties and punishment for poaching and other wildlife crimes. The new penalties include fines of up to RM500,000 with jail term of not more than five years. A special permit is required as per Part III (Licensing Provisions) for activities --

<u>Requirement for special permit</u>

11. Subject to the provisions of this Act, no person shall—

(a) hunt or keep any totally protected wildlife or take or keep any part or derivative of any totally protected wildlife;

(b) import, export or re-export any totally protected wildlife or any part or derivative of any totally protected wildlife;

(c) hunt any protected wildlife during the close season;

(d) carry on research or study on any totally protected wildlife;

(e) use any totally protected wildlife for his zoo, circus or wildlife exhibition operation or commercial captive breeding,

...unless he holds a special permit granted under this Act.

The Second Schedule (section 3) lists species under Totally Protected Wildlife category. This list includes several species of turtles. Please refer to Appendix 3-2 for reptiles' category under the Second Schedule.

National Parks Act 1980

The National Parks Act provides for the establishment and control of national parks and for matters connected therewith. The Director General responsible for the management of the national parks is the Director General of Wildlife and National parks appointed under the Protection of Wildlife Act 2010. However, this Act does not apply to the states of Sabah and Sarawak and the State Parks of Kelantan, Pahang and Terengganu as each have its own enactments in the management of national parks. The Act includes the provision for the State Authority to reserve any State land within the State (including any marine area) for the purpose of a National Park to be managed by a National Park committee.

Malaysian Maritime Enforcement Agency (MMEA) Act, 2004

The Malaysian Maritime Enforcement Agency (MMEA) is the principal government agency tasked to provide a "*platform and support services*" to any relevant agencies enforcing marine-related laws. It is in effect known as the Coast Guard of Malaysia. The Agency is not part of, nor are there are any plans to integrate it into the Malaysian Armed Forces. The Agency and its members are part of the Malaysian Civil Service and report directly to the Prime Minister's Department. The MMEA was formally established with the enactment of the Malaysian Maritime Enforcement Agency Act 2004 (Act 633) in May 2004. It came into force on 15th February 2005 and commenced operation on 30th November 2005.

The MMEA Act lists the functions and powers of the MMEA (or 'the Agency' as referred to in the Act), which includes enforcement of any federal law within the Malaysian Maritime Zone. The MMEA is empowered under Section 7 to inspection of any fisheries vessel suspected of committing an offence against the provisions of the Fisheries Act. The MMEA may also demand the production of any licence, permit, record, certificate or any other document and to inspect such licence, permit, record, certificate or other document or make copies of or take extracts from such licence, permit, record, certificate or other document (e.g. on behalf of the Fisheries Department for activities related to fishing or for polluting offences in any of the Malaysian Maritime Zone).

Whilst the MMEA Act recognises the MMEA to have responsibility for maritime enforcement throughout the maritime estate, other legislation remains un-amended, thus, continuing to give enforcement responsibilities to other Agencies (PR, 2011).

Customs Act 1967 (amended in 1988)

Under the Customs (Prohibition of Exports) Order 1988 – First Schedule and Customs (Prohibition of Import) Order 1988 – First Schedule, the import and export of turtle eggs are prohibited. In addition, import / export licence or permit from relevant authorities is required for corals (live or dead).

Exclusive Economic Zone Act, 1984

The Exclusive Economic Zone Act, 1984 (EEZ Act) provides the Director-General of the Environment the responsibility for the management of the marine environment in the EEZ area[4] (PR, 2011). Part IV of the Act refers to the sovereign right of Malaysia to exploit her natural resources pursuant to the national environmental policies and its duty to protect and preserve the marine environment.

Aquaculture

The following summary refers to provisions for certain types of tuna farming-related operations that might need further examinations. The EEZ Act permits dumping of old and disused aquaculture cages so long as the activity is regulated by the Act. Article 5 prohibits activities in the EEZ or on the continental shelf except where authorised as in Part III for fisheries activities and in Part IV for the protection and preservation of marine resources.

Merchant Shipping Ordinance (MSO), 1952

Part VA of the Ordinance regulates pollution from ships that also applies to fishing vessels. Part IX on the *International Convention relating to the Limitation of the Liability of Owners of Sea-going Ships* signed in Brussels on 10 October 1952 also applies to fishing vessels (PR, 2011). A proposed Merchant Shipping Act is undergoing a discussion phase between the Federal, Sabah and Sarawak Authorities.

Merchant Shipping (Oil Pollution) Act, 1994

The Act provides for civil liability for oil pollution by merchant ships and other matters connected therewith. The geographical scope of the Act covers the territorial waters of Malaysia, and where reference is made to another Liability Convention country then to the *'territorial sea of the Liability Convention'* country. Many definitions of the Act rely on the interpretations given to the same under MSO 1952.

Sabah State Legislations

Some of the more relevant laws in Sabah state are described in the following paragraphs. For a more comprehensive list of relevant laws, please refer to Appendix 3-3.

Environment Protection Enactment 2002

The Sabah Environment Protection Enactment 2002, amended in 2004 provides for the establishment of Environment Protection Council, and is administered by the Director of the Sabah Environment Protection Department. The purpose of the Council is to advise the Sabah State Government on

[4] Although the tuna aquaculture farm boundary is technically within the territorial seas of Malaysia, there will be ancillary activities that would occur in the EEZ. Thus, EEZ laws will be relevant for the venture.

matters relating to the Enactment. The Enactment empowers the Director to make policies, programmes and plans for environmental protection as required, and specifically to address significant environmental pollution or potentially significant pollution. Section 17 states licensing requirement to undertake controlled pollution activities.

Although the Enactment does not confine to the issues pollution, it does tend to skew towards pollution issues (PR, 2011). However, other activities that can require measures or conditions for protection of the environment are explicitly described under Section 20 to include (but not limited to):

- any use of land, cultivation of land or the methods used thereof;
- earthworks or land reclamation;
- cutting of trees, clearing or destruction of vegetation or setting fire in any land;
- excavation or dredging in water courses or altering the source and course of banks or streams;
- any discharge of any pollutant into water, watercourses, lakes or foreshore, and the storage of such pollutant;
- any activity relating to the production, storing, treating, transporting or disposal of waste;
- any activity relating to any sewage line, waste water treatment plant, incineration plant and waste landfill and on the design, operation and maintenance of such line or plant;
- any livestock activity and the disposal of animal or other organic waste;
- any activity relating to the excavation or altering of any geographical or geological feature.

Section 11 provides for the establishment of an area as "environmental protection area" for the general protection of the environment by notification in the Gazette. The Minister may, by notification prescribe the types of any development activities which are likely to have adverse effects on the environment. No individual may undertake any development activities as described without submission and approval (by the Director) of an environmental impact assessment (EIA) report or a proposal for mitigation measures. A Committee manages a register of "Environmental Consultants" with secretarial support provided by the Director. EIA reports must be prepared by registered Environmental Consultants (Section 48-50) (PR, 2011).

Section 18(1) provides for the designation of an "Environmental Hazard Zone" for degraded areas that may cause harm to human health and/or the environment.

Part IV of the Enactment allows for an Environment Protection Fund to be opened and managed by an "Environment Protection Fund Committee" consisting of the Permanent Secretary as the Chairman; the State Treasurer or authorised representative; and the Director. The Fund shall be used for the following purposes -

- the preparation and implementation of the environmental protection action plans;
- expenditures incurred in the establishment, protection, conservation and management of the environmental protection areas;
- research and development relating to environmental protection measures;
- investigative works on environmental hazard and pollution; or
- any work necessitated by the presence of or the likelihood of the occurrence of environmental hazard and pollution.

<u>Restrictions on activities along the coastal areas</u>

The Sabah Environment Protection Enactment specifically stipulates that: no person shall, in or along any coastal area -

- reclaim or drain any foreshore or seabed in a manner which has or is likely to have a significant adverse effect on the environment;

- alter, erect, demolish, place, reconstruct or remove any structure or any part of a structure that is fixed in, on, under or over any foreshore or seabed in a manner which has or is likely to have a significant adverse effect on the environment;
- damage, destroy or disturb any foreshore or seabed by excavating, drilling or tunnelling in a manner that has or is likely to have a significant adverse effect on the foreshore or seabed other than for the purpose of lawfully harvesting any plant or animal pursuant to any written law; or
- deposit in, on or under any foreshore or seabed any pollutant in a manner that has or is likely to have a significant adverse effect on the foreshore or seabed.

The most severe penalty under the Enactment is RM100,000.00 or 5 years in jail or both for the offence of undertaking a prescribed activity without the submission and approval of an EIA. Other offences carry fines of up RM50,000.00 and/or lesser jail terms.

The Enactment is supported by six (6) regulations:

- Environment Protection (Amendment) Enactment 2004
- Environmental Protection (Prescribed Activities) Order 2005
- Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005
- Environment Protection (Registration of Environmental Consultants) Rules 2005
- Environment Protection (Environmental Fees) Rules 2005
- Environment Protection (Compounding of Offences) Rules 2005

Forest Enactment 1968

The Sabah Forest Enactment 1968 is administered by the Sabah Forestry Department. Section 5 of the Enactment provides for the creation of seven (7) different classes of forest reserves and outlines the procedures for notification, control of activities, land acquisition and promulgation in the Gazette. A license for activities within the forest reserves is required. However, no license will be issued for activities undertaken within forest reserves Classes I (Protection), VI (Virgin Jungle) and VII (Wildlife Reserve). However, forest reserves Class V for mangrove forest are allowed for prescribed activities subject to approval of a license. Section 28A & B stipulates that a license holder of more than 1,000ha of forest reserve or State land, must prepare and implement a forest management plan or a forest harvesting plan, and a reforestation plan. Penalties for illegal logging and other offences under the Enactment are punitive and may range to a fine of not more than RM500,000.00 and up to 20 years in jail, along with a requirement to pay a sum not exceeding - ten times the value of royalties due, ten times the value of the forest product removed and other charges payable (PR, 2011). The rights of natives to harvest forest products for personal use from State or alienated lands that are not subject to prohibition or regulation in specified areas, is recognised in Section 41 (PR, 2011).

Forest (Constitution of Forest Reserves and Amendment) Enactment 1984

This Enactment provides the following classes of forest reserves (with a combined area of around 3,606,646.57ha):-

Class I: Protection Forest (60 Reserves totalling approximately 466,756 ha);
Class II: Commercial Forest (40 Reserves totalling approximately 2,550,022 ha);
Class III: Domestic Forest (10 Reserves totalling approximately 6,919 ha);
Class IV: Amenity Forest (19 Reserves totalling approximately 16,358 ha);
Class V: Mangrove Forest (23 Reserves totalling 326,487ha, including the 'Kudat and Marudu Reserve of 13,396 ha);
Class VI: Virgin Jungle (61 Reserves totalling approximately 103,037.733 ha); and
Class VII: Wildlife Reserve (4 Reserves totalling approximately 137,065 ha).

The rights and privileges and conditions governing any of the Forest Reserves are as provided in the Forest Enactment 1968 (PR, 2011).

Parks Enactment 1984

The Parks Enactment 1984 was endorsed to replace The National Parks Enactment 1977 as the law in relation to the provision and control of National Parks and National Reserves in Sabah, with improved provisions in line with to the Constitution, administration, procedures, functions and finance of Parks.

Some definitions are worth a mention: -

- animal means any mammal, reptile, insect, bird, fish, crustacean, coral (whether living or dead) any vertebrate or invertebrate animal living in aquatic and terrestrial environment;
- coral refers to the living polyps and/or the external skeleton, hard calcareous or soft, dead or alive, individually or in colony;
- land means the State land as defined in the Land Ordinance *[Cap. 68.]* and any other land granted or leased to the Board for the purpose of a Park or Nature Reserve and includes the territorial waters of the State and the seabed beneath.

Sabah has five (5) marine parks gazetted under the Enactment:

i. Tunku Abdul Rahman Park, 1974
ii. The Turtle Islands Park 1997
Designated as a protected are for protection of nesting sites for green turtles and hawksbill turtles.
iii. Pulau Tiga Park 1978
Designated to protect its unique island ecosystem which includes mud volcanoes, coral reefs and nesting habitat for sea snake.
iv. Tun Sakaran Marine Park 2004
v. Pulau Sipadan
The island was previously under the authority of National Security Council is now a proposed MPA under Sabah Parks.

Part VIII of the Enactment provides for the control of parks or nature reserves. Section 48 describes acts that are prohibited within the parks or nature reserves without written permission from the authority.

a) cut, fell, damage, remove, injure, destroy or set fire to any tree or protected plant in a Park or Nature Reserve; or
b) cut, damage, remove, injure, destroy or bomb any <u>coral</u> (whether living or dead) in a Park or Nature Reserve ; or
c) convey into a Park or Nature Reserve or, being within the confines thereof, be in possession of any weapon, explosive, trap, poison or noxious substance, boat, tractor, logging truck, heavy machineries or vehicles for moving logs or earth, chain saw, apparatus or tools for collecting specimen of plant or animal; or
d) within a Park or Nature Reserve, hunt, kill, injure, capture or disturb any animal other than coral (whether living or dead) or <u>take or destroy any egg or nest</u>; or
e) cut, damage, injure or destroy or set fire to any vegetation (other than trees and protected plants) or any object of geological, pre-historical, archaeological, historical or other scientific interest in a Park or Nature Reserve; or
f) introduce any animal, or permit or cause any domestic animal to enter or stray into a Park or Nature Reserve or introduce any vegetation into a Park or Nature Reserve; or
g) remove from a Park or Nature Reserve any animal or vegetation whether alive or dead; or
h) remove from a Park or Nature Reserve any mineral or object of geological, pre-historical, archaeological, historical or other scientific interest; or
i) destroy or deface any object, whether animate or inanimate, in a Park or Nature Reserve; or

j) erect or attempt to erect any building in a Park or Nature Reserve; or
k) clear or break up any land in a Park or Nature Reserve; or
l) damage, set fire or destroy any vegetation in a Park area or Nature Reserve as a result of any activity carried out from outside the Park area or Nature Reserve; or
m) spreads, discharge or causes the discharge of oil, chemical, poison, or other toxic or waste matters including solid waste capable of harming vegetation and/or animals in or adjacent to rivers, lakes and water in or flowing into a Park or Nature Reserve; or
n) obstructs or diverts any rivers, pools or other bodies of water in or flowing into a Park or Nature Reserve; or
o) recording or take any film or video recording or take still photographs for commercial purposes within the Park or Nature Reserve; or
p) enter any area of the Park or Nature Reserve except areas developed for public usage by the Park; or
q) carry out any research and/or collecting scientific or social and cultural data, with or without the collection of specimen of any sort.

Penalties vary according to specified acts. For example for acts (a) and (b), offenders can be imprisoned for a term not more than five years, or a fine not exceeding RM500,000.00 or both. For second time offences, prison time is increased to not more than seven years or a fine not more than RM750,000.00, or both. Lesser penalties for acts (c) to (q) include prison time of not exceeding one year, or a fine of not exceeding RM50,000.00 or both. For second time offences, prison time is increased to not more than five (5) years, or to a fine not exceeding RM100,000.00, or both.

Sabah Biodiversity Enactment 2000

The Sabah Biodiversity Enactment 2000 establishes the Sabah Biodiversity Council, Sabah Biodiversity Centre and Sabah Centre Fund, and outlines related provisions.

The Enactment defines "*biodiversity*" as "*biological diversity, being the variability among living organisms from all sources, including plant materials, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part of, and the diversity within species, between species and ecosystems, and includes biological resources*"; and "*biological resources*" to "*include genetic resources or materials of plant, animal or microbial origin or any other biotic components of the ecosystem, with actual or potential use or value for humanity*".

Section 15 requires any collector who intends to obtain access to biological resources to apply in writing to the Council for an access license. The Council, upon application may exempt individual, academic and research institution from the access application seeking to undertake any pure academic and non-profit oriented research. An application for an access licence shall be in respect of access to biological resources found on:

a. State lands;
b. any reserves, natives customary lands or any other sites over which indigenous and local communities exercise community-based or customary rights; or
c. any other areas, including rivers, tributaries, waterways or areas covered by water, marine parks or territorial waters of the State, and shall also include any ex situ collections maintained by the State.

Wildlife Conservation Enactment 1997

The Enactment is to make provisions for the *"...conservation and management of wildlife and its habitats in the State of Sabah for the benefit and enjoyment of the present and* *future generations of the people of the State of Sabah"*. Section 3 provides for the appointment of a Director of Wildlife for its implementation, along with Wildlife Officers for enforcement.

Section 9 provides for an establishment of a Wildlife Sanctuary to: -

a) protect nature and maintain wildlife habitats and natural processes in an undisturbed state;
b) ensure the maintenance of biodiversity values; or
c) ensure the conditions necessary to protect significant species of animals or plants, biotic communities or genetic resources.

Land may be acquired compulsorily in support of the establishment of a Wildlife Sanctuary (Sect. 12) and a management plan developed within three years after declaration of the Sanctuary (Sect. 13) (PR, 2011). Section 15 allows entry (under a valid permit) into Wildlife Sanctuary that is open to the public under the management plan for that Sanctuary, and other areas in the Sanctuary for the purpose of conducting research.

Section 16 outlines the provision for hunting of any animal or search for or harvest of any plant in a Wildlife Sanctuary. The activities require authorised by licence or permit to fish with rod and line or a hand line in a zone of a Wildlife Sanctuary where fishing may be permitted.

Other prohibited acts in a Wildlife Sanctuary include:

a) fell or cut any tree or cut, injure or set fire or allow fire lighted by himself or his servants outside a Wildlife Sanctuary to spread to any vegetation;

b) search for or collect any animal product;

c) wilfully damage any object of geological, prehistoric, marine or other scientific interest or remove such object or a portion thereof;

d) without lawful excuse, be in possession of any animal, animal product or plant;

e) knowingly introduce any animal or domestic animal or allow such animal to stray;

f) disturb or stampede any animal;

g) wilfully damage any structure;

h) occupy, clear, cultivate or break up for cultivation any land;

i) carry out any quarrying activities;

j) construct or occupy any structure or building; or

k) do any other thing that is prohibited by regulations (Sect. 17).

Environmental offences in Wildlife Sanctuaries include the:

a) spreading of chemicals or other toxic matters either from within or outside a Wildlife Sanctuary which cause harm to fauna or flora in that Sanctuary;

b) discharging of oil, chemicals or other toxic or waste matters capable of harming fauna and flora in or adjacent to any rivers, lakes and waters in or flowing into a Wildlife Sanctuary; or

c) obstructing or diverting any rivers, pools, lakes or other bodies of water in or flowing into a Wildlife Sanctuary (Sect. 18).

Conservation Areas can also be established in an area for the purpose of protection of wildlife, wildlife habitats, migration sites, migration corridors and sites of scientific or other importance or value to ensure the security of the wildlife or its habitats of a neighbouring Wildlife Sanctuary, or for the purpose of the control of the smuggling of animals, animal products or plants in areas bordering neighbouring States or countries (Sect. 21). In Conservation Areas, regulations may be promulgated for the control of:

a) development projects;

b) hunting and the carrying of firearms and other means of hunting;

c) the movement of animals, animal products and plants; and

d) aerial spraying of crops and grazing areas.

Importantly, Section 20 provides for the creation of provisional wildlife sanctuaries for up to 120 days when there is an urgent need to save wildlife, a wildlife habitat or an ecosystem of an area from imminent destruction or irremediable damage.

Schedule 1 to the enactment lists animals that are not to be hunted, and Schedules 2 and 3 list animals that are only to be hunted with a licence. The enactment allows the killing of an animal in self-defence or protection of others or livestock and property (Sect. 39). No person shall possess any animal of a species listed in Part I of Schedule 1 or an animal product of an animal listed in Part I of Schedule 1 unless authorised in writing by the Minister acting on the advice of the Director (please refer to Appendix 3-3 for lists of animal - Schedule 1 and mammals and reptiles in Schedule 2).

Section 63 and 68 describes that the Director can recommend the creation of Wildlife Hunting Areas, for which a management plan must be developed within three years of its establishment. Protected animal farming permits, zoological gardens and plant cultivation permits are also provided for under the Enactment. The Director can also declare turtle egg traditional collection areas (Sect. 87), and closed seasons for specified areas (Sect. 106).

Corporate bodies guilty of a Wildlife offence can be fined up to RM100,000, and private individuals up to RM50,000 and/or imprisonment up to five years. Courts may also order that offenders pay the cost of environmental restoration works (Sect. 18). The Director is given power by the Enactment to compound offences except where the offence relates to the:

a) hunting animals or harvesting plants within a Wildlife Sanctuary;

b) hunting an animal or harvesting a plant of a species listed in Schedule 1;

c) being in possession without lawful authority of an animal, animal product therefrom or plant of a species listed in Schedule 1; or

d) bringing or causing to be brought into the State, or taking or causing to be taken out of the State without a valid permit an animal, animal product or plant of a species listed in Appendix I or Schedule 1.

Summary of Other State Legislations

Forestry

All States have enactments governing the management of forests including the setting up of protected forests areas (PFAs) and productive forests.

State Parks

At present, Sabah, Sarawak, Johor, Pahang, Kelantan, Terengganu, Perlis and Perak have their respective enactments governing the establishment and management of state parks. The other states have no legislation to this effect. There are no state mangrove parks.

Biodiversity Management and Development

Sarawak is the only state to date, that has taken proactive action in biodiversity management with the development of the Sarawak Biodiversity Centre Ordinance in November, 1997. However, the primary objective of the Ordinance, is more focused on the exploration of biotechnology applications. The primary aim of the Sarawak ordinance is to undertake "policies and guidelines for scientific research or experiment related to the use of biological resources of Sarawak for pharmaceutical, medicinal and other specific purposes." Sarawak strongly assumes the biodiversity within its borders (including marine biodiversity) as its own. The Regulations on Access, Collection and Research which came into force in January, 1999 prevents export (including to other states within Malaysia) of biodiversity material (which includes part of a plant or animal) without a permit.

Case Study: Turtles Protection

Legal Protection

In Peninsular Malaysia - Perlis and Selangor do not have marine turtle related laws. The laws in other states mainly prescribe the procedures and fees for the purposes of securing licences to collect eggs, operating turtle watching areas (TRAFFIC Southeast Asia, 2009). There are also penalties prescribed for offences involving the possession or killing of turtles. Penalties for offences range from fines from RM100 up to RM3,000 and jail terms from three months to one year. Under the Customs (Prohibition of Exports) Order 1988 – First Schedule and Customs (Prohibition of Import) Order 1988 – First Schedule, the import and export of turtle eggs are not allowed. The Department of Fisheries Malaysia has received reports from the Royal Malaysian Customs of illegal trade; however no detailed study has been conducted to ascertain the extent and mechanisms of the illegal trade. So far, only Sabah's Wildlife Conservation Enactment 1997 and Sarawak's Wildlife Protection Ordinance 1998 have listed marine turtles under their legislation as totally protected animals. In Sabah, two government bodies oversee the management of turtles, which are Sabah Parks (only for Turtle Islands and islands under their jurisdiction) and the Sabah Wildlife Department. The ban on turtle egg consumption and sale covers the whole state of Sabah except for the rights to two families to collect eggs from the islands around Sipadan prior to 1997. Since the gazettement of the Wildlife Conservation Enactment 1997, the rights to the families have been withdrawn resulting in the families seeking for compensation (TRAFFIC Southeast Asia, 2009). Under Section 41 of the Wildlife Conservation Enactment 1997, offenders risk being fined up to RM50,000 or five years' jail, or both upon conviction. The recovery of the Sabah Turtle Islands populations has been attributed to the foresight of the state government to ban turtle egg consumption and sale and to afford protection to the Turtle Islands in the 1970s. For Sarawak, under the Wildlife Protection Ordinance 1998, all marine turtles or any recognizable part or derivative thereof are listed under totally protected animals, whereby any person who kills, captures, sells, offers for sale or claims to be offering for sale, imports, exports, or is in possession of, except in accordance with the permission in writing of the controller for scientific or educational purposes or for the protection and conservation of such totally protected animals, shall be guilty of an offence. Under section 29 (1) subsection c, the penalty is imprisonment for two years and a fine of RM25,000. The interviews with officials from the State Department of Fisheries in Johor, Pahang and Penang, mentioned that their departments buys all the eggs collected by the licensed collectors and send to the department's hatcheries, and at the same time they also discourage public from consuming turtle eggs. Table 3-1 lists the related legislations in the management of marine turtles.

Policy Protection

Encouragingly, in September 2011, Malaysia has become the latest signatory to the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their habitats within the Indian Ocean and South-East Asia (IOSEA) region. The MoU was signed by the Director of Department of Fisheries Malaysia and by IOSEA coordinator. The MoU entails a Conservation and Management Plan which contains 24 programmes and 105 specific activities focused on reducing threats, conserving critical habitat, exchanging scientific data, increasing public awareness and participation, promoting regional cooperation and seeking resources for implementation (Wong, 2011). The MoU shall come into effect on December 1, 2011 and is hoped to complement the priorities set by the government in the 2008 National Plan of Action for Conservation and Management of Sea Turtles.

TABLE 3- 1: LEGISLATIONS IN RELATION TO MARINE TURTLES IN MALAYSIA

FEDERAL LEGISLATION	Fisheries Act 1985; Protection of Wildlife Act 1972; The Customs Act 1967
FEDERAL SUBSIDIARY LEGISLATION	Fisheries (Prohibited Areas) (Rantau Abang) Regulations 1991 Fisheries (Prohibition of Method of Fishing) (Amendment) Regulation 1990 Customs (Prohibition of Exports) Order 1988 Customs (Prohibition of Import) Order 1988
STATE LEGISLATION	<u>Terengganu</u> Turtle Enactment 1951 (Amendment 1987) Turtle Enactment 1951 (Amendment 1989) Section 3A Notification Under Turtle Enactment 1951
	<u>Johor</u> Fisheries (Turtles and Turtle Eggs) Rules 1984
	<u>Kedah</u> Turtle Enactment 1972 Turtle Rules 1975
	<u>Kelantan</u> Turtles and Turtles Eggs of 1072 (Amended 1935, Enactment No.8) Fisheries (Turtles and Turtle's Eggs) Rules 1978
	<u>Malacca</u> Fisheries (Turtles and Turtle Eggs) Rules 1989
	<u>Negeri Sembilan</u> Fisheries (Turtles and Turtle Eggs) Rules 1976
	<u>Pahang</u> Fisheries (Turtles and Turtle Eggs) Rules 1996
	<u>Penang</u> Fisheries (Turtles and Turtle Eggs) Rules 1999
	<u>Perak</u> River Right Enactment 1915
	<u>Sabah</u> Wildlife Conservation Enactment 1997 Parks Enactment 1984 Customs (Prohibition of Exports) Order 1988 Customs (Prohibition of Import) Order 1988
	<u>Sarawak</u> Turtle Trust Ordinance, 1957 Turtle (Prevention of Disturbance) Rules, 1962 Wildlife Protection Ordinance, 1958 (Amended 1973) Wildlife Protection Ordinance, 1990 (Amended 1995) Wildlife Protection Rules, 1998 National Parks and Nature Reserves Ordinance 1998 National Parks and Nature Reserves Rules, 1999 Wildlife Protection Ordinance, 1998 (Amended 2003) Customs (Prohibition of Exports) Order 1988 Customs (Prohibition of Import) Order 1988
	<u>Selangor and Perlis:</u> No legislation

source: TRAFFIC Southeast Asia, 2009

Policies

Federal Policies

There are several policies that address biodiversity and resources management. At the Federal level, these include (list not exhaustive):

- The National Biodiversity Policy (NBP), 1998
- The National Forestry Policy (NFP)
- National Environment Policy
- The National Agriculture Policy 3 (NAP3)
- National Physical Plan (NPP)
- National Ecotourism Plan (NEP)
- National Policy on Climate Change (NPCC)

The National Biodiversity Policy (NBP), 1998

The National Biodiversity Policy aims to conserve biological diversity in Malaysia and ensure that its components are utilised in a sustainable manner for the continued progress and socio-economic development of the nation. The policy addresses biological diversity at three levels, i.e., genetic diversity, species diversity and ecosystem diversity. It also notes that much of the biological diversity in Malaysia has yet to be investigated and documented. A lack of data impedes efforts to better utilise biological resources, and continual habitat destruction is leading to loss of biological diversity even before much of it has been documented. This loss of biological diversity almost certainly includes a loss of species that have the potential to be developed into useful products.

The NPBD reviews the status of conservation and management of biological diversity in terms of types of conservation efforts being carried out and their effectiveness; sectoral policies concerning biological diversity; current applicable legislative framework and its restrictions; and international cooperation and linkages involving biodiversity conservation and management in Malaysia (PR, 2011).

Objectives of the NBP are:

i. To optimise economic benefits from sustainable utilisation of the components of biological diversity;
ii. To ensure long-term food security for the nation;
iii. To maintain and improve environmental stability for proper functioning of ecological systems;
iv. To ensure preservation of the unique biological heritage of the nation for the benefit of present and future generations;
v. To enhance scientific and technological knowledge, and educational, social, cultural and aesthetic values of biological diversity;
vi. To emphasize biosafety considerations in the development and application of biotechnology;

The Policy lists 15 strategies for effective management of biological diversity, followed by action plans to achieve each strategy.

1. **Improve the Scientific Knowledge Base**
   Survey and document the biological diversity in Malaysia, and undertake studies to assess its direct and indirect values, and identify the potential threats to biological diversity loss, and how they may be countered.
2. **Enhance Sustainable Utilisation Of The Components Of Biological Diversity**
   Identify and encourage the optimum use of the components of biological diversity, ensuring fair distribution of benefits to the nation and to local communities.
3. **Develop A Centre Of Excellence In Industrial Research In Tropical Biological Diversity**
   Establish Malaysia as a centre of excellence in industrial research in tropical biological diversity.
4. **Strengthen The Institutional Framework For Biological Diversity Management**
   Establish and reinforce the mechanisms for planning, administration and management of biological diversity.
5. **Strengthen And Integrate Conservation Programmes**
   Increase efforts to strengthen and integrate conservation programmes.
6. **Integrate Biological Diversity Considerations Into Sectoral Planning Strategies**
   Ensure that all major sectoral planning and development activities incorporate considerations of biological diversity management.
7. **Enhance Skill, Capabilities And Competence**
   Produce a pool of trained, informed and committed manpower in the field of biological diversity.
8. **Encourage Private Sector Participation**
   Promote private sector participation in biological diversity conservation, exploration and sustainable utilisation.
9. **Review Legislation To Reflect Biological Diversity Needs**
   Review and update existing legislation to reflect biological diversity needs and introduce new legislation where appropriate.
10. **Minimise Impacts Of Human Activities On Biological Diversity**
    Take mitigating measures to reduce the adverse effects of human activities on biological diversity.
11. **Develop Policies, Regulations, Laws And Capacity Building On Biosafety**
    Introduce measures for the incorporation of biosafety principles and concerns, especially in relation to genetic engineering, and the importation, creation and release of genetically modified organisms.
12. **Enhance Institutional And Public Awareness**
    Promote and encourage the understanding and participation of the public and institutions for the effective conservation and protection of biological diversity.
13. **Promote International Cooperation And Collaboration**
    Promote international cooperation and collaboration in order to enhance national efforts in biological diversity conservation and management.
14. **Exchange Of Information**
    Promote and encourage the exchange of information on biological diversity at local and international levels.
15. **Establish Funding Mechanisms**
    Identify and establish appropriate funding mechanisms for biological diversity conservation and management.

However, with the absence of a clear action plan with time lines and objectives means that much of the policy is left to individual agencies to undertake to suit their own agencies' internal policies. It is also interesting to note that while this is a Policy document, there is no one legislative instrument that can support its implementation.

National Forestry Policy (NFP), 1978 (Revised 1993)

The need for biodiversity conservation is clearly highlighted in the NFP. Some of the more relevant points of the NFP are as follows:

- To dedicate Permanent Forest Estates (PFEs) to ensure sound climatic and physical condition of the country (Protective Forests);
- To ensure a sustainable supply of all forest produce (Productive Forests) and for recreation, education and research (Amenity Forests);
- To manage PFEs with a view of maximising social, economic and environmental benefits;
- To pursue a sound program of forest development through regeneration and rehabilitation;
- To ensure thorough and efficient utilisation of siting and utilisation of all forms of forest produce; and
- To undertake and support a comprehensive programme of forestry training.

National Environment Policy, 2002

The National Environment Policy (NEP) is the guiding policy framework for the Department of Environment (DoE) under the Ministry of Natural Resources and Environment. The NEO aims at continued economic, social, and cultural progress of Malaysia and enhancement of the quality of life of its people through environmentally sound and sustainable development. The policy statement sets out the principles and strategies necessary to ensure that the environment remains productive, both ecologically and economically.

The NEP is based on eight principles that are hoped to harmonise economic development goals with environmental concerns:

i. Stewardship of the Environment
ii. Conservation of Nature's Vitality and Diversity
iii. Continuous Improvement in the Quality of the Environment
iv. Sustainable Use of Natural Resources
v. Integrated Decision-Making
vi. Role of the Private Sector
vii. Commitment and Accountability

These principles are supported by a set of three core objectives:

i. A clean, safe, healthy and productive environment for present and future generations;
ii. Conservation of the country's unique and diverse cultural and natural heritage with effective participation by all sectors of society; and
iii. Sustainable lifestyles and patterns of consumption and production.

The Federal and state economic planning units plays a central role in policy planning and implementation through the provision of important links between Federal, State and local levels.

National Agro-Food Policy (2011-2020)

The National Agro-Food Policy (2011 – 2020) was launched in January 2012 to replace the Third National Agriculture Policy (NAP3) and is focused on safeguarding national food supply including capture fisheries and aquaculture. However, marine biodiversity conservation is not clearly stated but is implied in provisions for resource sustainability. Similar to the NAP3, the overriding objective of the Policy is to maximise income through optimal utilisation of resources. This includes the maximisation of the agriculture's sector to the national income and export earnings as well as maximising income of producers. Specifically, the objectives of the Policy are similar to NAP3:

- to enhance food security;
- to increase productivity and competitiveness of the sector;
- to improve linkages with other sectors;

- to create new sources of growth for the sector; and
- to conserve and utilise natural resources on a sustainable basis.

National Policy on Climate Change, 2009

The National Policy on Climate Change aims to ensure climate-resilient development that fulfils national aspirations for sustainability. The Policy set out the following objectives:

- Mainstreaming measures to address climate change challenges through strengthened economic competitiveness, wise management of resources, environmental conservation and enhanced quality of life of sustainable development;
- Integration or responses into national policies, plans and programmes to strengthen the resilience of development from arising and potential impacts of climate change; and
- Strengthening of institutional and implementation capacity to harness opportunities in reducing the negative impacts of climate change.

One of the Policy's principles is on the *"Sustainability on Environment and Natural Resources",* which emphasises on the adoption of balanced adaptation and mitigation measures to climate-proof development; and the strengthening of environmental conservation and promotion of sustainable use of natural resources.

Some of the key actions emphasise on the integration of balanced adaptation and mitigation measures into policies and plans related to the environment and natural resources, and the development and implementation of plans for public-private collaboration. Importance is also given to the conservation and enrichment of carbon pools in natural ecosystems; and the rehabilitation of degraded ecosystems through appropriate management practices. Therefore, there is a need to identify and recognize the value of ecosystem services to be integrated into development planning process; and to develop a national approach on reducing emissions from avoided deforestation. National carbon accounting systems and baseline studies for forest ecosystems also are required to be established together with multiple national climate and hydro climate projection models to identify potential impacts of climate change.

National Ecotourism Plan (NEP), 1997

The National Ecotourism Plan (NEP) aims to assist the Government of Malaysia in the development of Malaysia's ecotourism potential. The plan is intended to serve both as an instrument within the overall sustainable development of Malaysia and the economy as a whole; and as an effective tool for conservation of the natural and cultural heritage of the country (PR, 2011).

The NEP lists 37 issues, which are then addressed by 21 Action Plans. The Action Plans revolve around three main criteria, which are:

- Implementation of the National Ecotourism Plan;
- Site Planning and Management; and
- Institutional Strengthening and Capacity Building.

Most of the issues highlighted in the NEP relate to conservation and management of natural resources of tourism interest. This includes natural resources from the ocean such as corals reefs and beaches. The NEP strongly emphasizes on the needs for sustainable form of ecotourism and lists measures and guidelines to accomplish its goals. The NEP also lists guidelines for all players in the ecotourism field to be used in the planning stages of an ecotourism activity as well as in daily operational basis for the purpose of management and conservation.

National Physical Plan, 2006

The National Physical Plan is a plan aimed at the provision of a guideline for physical planning and development applicable throughout Peninsular Malaysia. The NPP includes conservation natural resources and the environment as a major element in the national physical development.

- Environment Sensitive Areas (ESA) shall be integrated in the planning and management of land use and natural resources to ensure sustainable development.
- A central Forest Spine (CFS) shall be established to form the backbone of the Environmentally Sensitive Area network.
- Sensitive coastal ecosystem shall be protected and used in a sustainable manner.
- Land development in highlands shall be strictly controlled to safeguard human safety and environment quality.
- All surface and ground water resources are strategic assets to be safeguarded and use optimally.

There are eight themes under the National Physical Plan:

i. Shaping national spatial framework
ii. Improvement of national economic competitiveness
iii. Modernization of agricultural sector
iv. Strengthen of tourism development
v. Management of human settlement
vi. Conservation of wildlife and natural resources
vii. Integration of all national transportation network
viii. Installation of appropriate infrastructure

Sabah State Policies

Sabah Forestry Policy, 2005

The Sabah Forestry Policy (SFP) was formulated to achieve sustainable management and usage of Sabah forest resources. The strategies that have been adopted in 2005 cater for the needs of all stakeholders in the State. The strategies of SFP are:

- To declare sufficient land that is strategically located throughout Sabah as Permanent Forest Reserves in accordance with the concept of rational land use to ensure:
- Sound climatic and physical conditions of the State, maintenance of watershed, soil fertility and environmental quality, conservation of nature and biodiversity, and minimal flood damage and soil erosion; such forest areas are classified as PROTECTION FORESTS.
- Perpetual supply of forest products for subsistence and industrial uses; such forest areas are classified as PRODUCTION FORESTS.
- Conservation of adequate forest areas for recreation, education and research; such forest areas are classified as AMENITY FORESTS.
- To manage the Permanent Forest Reserves so as to maximise social, economic and environmental benefits for the State and its people in accordance with the principles of sustainable forest management.
- To pursue forest development programmes through forest conservation and rehabilitation operations in accordance with approved silvicultural practices to optimise productivity of the Permanent Forest Reserves.
- To ensure proper utilisation of forest resources from land that is not classified as Permanent Forest Reserves through careful planning and in co-operation with land development agencies before the said land is alienated in order to maximise the returns for the people by means of suitable harvesting and processing methods.
- To promote efficient harvesting and utilisation of all types of forests and to stimulate the development of appropriate forest-based industries so as to maximise resource utilisation,

create employment opportunities and generate foreign exchange earnings.

- To encourage the development of trade in forest products.
- To encourage Bumiputera participation in forest and wood-based industries.
- To undertake and support intensive research programmes in forestry development aimed at achieving optimum yield and returns from harvesting and utilisation of the Permanent Forest Reserves as well as maximising the return of investment from forestry development activities.
- To undertake and support comprehensive training programmes in forestry at all levels to provide adequate trained personnel to meet the needs of the forestry sector.
- To encourage private sector participation at all levels of forestry research and training with a view to enhancing professionalism in forestry and forest industries.
- To foster better understanding among the general public of the multiple values of the forest through education and public awareness programmes.
- To utilise information and communication technology for the efficient management of the State's forest resources.
- To foster close relationship and co-operation at the international level to enhance forest development and management of the State's forest resources.

Although the SFP does not directly mention the management and conservation of mangroves, it does in fact emphasize the sustainable management of forest reserves for the maintenance of watershed, soil fertility and environmental quality, conservation of nature and biodiversity, and minimal flood damage and soil erosion; which would most certainly include the mangrove forests (PR, 2011).

SABAH AGRICULTURAL POLICY (1999-2010)

The Sabah Agricultural Policy (SAP2) sets the strategic directions for agricultural, livestock and fisheries development and has been formulated to ensure that the state's agricultural development policy is in line with the National Agricultural Policy 3 (NAP3) at the Federal level.

Within the 'Fisheries Development' segment of the Policy, the Sabah State acknowledged that the State is self-sufficient in production of fish and is a net-exporter of fish. In addition, the State has immense potential to increase production especially in deep-sea fishing activities within the EEZ waters and also in brackish water aquaculture. The SAP2 intends to promote and intensify the development of a robust and applying environmentally sound fishery, including aquaculture based on the guiding principles of sustainable utilisation and management of resources to ensure the quality, diversity and availability of fisheries resources.

CAPTURE FISHERIES

The goal for the SAP2 is to maximise production based on maximum sustainable yield. Emphasis is on increasing fish production from deep-sea fishing. Adoption of efficient and resource-friendly marine and fishing technologies are encouraged. In addition, joint ventures between local and foreign private sector is also encouraged under regional groupings such as Brunei Darussalam Indonesia Malaysia the Philippines - East ASEAN Growth Area (BIMP-EAGA) in deep-sea fishing activities. It is important to note that the Policy requires that developments take into consideration the conservation on natural resources and its ecosystem such as mangroves forests and wetlands.

AQUACULTURE

Aquaculture is targeted to contribute to the increase in the production from fisheries sector. *"Production is encouraged through more aquaculture ventures that includes marine, brackish water and freshwater fish ponds, fish cage culture, mariculture, pen* *culture and on- bottom and off-bottom culture, seed and fry production centres as well as ornamental and aquarium fish culture."* Several aquaculture development zones will be identified to undertake the above-mentioned activities. However, noting on the absence of a single legislative instruments to manage the zones, these zones are subject to respective operators' interpretation in operating and managing it and thus is open to potential environmental issues typical in aquaculture industries.

Sabah Environmental Education Policy (SEEP)

Sabah Environmental Education Policy (SEEP) was approved as a State policy in April 2009. This Policy was developed under the Bornean Biodiversity and Ecosystems Conservation (BBEC) Programme, which is a joint technical cooperation between the Sabah State Government, the Malaysian Federal Government and Japan International Cooperation Agency (JICA). Its mission is to "*To facilitate the effective implementation of education, public awareness and training programs for the environmental conservation and sustainable development in order for Sabah's people to enhance, change and guide their knowledge, skills, attitudes and behaviours".* Although, again this is a Policy document without supporting legislative instrument, it is a good start and indicate that the State Government of Sabah understand the value and importance of environmental education as an important element in its effort to protect, conserve and manage its diverse environmental resources which most States tend to remain silent on.

Other State Policies

Generally speaking, states policy takes its cue from corresponding Federal policies. Thus state forestry policies are usually a reflection of the national policy document (PR, 2011). However, to date, only Sarawak has evolved a biodiversity policy. However, that policy tends to focus mainly on the potential economic value of biodiversity, the development of this potential on a sustainable basis and, most consistently, how the benefits of that development should accrue back to the state. Other states do not have individual policies governing biodiversity, though in some cases biodiversity issues have been addressed under other policies. For instance, Selangor's 2010 Policy (to become a developed state by 2010) and the Agenda 21 policy implemented by its local authorities, call for conservation and management of natural resources, though specific policy objectives and strategies for biodiversity conservation and management have not been identified.

Issues in Institutional Arrangements

The institutional environment governing marine biodiversity management and conservation in Malaysia, like any other developing countries faces issues of overlapping jurisdiction or in some cases, no jurisdictional powers at all. At least five (5) departments and three (3) ministries are involved at the Federal Level:

- National Council on Biodiversity and Biotechnology, Ministry of Natural Resources and Environment (NRE)
- Biodiversity Secretariat, NRE
- Department of Forestry, NRE
- Marine Park Department Division, NRE
- Department of Fisheries, Ministry of Agriculture
- Environmental and Natural Resource Economics Division, Economic Planning Unit, Prime Minister's Department

The main institution for marine biodiversity conservation and management is the National Council on Biodiversity and Biotechnology in 2002headed by the Prime Minister. The council comprise of ten cabinet ministers 13 state chief ministers. The council is the highest body in decision making for biodiversity management in Malaysia. The fourth National Biodiversity Biotechnology Council was held on 13 January 2005 and was chaired by the Prime Minister. Amongst the decisions made by the council during the 4th meeting were the creation of National Mangroves Replant Programme, to strengthen in research programme; establishment of Rainforest Tropical Centre at Forest Research Institute of Malaysia, to improve institutional memory in biodiversity management and research and to combat bio piracy.

In addition to the Council, there are other biodiversity related councils that also plays important roles in managing national biodiversity:

- National Forestry Council
- National Land Council
- National Minerals Council
- National Physical Plan; Biodiversity Unit in Town Country Planning Department
- National Maritime Council
- National Strategies and Plans for Agro-biodiversity
- National Tropical Biodiversity Centre (Planned)
- National Bio-safety Board (Planned)
- National Advisory Council for Marine Park and Marine Reserve

In reality, the arrangements for the management and protection of biodiversity and their habitats in Malaysia are complicated and delicate to address without it being sensitive amongst different agencies and Ministries. The core of the problem is the absence of a single institution that may or can act as the driver to address biodiversity conservation and management.

The core of the problem is the absence of a single institution that may or can act as the driver to address biodiversity conservation and management

There are several government agencies involved, and each is governed by its own set of objectives, rules and regulations to cater to specific geographic areas or species. By definition of the relevant laws relating to wildlife and their habitats, nine (9) government agencies are directly or indirectly responsible for the protection of biodiversity species and/or their habitats in the whole of Malaysia. In addition, all 13 states have rights relating to marine biodiversity (PR, 2011).

Only Sarawak and Sabah have asserted their rights through the establishment of several institutions for biodiversity management and conservation. In particular, Sabah has its own Wildlife Department and Sabah Parks Board to oversee marine resource conservation and management.

Federal agencies are largely confined in terms of geographical coverage. The Department of Environment (DOE) largely operates within Peninsular Malaysia. The Department of Forestry coordinates forestry activity only within Peninsular Malaysia (though the individual State Forestry Departments are answerable to their respective State Governments). Nonetheless, forestry management in Sabah and Sarawak, as well as all states in Peninsular Malaysia, still conform to the dictates of the National Forestry Council. Marine Parks Malaysia is similarly confined to the Peninsular and Labuan, while Sabah Parks Board manages marine parks in Sabah (PR, 2011).

The underpinning factor for the minimum coordination efforts between agencies is the lack of understanding of biodiversity among the agencies concerned (PR, 2011). As each agency has its own set of objectives, the nature of the work done is dependent on the said objectives as summarised below:

TABLE 3- 2: AGENCIES RELATED TO MARINE BIODIVERSITY CONSERVATION AND MANAGEMENT

A. Agencies dedicated to marine biodiversity conservation & management as a primary goal	
Federal Level	
Marine Park Department	Only within marine parks
Department of Fisheries, Malaysia	Only for selected cetaceans/elasmobranchs and marine reptiles in Peninsular Malaysia and Sarawak waters
Biodiversity Secretariat, NRE	Coordination and planning. No management.
State Level	
State Biodiversity Centre, Sarawak	Coordination and planning. Issue of permits for biodiversity research and study. Enforcement of laws relating to removal and export of biodiversity materials.
National Parks Section, Sarawak Forestry Corporation	This is under the Forest Corporation, Sarawak. Undertakes biodiversity conservation and management in its entirety.
Sabah State Parks	This is under the Sabah Parks Enactment. Undertakes biodiversity conservation and management in its entirety.
Department of Fisheries, Sabah	Only for selected cetaceans/elasmobranchs and marine reptiles in Sabah waters.

B. Agencies for which biodiversity conservation & management is a subsidiary but supporting goal	
Federal Level	
Marine Park Department	Only within marine parks
Department of Forestry	Relevant to mangroves and coastal forest management. Management and conservation is subordinate and supportive of timber production.
Department of Fisheries, Malaysia	Outside selected cetaceans/elasmobranchs and marine reptiles in Peninsular Malaysia and Sarawak waters, conservation efforts are supportive of fisheries production.
State Level	
Department of Fisheries, Sabah	Outside selected cetaceans/elasmobranchs and marine reptiles in Sabah waters, conservation efforts are supportive of fisheries production.

source: PR, 2011

The Sabah Model

A model here would be to look at Sabah, which have institutions that have effectively separated custodial and management/developmental functions where biodiversity is concerned (PR, 2011). Sabah Parks performs the custodial function, covering the conservation and management of national parks. Sabah Parks jurisdiction covers both marine and terrestrial parks. The Sabah Forest Department is responsible for forest management. It is empowered to ensure sustainable forest management and exploitation and the development of the forest industry.

The Sabah Department of Wildlife is in charge of wildlife beyond the park parameters. Though sometimes there are overlapping issues between Sabah Wildlife and Sabah Parks, these organisations stand on equal footing with the Forestry Department in dealing with the timber industry and their interests.

Nationwide, State Governments should consider an overall agency that can be given the mandate to support and assist states in setting arrangements, standards and protocols for their marine biodiversity and marine coastal management and protection. Such an Agency would serve as the primary implementing agency for biodiversity conservation, providing technical support and advice to State Parks as well as other agencies on the issue (PR, 2011).

Challenges and Gaps in Implementing Ocean-Use Laws and Policies

Laws

The challenges to implement legal rules to protect, manage and conserve marine resources are not unique to Malaysia. It resonates throughout many countries especially in the developing countries. However, complications that arise in Malaysia are mainly due to the absence of a single body of government that holds the sole responsibility for the management of the coastal and marine realm. Experience elsewhere suggests that cooperation and coordination between community, industry and the relevant government bodies is the key to seek real improvements in the coastal and ocean resources management. Such approach has been utilised by the Malaysian government in many related issues, thus should be continued and viewed as the best tool to seek for solutions in issues such that it includes the views and recommendations by all stakeholders.

The challenges discussed below represent a discussion on some of the challenges posed in selected critical issues and are extracts from a project report commissioned by the National Oceanography Directorate under the Ministry of Science, Technology and Innovation (MOSTI) for the development of the Malaysia Ocean Policy.

Biodiversity

The Environmental Quality Act (EQA) that is enforced by the Department of Environment (DOE) seems to be the Act that is responsible for the management of terrestrial and marine biodiversity. This responsibility includes reporting and managing the marine ecosystem biodiversity of, for example, coral reef, seagrass beds, tidal mud flats within the coastal zone system. Often, related government agencies provide little cooperation and thus minimum coordination efforts in their activities to ensure sustainable management of marine biological diversity.

Dumping of dredged materials

One similar critical issue in many coastal reports is indiscriminate and uncontrolled dumping of dredged materials. This is predominant in Malaysian ports where it experiences frequent siltation and sand accretion problems. The channels and approaches to the ports are thus often dredged to ensure that the ports have adequate depths for navigation and berthing of vessels.

Dredged material is almost always taken to sea and dumped. Dredged spoil from ports may be polluted, especially by hydrocarbons and heavy metals. Most ships are still using tributyltin (TBT) anti-fouling paint and this substance is known to leach into the environment while ships are in ports. This may increase the possibility for delicate ecosystems near the ports to be polluted and destroy it.

The Merchant Shipping Ordinance (MSO), 1952 does not cater to the dumping of dredged materials at sea and excludes dumping from the provisions governing discharge from vessels at sea. However, the EQA 1974 prohibits the discharge of polluting substances but point sources (only). However, in Malaysia, dredged spoil is generally considered to consist of naturally occurring materials; therefore difficult to categorise as either a harmful or polluting substance under Malaysian law. In the absence of any sediment analysis required under law to identify the presence of heavy metals or other pollutants, dumping of dredged materials at sea will continue with minimal regard for the protection of the marine environment and its consequences to human health (DFR, 2010).

In addition, upon examination of the statutory powers of the Ports Authority suggests that the environmental aspect of dumping of dredged materials is not addressed.

Moreover, zoning schemes under the Department of Town and Country Planning (Structure Plan) and the Local Authorities (Local Plan) do not extend beyond the low-water line, therefore do not provide guidance on the location for dumping of dredge materials (DFR, 2010).

Marine Water Quality Standard

Water quality monitoring for Peninsular Malaysia started in 1978; for Sabah and Sarawak in 1985; and the coastal waters of selected islands in 1999. Up until 2010, the Interim Marine Water Quality Standard (IMWQS) that addresses nine parameters; i.e. *Escherichia coli (E.coli);* oil and grease; total suspended solids; arsenic cadmium; chromium (total); copper; lead and mercury[5]. The criticism for the IMWQS was that it is a single-value standard for a set of parameters and does not vary in consideration of the beneficial; uses or ecosystem type of the marine waters in question.

A total of 1,070 samples from 231 monitoring stations were analysed in 2008. The main contaminants of the coastal waters of all States that exceeded the *Interim Marine Water Quality Standard* (IMWQS) were total suspended solids (63.5%), *Escherichia coli* (55.1%) and oil and grease (47.9%). However, there is no analysis given to the extent that parameters exceeded standards or the potential significance of such excess for different pollutants.

Encouragingly, in November 2010, the Department of Environment (DOE) published the new Malaysian Marine Water Quality Criteria and Standard that takes into consideration the uses and ecosystem type in marine waters. It now have segregated the parameters in terms of the beneficial uses in marine and coastal waters into four classes – (i) Class 1: Preservation, Marine Protected Areas, and Marine Parks; (ii) Class 2: Marine life, fisheries, coral reefs, recreational and mariculture; (iii) Class 3: Ports, oil and gas fields; (iv) Class E: Mangroves, estuarine and river-mouth water. Table 3-3 below illustrates the various parameters and its acceptable value in accordance to the classes. The publication of data based on the new criteria and standard is yet to be published.

[5] Heavy metals are monitored but do not necessarily point to particular source / sources of pollution.

Although States enjoy jurisdiction out to three nautical miles seaward from the low-water line, spatial zonation planning does not extend into the marine area, and marine water quality objectives are not taken into consideration at the planning stage. Consequently, there is no linkage between land-based activities and nearby water quality. Although the DOE publishes the marine water quality data annually, there is no administrative or legislative consequence in the event that the set parameters have been exceeded (DFR ,2010).

Marine Park Area Management

Marine parks management comes under the purview of the *Fisheries Act,* Part IX Marine Parks and Marine Reserves. The Act provides for the Minister (defined as the Federal Minister who is for the time being responsible for fisheries) to order for the establishment of an area called 'marine park' and activities within the prescribed two-nautical mile band of marine parks. However, the Act did not define 'Marine Park' but provides for the establishment of it for a range of purpose including special protection for aquatic flora and fauna within the designated area (DFR, 2010). This protection includes protecting, preserving and managing the natural breeding ground and habitat of aquatic life. The establishment of a marine park may also be to regulate recreational and other activities in such area to avoid irreversible damage to its environment.

The latest 10th Malaysian Plan (2011-2012) has acknowledged the importance of good sustainable practices for marine park area management in that the Marine Park Management Plan for Peninsular Malaysia and existing legislation will be reviewed to further enhance the management of marine biodiversity (10MP, 2011).

Over the years, the minimum coordination and cooperation between local-State-Federal government agencies over the management of marine park areas (MPAs) have led to the impression that marine parks are only of federal concern, especially in Peninsular Malaysia (DFR, 2010). Sabah has been on the forefront of marine park area management in which it has promulgated the Parks Enactment in 1984 to gazette areas as 'Marine Parks'.

Latest development has indicated due to constitutional issues, the new Marine Park Act will be embedded within the existing Fisheries Act.

Marine Enforcement in Malaysia

The 2004 Malaysian Maritime Enforcement Agency (MMEA) Act was a positive move towards an integrated enforcement of coastal marine laws. The Act underpins a new enforcement agency that takes over roles and functions that were previously done by several sectorally focussed agencies. Following the establishment of the MMEA Act, an "administrative decision" was made that the existing enforcement agencies would transfer their operational assets to the Agency. However, no amendment was made to any of the enabling legislation for the other enforcement agencies, which thus retain a legal requirement and mandate to conduct enforcement operations (DFR, 2010).

TABLE 3- 3: MALAYSIA MARINE WATER QUALITY CRITERIA AND STANDARD

Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
BENEFICAL USES	Preservation, Marine Protected areas, Marine Parks	Marine Life, Fisheries, Coral Reefs, Recreational and Mariculture	Ports, Oil & Gas Fields	Mangroves Estuarine & River-mouth Water
Temperature (°C)	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient
Dissolved oxygen (mg/L)	>80% saturation	5	3	4
Total suspended solid (mg/L)	25 mg/L or ≤ 10% increase in seasonal average, whichever is lower	50mg/L (25 mg/L) or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 30 % increase in seasonal average, whichever is lower
Oil and grease (mg/L)	0.01	0.14	5	0.14
Mercury* (µg/L)	0.04	0.16 (0.04)	50	0.5
Cadmium (µg/L)	0.5	2 (3)	10	2
Chromium (VI) (µg/L)	5	10	48	10
Copper (µg/L)	1.3	2.9	10	2.9
Arsenic (III)* (µg/L)	3	20(3)	50	20 (3)
Lead (µg/L)	4.4	8.5	50	8.5
Zinc (µg/L)	15	50	100	50
Cyanide (µg/L)	2	7	20	7
Ammonia (unionized) (µg/L)	35	70	320	70
Nitrite (NO2) (µg/L)	10	55	1,000	55
Nitrate (NO3) (µg/L)	10	60	1,000	60
Phosphate (µg/L)	5	75	670	75
Phenol (µg/L)	1	10	100	10
Tributyltin (TBT) (µg/L)	0.001	0.01	0.05	0.01
Faecal coliform (Human health protection for seafood consumption) - most Probable Number (MPN)	70 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)	200 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)
Polycyclic Aromatic Hydrocarbon (PAHs) ng/g	100	200	1000	1000

**MWQS in parentheses are for coastal and marine water areas where seafood for human consumption is applicable.*

Policies

Policies such as the National Forestry Policy, National Environment Policy and the National Agrofood Policy bind many management agencies. Its management and enforcement agencies have their own set of objectives and often are not complementary in nature with other Ministries' objectives.

Similar to the 'Law' discussion above, the challenges discussed below represent a discussion on some of the challenges posed in selected policies and are extracts from a project report for the development of the Malaysia Ocean Policy. Some of the challenges discussed below are shared by implementing agencies in other policies not mentioned here.

National Environment Policy (NEP)

The mandate of the Department of Environment (DOE) in the policy itself has never been directly in biodiversity management and conservation, being concerned more with pollution management and abatement. However, the issue of biodiversity management and conservation, has been given emphasis where the issue of Environment Impact Assessments (EIAs) are concerned. The DoE has the statutory authority to request EIAs and insists that biodiversity considerations be taken into account in the evaluation of any project. The DoE does not manage the discharge of aquaculture activities, and has limited capacity to manage activities at sea that might impact on the marine environment.

National Agro-food Policy (2011-2020)

The National Agro-Food Policy is meant to replace the Third National Agricultural Policy (NAP3) calls for the establishment of marine parks and marine reserves to protect natural marine ecosystems. However, the Policy does not directly call for biodiversity conservation as a whole. The issue of marine protected areas comes as a management measure for sustaining fisheries resources, not conservation of marine biodiversity in its own right. None of the others are concerned with biodiversity conservation per se. For that matter, the strategy itself is implied under provisions relevant to resource sustainability clearly identifying the overall objectives to increase production of fisheries to generate more income.

The National Biodiversity Policy (NBP)

Many have lauded the development of the NBP policy document, however it does not articulate a clear action plan by which its goals are to be achieved. The absence of an action plan, with time lines and objectives means that much of the policy is left to individual agencies to internalise and undertake at their own pace and in tandem with their own internal policies, if any. It is important to note as of to date, there is no one legislative instrument that can support the NBP implementation.

The NBP addresses the issue of loss of biodiversity caused by development plans that relegate conservation to a low priority status. The Policy regards some existing conservation efforts as inadequate based on factors such as:

Several important habitats are under-represented

Wetlands, such as mangrove forests, peat swamps and freshwater swamps that play important roles in providing resting places for migratory birds and breeding grounds for fisheries; and in regulating the hydrological regime, are not adequately protected.

Conservation efforts of individual species are targeted towards large animals, and to some extent birds.

There is little emphasis on the conservation of individual species of plants, insects or fish (marine and freshwater). This is due mainly to a lack of adequate knowledge.

The establishment of marine parks in Peninsular Malaysia focuses on aquatic considerations.

There is a need for additional attention to be accorded to the adjoining terrestrial components, as these too, if disturbed, will have negative impacts on the marine ecosystem.

Lack of regional and international cooperation

Common marine and terrestrial biological resources (e.g. in transboundary areas) lack adequate regional and international cooperation in their conservation and management efforts.

The NBP also acknowledges gaps in Malaysia's legislative framework with regard to biodiversity management and conservation. Among the gaps discussed are:

- *Absence of a single comprehensive legislation in Malaysia that addresses biological diversity conservation and management as a whole.*

  Most legislation is sector-based, e.g., the Fisheries Act 1985 deals mainly with the conservation and management of fisheries resources; the Protection of Wild Life Act 1972 deals with the protection of wildlife; and the National Forestry Act 1984 concerns the management and utilisation of forests alone. Some were legislated without specific consideration given to the issue of conservation and management of biological diversity as a whole. Legislation is also generally inadequate in that species endangered due to habitat destruction are not protected by way of a national law for endangered species.

- *Dispersed authority to legislate matters relevant to biological diversity*

  The most distinct shortfall of the legislative framework relating to biological diversity is that under the Federal Constitution, the authority to legislate for matters relevant to biological diversity does not fall under one single authority. Although some responsibilities in respect of issues related to the conservation and management of biological diversity are shared between Federal and State authorities, others fall under the responsibility of one authority alone, be it the Federal or State authority. These areas of responsibility are specified in the Federal Constitution, under the Federal, Concurrent and State List of the Ninth Schedule. Furthermore, in respect of Sabah and Sarawak, the Concurrent and State Lists are modified.

- *Absence of uniformity in laws*

  Some laws are Federal legislation and some are State enactments; thus, not all legislation enacted applies to all states in Malaysia. Since this is a constitutional position, the question of how uniformity across various relevant laws may be promoted, particularly with respect to matters that fall under State jurisdiction alone, needs to be addressed.

The Policy notes that, due to the limited scope of various enactments in relation to the conservation of biological diversity, and an absence of integration across various sectors, there is a lack of comprehensive coverage for biological diversity issues. Moreover, the areas of jurisdiction of Federal and State Governments as defined in the Constitution lead to non-uniform implementation between States.

INTERNATIONAL OBLIGATIONS & PARTICIPATIONS

Malaysia became directly involved in its pursuit of national interests at the international level in aspects of expansion of maritime jurisdiction for the purposes of security and self-preservation; resource exploration and exploitation; and political well-being since its Independence. Malaysia's involvement in international negotiations concerning law of the sea - beginning from participation in the First United Nations Conference on the Law of the Sea (UNCLOS I) from February 24 – April 29, 1958; the Second United Nations Conference on the Law of the Sea (UNCLOS II) from March 17 – April 26, 1960; to the Third United Nations Conference on the Law of the Sea (UNCLOS III) from 1973 to 1982 - saw the promulgation of several fundamental laws establishing Malaysia's maritime estate extending seawards to 200 nautical miles - drawn particularly upon perceived needs of a young developing nation (DFR, 2010). Thus, during the period leading to Malaysia's ratification of the Law of the Sea Convention (LOSC) in 1996, many sectorally-written national laws of the sea were established. These included inter alia measures to declare and delimit parts of Malaysia's territorial sea up to 12 nautical miles under the Emergency (Essential Powers) Ordinance, 1969; the declaration of Malaysia's Exclusive Economic Zone (EEZ) of 200 nautical miles vide the Exclusive Economic Zone Act, 1984; and proclamation of the legislation pertaining to conservation, management and development of maritime & estuarine fishing and fisheries provided for in the Fisheries Act, 1985 (DFR, 2010).

Of particular importance was the intent underlying Malaysia's proclamation of the EEZ on 25 April 1980 by the then Prime Minister, Dato' Hussein Onn. Malaysia's interests are highlighted in the excerpts of the proclamation presented below:

> *"AND WHEREAS a number of States have taken action in pursuance of the existing law and practice and have made declaration in regard to their exclusive economic zones; NOW THEREFORE WE, Sultan Haji Ahmad Shah Al-Musta'in Billah Ibni Al-Marhum Sultan Abu Bakar Yang di-Pertuan Agong of the States and territories of Malaysia, hereby declare and proclaim that the Federation of Malaysia shall have –*
>
> *a. sovereign rights for the purpose of exploring, exploiting, conserving and managing the natural resources, whether living or non-living, of the sea-bed and subsoil and the superadjacent waters, and with regard to other activities for the economic zone, such as the production of energy from the water, currents and winds;*
>
> *b. jurisdiction with regard to –*
>
> *i. the establishment and use of artificial islands, installations and structures;*
>
> *ii. marine scientific research;*
>
> *iii. the preservation of the marine environment in the exclusive economic zone which is hereby established and that such exclusive economic zone extends to 200 nautical miles from the baseline which the breadth of the territorial sea is measured."*

Following the EEZ Proclamation, the then Acting Minister of Law, Tan Sri Datuk Haji Abdul Kadir bin Yusof, on 28 April 1980, made an announcement asserting Malaysia's rights and responsibilities in the newly proclaimed EEZ. The Minister affirmed that–

> *[T]he proclamation over our EEZ is consistent with current State practice…We will enjoy exclusive rights over fishery resources of the zone…I would like to state here that the proclamation is only in respect of living resources, marine scientific research and preservation of the marine environment.*

In a separate statement reported by *Bernama* on 22 May 1980, the Minister stated that the proclamation of the EEZ would allow Malaysia to venture into deep-sea fishing in deeper waters, which had previously been explored by foreign fishermen. He recognised the interests of foreign fishing vessel from Thailand and South Korea in our EEZ area and encouraged joint ventures with Malaysian fishermen or government agencies - which would require approval and support of the respective Governments - to exploit the abundant fisheries resources in the Malaysian EEZ.

Further to this, the Minister announced that "*a Bill would be introduced in Parliament to confer enforcement powers on the various agencies and to provide penalties for the infringement of our rights*." In 1984, the *Exclusive Economic Zone, Act* [ACT 311] was passed and came into force on 1 May 1985. The ratification of the LOSC augments the Malaysian proclamation of the EEZ. Malaysia can now legitimately exercise sovereign rights over a vast sea area for resource exploration and exploitation *inter alia*, which is delicately balanced with responsibilities to protect and preserve the surrounding marine environment (DFR, 2010).

MALAYSIA'S RATIFICATION OF THE 1982 UN LAW OF THE SEA CONVENTION

On 2 October 1996 the Minister of Foreign Affairs of Malaysia, Dato' Seri Abdullah bin Haji Ahmad Badawi signed on behalf of the Government of Malaysia, the instrument of ratification to the *1982 United Nations Convention on the Law of the Sea*. The instrument of ratification was deposited with the Secretary-General of the United Nations on 14 October 1996 - as required by LOSC, Article 306.

The ratification of the LOSC by Malaysia was significant in marking the end of a long decision-making process on when if at all, Malaysia would ratify the LOSC which it had signed along with 118 other States in Montego Bay on 10 December 1982 (DFR, 2010). While some parts of the LOSC were emerging as customary law, Malaysia begun to adopt practices deemed beneficial to Malaysia: the most significant was the declaration of an exclusive economic zone (EEZ).

This was followed by the enactment of the *1985 Fisheries Act* [ACT 317] that declared the zone of Malaysian Fisheries Waters (MFW) of 200 nautical miles in which some concepts introduced by LOSC albeit briefly, such as conservation and management principles and optimum utilisation were included (DFR, 2010).

Although Malaysia had not yet then ratified the LOSC, the adoption of an EEZ (and MFW) was consistent with the practices of many developing countries, which favoured the EEZ regime. The regime empowered coastal States with sovereign rights over resources in adjacent maritime areas of up to 200 nautical miles measured from the territorial sea baselines.

At UNCLOS III, Malaysia was a member of Group 77 that fought for coastal State sovereignty and sovereign rights over an expanded area of maritime zones whilst challenging the concept of *mare liberum* (DFR, 2010). As a State almost surrounded by the seas, Malaysia is highly dependent on the seas for economic, resource exploitation, trade, communication and security.

Malaysia is endowed with an abundance of marine living and non-living resources. To date, all of Malaysia's hydrocarbon deposits are found offshore, and 80% of Malaysians depend on fish as a source of daily protein. Additionally, almost 95% of Malaysia's trade is seaborne. Therefore, Malaysia's proclamation of the EEZ followed by the ratification of the LOSC reinforced Malaysia's pursuit to develop its management of surrounding seas and resources (DFR, 2010).

OTHER RELEVANT CONVENTIONS / TREATIES

In recent years, Malaysia has demonstrated further commitment toward enhancing understanding and management of national ocean affairs by active engagement at United Nations Meetings of States Parties to the 1982 United Nations Convention on the Law of the Sea (SPLOS); Commission on the Limits of the Continental Shelf (CLCS) - including successful lobbying for the election of a Malaysian as a member of the Commission; International Maritime Organisation (IMO) committee meetings - including the appointment of a Maritime Attaché to the IMO; Conference of Parties (COP) to the Convention on Biological Diversity (CBD); and many other marine-related international fora.

Table 3-4 below reflects the various relevant international conventions and treaties that Malaysia is a party to and thus is responsible to ensure that the objectives of the various conventions / treaties are met.

TABLE 3- 4: RELEVANT INTERNATIONAL CONVENTIONS AND TREATIES SIGNED BY MALAYSIA

CONVENTIONS / TREATIES	DESCRIPTION / OBJECTIVES	CONVENTION DATE OF ENTRY INTO FORCE	MALAYSIA'S STATUS: ENTRY INTO FORCE; ACCESSION (A)
CITES: CONVENTION ON THE INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FLORA AND FAUNA, 1975	Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Roughly 5,000 species of animals and 29,000 species of plants are protected by CITES against over-exploitation through international trade	1 July 1975	18 Jan 1978
CBD: CONVENTION ON BIOLOGICAL DIVERSITY, 1992	CBD objectives are to achieve conservation of biological diversity; The sustainable use of the components of biological diversity; and The fair and equitable sharing of the benefits arising out of the utilization of genetic resources	29 Dec 1993	24 June 1994
UNFCCC: UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, 1992	The UNFCCC sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. It recognises that the climate system is a shared resource that stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.	21 March 1994	11 Oct 1994
- Kyoto Protocol	The Kyoto Protocol is an international agreement linked to the UNFCCC. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amounts to an average of 5% against 1990 levels over the five-year period 2008-2012.The major	16 Feb 2005	16 Feb 2005

CONVENTIONS / TREATIES	DESCRIPTION / OBJECTIVES	CONVENTION DATE OF ENTRY INTO FORCE	MALAYSIA'S STATUS: ENTRY INTO FORCE; ACCESSION (A)
	distinction between the Protocol and the Convention is that the Convention **encouraged** industrialised countries to stabilize GHG emissions, the Protocol **commits** them to do so. Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "*common but differentiated responsibilities*."		
RAMSAR CONVENTION: CONVENTION ON WETLANDS, 1971	The RAMSAR member states commits themselves to implement the three 'pillars' of the Convention: (i) to designate suitable wetlands for the List of Wetlands of International Importance ("Ramsar List") and ensure their effective management; (ii) to work towards the wise use of all their wetlands through national land-use planning, appropriate policies and legislation, management actions, and public education; and (iii) to cooperate internationally concerning transboundary wetlands, shared wetland systems, shared species, and development projects that may affect wetlands.	21 Dec 1975	10 March 1995
CMS: CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS, 1979 - IOSEA: Indian Ocean South East Asian Marine Turtle MoU	Malaysia is NOT a signatory of CMS, but IS a signatory to the IOSEA Marine Turtle MoU. The IOSEA Marine Turtle MoU is an intergovernmental agreement that aims to protect, conserve, replenish and recover marine turtles and their habitats of the Indian Ocean and South-East Asian region, working in partnership with other relevant actors and organisations.	1 Sept 2001	1 Dec 2011 (Effective Date of MoU)
BASEL CONVENTION: CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENTS OF HAZARDOUS WASTES AND THEIR DISPOSAL, 1989	The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as 'hazardous wastes' based on their origin and/or composition and their characteristics, as well as two types of wastes defined as 'other wastes' – household waste and incinerator ash.	5 May 1992	08 Oct 1993 (a)

Conventions / Treaties	Description / Objectives	Convention Date of Entry into Force	Malaysia's status: Entry into Force; Accession (a)
INTERNATIONAL MARITIME ORGANISATION (IMO) CONVENTIONS			
MARPOL Convention: International Convention for the Prevention of Pollution from Ships 1973, modified by the Protocol of 1978 relating thereto (MARPOL 73/78)	The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. special Areas with strict controls on operational discharges are included in most Annexes: **Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)** Covers prevention of pollution by oil from operational measures as well as from accidental discharges. The 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003. **Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)** Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. Some 250 substances were evaluated and included in the list appended to the Convention. The discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land. More stringent restrictions apply to the Baltic and Black Sea areas.	2 Oct 1983 (Annexe I and II)	1 May 1997
International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001	The Convention was adopted to ensure that adequate, prompt, and effective compensation is available to persons who suffer damage caused by spills of oil, when carried as fuel in ships' bunkers.	2 Nov 2008	12 Feb 2009 (a)

Conventions / Treaties	Description / Objectives	Convention Date of Entry into Force	Malaysia's status: Entry into Force; Accession (a)
AFS2001: International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001	The Convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti fouling systems.	17 Sept 2008	27 Sept 2010 (a)
BWM: INTERNATIONAL CONVENTION FOR THE CONTROL AND MANAGEMENT OF SHIPS' BALLAST WATER AND SEDIMENTS	The Convention aims to prevent the potentially devastating effects of the spread of harmful aquatic organisms carried by ships' ballast water from one region to another. The Convention will require all ships to implement a Ballast Water and Sediments Management Plan. All ships will have to carry a Ballast Water Record Book and will be required to carry out ballast water management procedures to a given standard.	Adoption: 13 Feb 2004 Entry into Force: Not yet into force. 12 months after ratification by 30 states, representing 35% of world merchant shipping tonnage As at Feb 2012, no. of contracting parties is at 33 (the combined merchant fleets of which constitute approximately 26.46 % of the gross tonnage of the world's merchant fleet.	27 September 2010 (a) (Date of Deposit of instrument)

Source: respective conventions' websites

Regional Fisheries Bodies (RFOs)

Regional Fishery Bodies (RFOs) are critical vehicles for the promotion of long-term sustainable fisheries where international cooperation is required in conservation and management. Since the 1992 United Nations Conference on Environment and Development (UNCED or 'Earth Summit'), legal instruments have been in place empowering RFB to take on a key role in the facilitation of international cooperation.

Regional Fisheries Management Organisations (RFMOs) especially play a unique role in the facilitation of international cooperation for the conservation and management of fish stocks. These organisations provides a realistic means of governing fish stocks that occur either as straddling or shared stocks between zones of national jurisdiction or between these zones and the high seas, or exclusively on the high seas. It carries conservation and management measures that are binding upon their members.

Currently, Malaysia is a member of three (3) RFBs, namely (i) Asia-Pacific Fishery Commission (APFIC); (ii) Indian Ocean Tuna Commission (IOTC); and (iii) Southeast Asian Fisheries Development Centre (SEAFDEC).

Asia-Pacific Fishery Commission (APFIC)

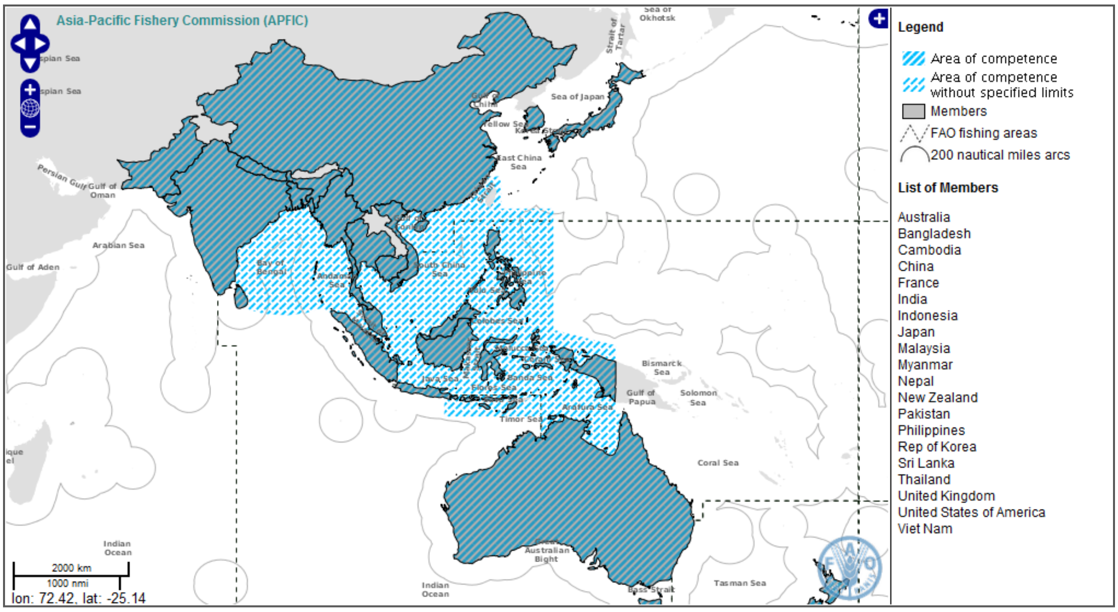
The Asia-Pacific Fishery Commission was established under the APFIC Agreement as the Indo-Pacific Fisheries Council in 1948 by the Food and Agriculture Organization of the United Nations. APFIC is an Article XIV FAO Regional Fishery Body established by FAO at the request of its members. The Secretariat is provided and supported by FAO.

The main objectives of APFIC is to promote full and proper utilisation of living aquatic resources of the Asia-Pacific area in regards to the development and management of fishing and culture operations and also the development of related processing and marketing activities in conformity with the objectives of its members (APFIC, 2010).

Over the period 2007-2012, APFIC will continue:

- to act as a regional consultative forum to raise awareness and discuss difficult and emerging issues in the APFIC region;
- to coordinate regularly with other regional organizations to exchange information on projects, workshops and initiatives;
- to build capacity in responsible fisheries and aquaculture as well as support member countries in addressing the global normative expectations for responsible fisheries as laid out in the Code of Conduct for Responsible Fisheries and other relevant global norms;
- to facilitate the emergence of regional agreements and arrangements.

FIGURE 3- 2: ASIA-PACIFIC FISHERY COMMISSION (APFIC) MAP

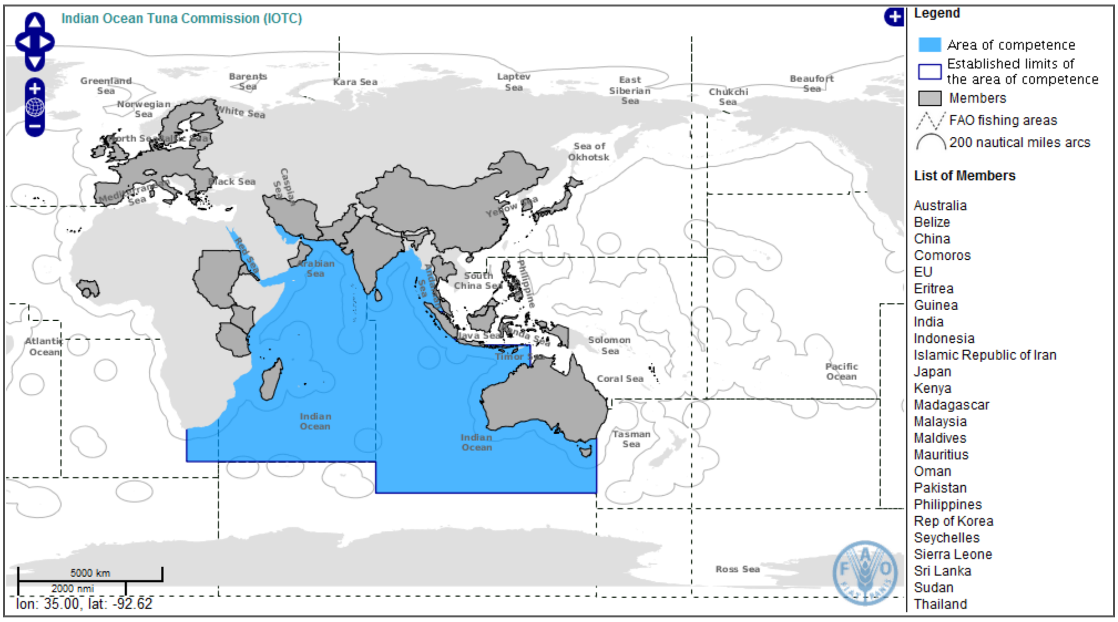


source: http://www.fao.org/figis/geoserver/factsheets/rfbs.html

INDIAN OCEAN TUNA COMMISSION (IOTC)

The Agreement for the Establishment of the Indian Ocean Tuna Commission was concluded under Article XIV of the FAO Constitution. It was approved by the FAO Council in November 1993 and came into force upon accession of the tenth member in March 1996. The IOTC is an intergovernmental organization mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. The Commission's objective is to promote cooperation among its members with a view to ensure, through appropriate management, the conservation and optimum utilisation of stocks covered by this Agreement and to encourage sustainable development of fisheries based on such stocks (IOTC, 2010). Malaysia deposited her instruments of acceptance on 22nd May 1998.

FIGURE 3- 3: INDIAN OCEAN TUNA COMMISSION (IOTC) MAP



source: http://www.fao.org/figis/geoserver/factsheets/rfbs.html

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTRE (SEAFDEC)

The Southeast Asian Fisheries Development Centre (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in Southeast Asia. In April 2009, during its 41st meeting, the SEAFDEC Council adopted a new mandate: "*to develop and manage the fisheries potential of the region by rational utilization of the resources for providing food security and safety for people and alleviating poverty through transfer of new technologies, research and information dissemination activities*" (SEAFDEC, 2010)

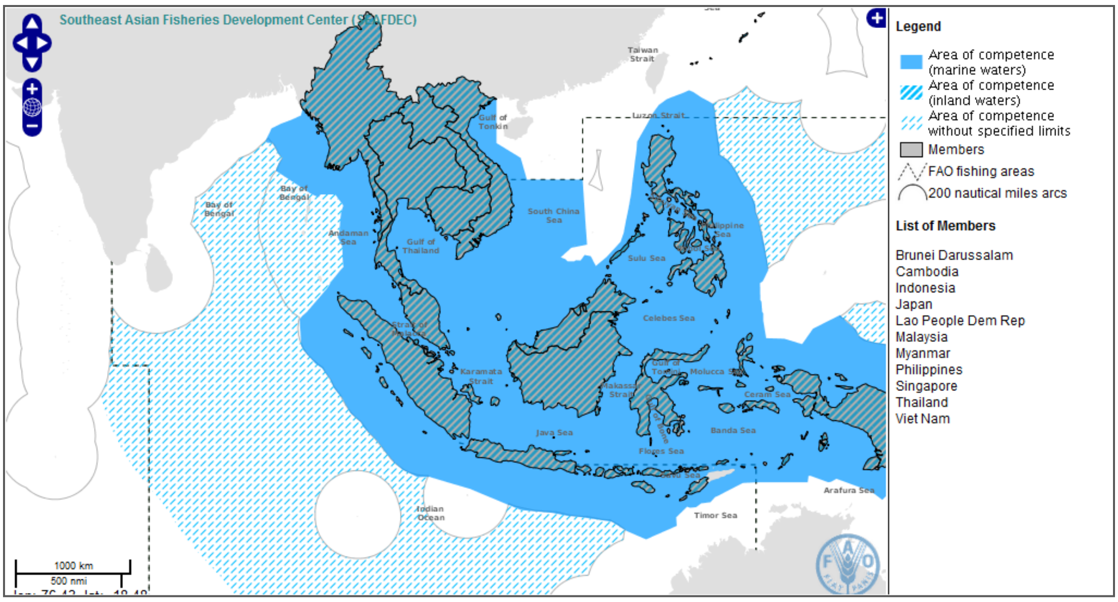
To achieve its mandate, SEAFDEC carries out the following functions:

- Conducts research and development on fishing gear technologies and practices, fishery resources surveys and exploration, fisheries management, post-harvest technology and food safety/quality, and aquaculture development.
- Offers training courses, organizes workshops and seminars to enhance the capacity of member countries in the areas of competence as mentioned above.
- Facilitates the transfer of technology to the countries in the region and provides information materials to the print and non-print media, including the publication of statistical bulletins and reports for the dissemination of survey, research and other data on fisheries and aquaculture.
- Safeguards the priority and interests of the member countries on emerging regional/international issues that may have implications for fishery activities of the region, by monitoring and developing common/coordinated positions among the member countries in response to the issue.

The SEAFDEC has a memorandum of understanding with ASEAN and provides technical advice in fisheries under the ASEAN SEAFDEC Strategic Partnership. The SEAFDEC also has a memorandum of understanding with other organizations, including FAO.

SEAFDEC's area of competence encompasses marine and inland waters of member countries in Southeast Asia and contiguous high sea areas.

FIGURE 3- 4: SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTRE (SEAFDEC) MAP



source: http://www.fao.org/figis/geoserver/factsheets/rfbs.html

Intergovernmental & Regional Cooperation

Putrajaya Declaration of Regional Cooperation for the Sustainable Development of the Seas of East Asia

Date of Adoption: 12 Dec 2003

In December 2003, Ministers from 12 coastal states of the East Asian region[6] have gathered in Putrajaya, Malaysia to discuss policies and actions in an effort to achieve sustainable development of the seas of East Asia. During this time, the Ministers have agreed to formulate a Sustainable Development Strategy for the Seas of East Asia (SDS-SEA).

The SDS-SEA addresses, amongst others, key concerns of the coasts and oceans, providing a platform for cooperation at the regional, sub-regional, national and local levels, and for intergovernmental, interagency and inter-sectoral collaboration on (PEMSEA, 2003):

- The World Summit for Sustainable Development (WSSD) targets for sustainable development;
- Implementation of integrated ocean and coastal management approaches; and
- Action programs aimed at solving problems and deficiencies in ocean and coastal governance.

At the same time, the SDS-SEA facilitates synergistic actions to:

- Enhance maritime safety and protection of the marine environment from pollution and environmental damage caused by ships, including the introduction of invasive alien species, and oil and chemical pollution preparedness and response, through capacity-building, application of the Voluntary International Maritime Organization (IMO) Member States' Audit Scheme, and the implementation of IMO conventions and other agreements, such as the Tokyo Memorandum of Understanding (MOU) on Port State Control;
- Protect the coastal and marine environment from land-based sources of pollution through the implementation of the Global Programme of Action (GPA) and the Montreal Declaration, with special emphasis on municipal wastewater, the physical alteration and destruction of habitats and nutrients through efforts at all levels;
- Significantly reduce the loss of marine biodiversity and maintain the productivity and biodiversity of coastal and marine ecosystems, species and genetic resources through the implementation of the Convention on Biological Diversity and Jakarta Mandate and other existing international conventions and programs of action; and
- Ensure that fish stocks are maintained or restored to levels that can sustainably support present and future generations through the application of the integrated coastal management (ICM) approach, ecosystem management, marine protected area designation and implementation of the Code of Conduct for Responsible Fisheries and other Food and Agriculture Organization (FAO) and Law of the Sea instruments including measures against unsustainable fisheries practices.

The SDS-SEA provides a strategic approach to the development and management of marine and coastal resources in a sustainable manner, with utmost consideration to the different uses, perceptions of value, and priorities that national governments and other stakeholders place on such resources. By employing integrated approaches to more effectively implement international conventions, the SDS-SEA aims to harness resources and strengthen synergies and linkages in capacity building and to mobilise all stakeholders – including government

[6] Countries include Brunei, Malaysia, Cambodia, Philippines, The People's Republic of China, Democratic People's Republic of Korea, Indonesia, Singapore, Japan, Thailand and Vietnam.

agencies, international organizations, donors, financial institutions, the private sector, non-government organizations (NGOs), scientists, academicians, communities and other members of civil society — to discharge their social responsibilities and actively contribute to sustainable development programmes. At the local level, the SDS-SEA provides directions and approaches for the authorities and stakeholders to act on and resolve local environmental and natural resource issues that have national, regional and global significance, to identify and promote opportunities for environmental investments, and to facilitate sustainable financing options (PEMSEA, 2003).

Sulu-Sulawesi Marine Eco-region (SSME)

Signing of Memorandum of Understanding (MoU): February 2004

The Sulu and Celebes Seas comprise the Sulu-Celebes Sea Large Marine Ecosystem (LME), an area of about 900,000 square kilometres of marine resources. The expanse covered by these two seas, also called the Sulu-Sulawesi Marine Ecoregion (SSME), is partially divided by a chain of small islands known as the Sulu Archipelago. A large portion of the LME is located in the midst of three ASEAN nations – Indonesia, Malaysia and the Philippines. The seascape is characterized by a tropical climate, tepid waters, and complex and wide-ranging biophysical characteristics and oceanography that contribute to its exceptionally abundant marine biodiversity (ASEAN, 2010). However, the SSME has to cope with threats of piracy and illegal fishing (e.g. cyanide and blast fishing), which leads to considerable environmental degradation. The over-exploitation of marine resources, population pressure, and pollution further threatens its rich legacy.

The multi-gear and multi-species fisheries of this marine ecoregion provide sustenance and livelihood to some 35 million people. Fishing in the area has been reported to be excessive and destructive, and has resulted to declining catches and reduced economic returns, changes in fish population structures, depleted coral reefs, and heightened threats to rare and endangered species.

Conservation initiatives in the ecoregion have been taken up by the WWF (i.e. the Sulu Sulawesi Marine Ecoregion Conservation Program, launched in 1999) and the Conservation International (i.e., Sulu Sulawesi Seascape Initiative 2005-2010). Both NGOs have strategically mobilized the establishment of marine protected areas, accompanied by law enforcement support in priority conservation areas, otherwise known as marine biodiversity conservation corridors (MBCCs). As a result, networks of MPAs have been established, including the social network of MPAs in the Verde Island Passage Corridor and the network of Marine Turtle Protected Areas in the Sea Turtle Corridor.

In Malaysia, the technical preparation of the Ecoregional Conservation Plan (this Plan is a consolidation of various existing policies, strategies and plans) was done with participation from various implementing agencies, including both Federal and State Departments and Agencies, mostly from Sabah. The final stage for the SSME Programme planning process was the formulation of a Malaysia Stakeholder Conservation Plan in early 2003. By late 2003 this national plan became an integral part of the Ecoregion Stakeholder Conservation.

The signing of the MoU in February, 2004, by all three member States formalised the Ecoregion Stakeholder Conservation Plan and the SSME program and framework for cooperation[7].

[7] Source: http://www.fishdept.sabah.gov.my/ssme.asp

Intergovernmental Oceanographic Commission (IOC)

Malaysia membership since July 1964

The Intergovernmental Oceanographic Commission (IOC) was founded in 1960 by the UNESCO General Assembly and is the United Nations body for ocean science, ocean observatories, ocean data and information exchange, and ocean services such as tsunami warning systems. Its mission are to promote international cooperation and to coordinate programmes in research, services and capacity building to learn more about the nature and resources of the oceans and coastal areas, and to apply this knowledge to improved management, sustainable development and protection of the marine environment and the decision making processes of States (http://ioc-unesco.org).

On a regional level, the IOC coordinates the development of tsunami early warning and mitigation systems in the Pacific, the Indian Ocean, the North-eastern Atlantic and the Mediterranean, and the Caribbean.

The Commission also facilitates inter-agency coordination through the UN-Oceans mechanism and works with the United Nations Environment Programme (UNEP) in establishing a process for global reporting and assessment of the state of the marine environment. Through the Global Ocean Observing System (GOOS)—the ocean component of the Global Climate Observing System (GCOS)—the IOC helps improve operational oceanography, weather and climate forecasts and monitoring and support the sustained observing needs of the UN Framework Convention on Climate Change (UNFCCC) (http://ioc-unesco.org).

Malaysia is a member of the IOC Executive Council.

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APPENDIX 3-1: LIST OF OCEAN-RELATED LAWS AND IMPLEMENTING AGENCIES IN MALAYSIA

Constitution Federal State - List

The *Federal Constitution* is the supreme law of the land. The Federal Constitution[8] provides for the distribution of legislative powers[9], which confers on the Federal Parliament and the State Legislatures authority to legislate laws enumerated in the Ninth Schedule of the Constitution.

The Ninth Schedule divides the 'Legislative Lists' into three parts: List I – Federal List, List II – State List and List III – Concurrent List. Parliament may make laws with respect to any of the matters enumerated in the Federal List or the Concurrent List (List I and List III).[10] The State Legislature, on the other hand, may make laws with respect to matters enumerated in the State List or the Concurrent List (List II and List III)[11], including any matter that is not enumerated in any of the lists in the Ninth Schedule as long as it is not a matter over which Parliament has the power to make laws.[12] In addition to these, the States of Sabah and Sarawak are given additional lists (List IIIA), which is supplemental to the Concurrent List for the States of Sabah and Sarawak.[13]

The legislative lists relevant for coastal and ocean management in Malaysia include –

- List I - Federal List: 1. External affairs including treaties with other countries, participation in international bodies and implementation of decisions taken there at; 2. Defence of the Federation; 3. Internal security; 4. Civil and criminal matters including Admiralty Jurisdiction; 6. The machinery of government; 8. Trade, commerce and industry including imports into, and exports from, the Federation, development of mineral resources, oils and oil fields, regulation of labour and safety in oil fields; 9. Shipping, navigation and fisheries; 10. Communications and transport; 11. Federal works and power; 12. Surveys, inquiries and research including social, economic and scientific surveys, scientific and technical research, commissions of inquiry; 13. Education; 16. Welfare of the aborigines; 20. Control of agricultural pests, protection against such pests, prevention of plant diseases; 25A. Tourism; 27. Antiquities, (for Federal Territory of Labuan) all land matters as enumerated in List II-2, agriculture and forestry local government, federal ports and harbours, regulation of traffic in federal ports or harbours, cadastral land surveys, declared federal libraries, museums, ancient and historical monuments and, records and archaeological sites and remains.

- List II - State List: 2. Land matters including treasure trove; 3. Agriculture and forestry; 4. Local government; 6. State works including public works for State purposes, roads, bridges and ferries, control of silt and riparian rights; 7. Machinery of the state government; 12. Turtles and riverine fishing; 12A. Libraries, museums, ancient and historical monuments and records and archaeological sites and remains.

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[8] Article 4(1) of the Federal Constitution provides that the Constitution is the supreme law of the Federation and any law passed after Independence Day, which is inconsistent with the Constitution, shall, to the extent of the inconsistency, be void.
[9] See, Article 73, Federal Constitution.
[10] Article 74(1), Federal Constitution.
[11] Article 74(2), Federal Constitution.
[12] See, Article 77, Federal Constitution: Residual power of legislation
[13] See Article 95B (1), Federal Constitution: Modifications for States of Sabah and Sarawak of distribution of legislative powers.

- List IIA – Supplement to State List for Sabah and Sarawak: 13. Native law and custom including native courts; 14. Incorporation of authorities; 15. Ports and harbours except those declared to be federal by or under federal law; regulation of traffic by water in ports and harbour or on rivers wholly within the State; foreshores; 16. Cadastral land surveys.

- List III – Concurrent List: 3. Protection of wild animals and wild birds, National Parks; 5. Town and country planning; 7. Public health, sanitation and the prevention of diseases; 8. Drainage and irrigation; 9. Rehabilitation of land, which has suffered soil erosion; 9B. Culture and sports.

- List IIIA – Supplement to concurrent list for Sabah and Sarawak: 12. Shipping less than 15 registered tons, including the carriage of passengers and goods by shipping; maritime and estuarine fishing and fisheries; 14. Agricultural and forestry research, control of agricultural pests and protection against such pets, prevention of plant diseases.

The following table provides the list of Federal legislation that influence the use and management of the ocean in Malaysia. Federal agencies administering the laws are also identified in the same table. This list is not exhaustive.

MINISTRY of DEFENCE	
Armed Forces Act 1972 (Act 77) *Malaysian Armed Forces*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 June 1976 – PU(B) 271/76 An Act to amend and consolidate the law relating to the establishment, government and discipline of the armed forces of Malaysia.	*Am:* • Act A440 Armed Forces (Amendment) Act 1978 • Act A583 Armed Forces (Amendment) Act 1984 • Act A974 Armed Forces (Amendment) Act 1996 • Act A1243 Armed Forces (Amendment) Act 1996
Atomic Energy Licensing Act 1984 (Act 304) *Nuclear Malaysia*	
c.i.f. 1 February 1985 – PU(B) 44/85 To provide for the regulation and control of atomic energy, and for the establishment of standards on liability for nuclear damage.	*Am:* Nil
Military Manoeuvres Act 1983 (Act 295) *Malaysia Maritime Enforcement Agency*	
c.i.f. 1 October 1984 – PU(B) 443/84 The law relating to military manoeuvres.	*Am:* Nil

MINISTRY of NATURAL RESOURCES and ENVIRONMENT

Attestation of Registrable Instruments (Mining) Act, 1960 (Act 387) – (Revised 1989) *Department of Land and Information*	
Incorporating amendments up to 1 January 2006 c.i.f. 5 May 1960 The law relating to the attestation of instruments required to be registered under any written law relating to mining.	*Am:* • L.N 477/1965 National Land Code (Repeals and Amendments) Order 1965. • Act A587 National Land Code (Amendments) Order 1965
Atomic Energy Licensing Act 1984 (Act 304) *Nuclear Malaysia*	
c.i.f. 1 February 1985 – PU(B) 44/85 To provide for the regulation and control of atomic energy, and for the establishment of standards on liability for nuclear damage.	*Am:* Nil
Drainage Works Act 1954 (Act 354)-(Revised 1988) *Department of Irrigation and Drainage*	
Incorporating amendments up to 1 January 2006 c.i.f. 25 February 1954 An act relating to drainage works.	*Am:* • Ord No 60/1956 The Settlements Nominated Council (Change of Title) Ordinance 1956 • L.N. 332/1958 Federal Constitution (Modification of Laws) (Ordinances and Proclamations) Order 1958 • Act 56/1965 National Land Code • Act 160 Malaysian Currency (Ringgit) Acts 1975

Environmental Quality Act 1974 (Act 127) *Department of Environment*	
Incorporating amendments up to February 2009 c.i.f. 15 April 1957 An Act relating to the prevention, abatement, control of pollution and enhancement of the environment, and for purposes connected therewith.	*Am:* • Act A636 Environmental Quality (Amendment) Act 1985 • Act A953 Environmental Quality (Amendment) Act 1996 • Act A1030 Environmental Quality (Amendment) Act 1998 **<u>Regulations:</u>** • Environmental Quality (Sewage and Industrial Effluents) Regulations 1979 • Environmental Quality (Prescribed Premises) (Raw Natural Rubber) Regulations 1978 • Environmental Quality (Prescribed Premises) (Crude Palm-Oil) Regulations 1977 • Environmental Quality (Clean Air) Regulations 1978 • Environmental Quality (Compounding of Offences) Rules 1978 • Environmental Quality (Licensing) Regulations 1977 • Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 • Environmental Quality (Scheduled Wastes) Regulations 1989 • Environmental Quality (Prescribed Premises) (Scheduled Wastes treatment and Disposal Facilities) Order 1989 • Environmental Quality (Prescribed Premises) (Scheduled Wastes treatment and Disposal Facilities) Regulations 1999 • Environmental Quality (Delegation of Power on Marine Pollution Control) Order 1993 • Environmental Quality (Delegation of Powers on Marine Pollution Control) Order 1994 • Environment Quality (Industrial Effluent) Regulations 2009 (PU (A) 434) • Environment Quality (Sewage) Regulations 2009 (PU (A) 432) • Environment Quality (Control of Pollution from Solid Waste Transfer Stations and Landfill) Regulations 2009

National Forestry Act 1984 (Amendment) Act 1993 (Act 313) *Department of Forestry*	
c.i.f. 1 April 1986 (Federal Territory of Kuala Lumpur) – P.U.(B)148/86 To provide for the administration, management and conservation of forests and forestry development within the States of Malaysia	*Am:* • PU (A) 82/86 A law made under Article 76(1) (b) of the Federal Constitution to which Clause (3) of that Article of that Article applies.
National Parks Act 1980 (Act 226) *Department of Wildlife and National Parks*	
Incorporating amendments up to 1 January 2006 c.i.f. 29 February 1980 An Act to provide for the establishment and control of National Parks	*Am:* • Act A571 National Parks (Amendment) Act 1983
Land Development Act 1956 (Revised 1991) *Land and Minerals Department*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 July 1956 (Peninsular Malaysia) L.N. 205/1956 1 January 1968 (Sabah and Sarawak) P.U. 645/1967 An Act to provide for the establishment of a Federal development authority and local development boards to promote and carry out projects for land development and	*Am:* • Ord. 60/1956 Settlements Nominated Council (Change of Title) Ordinance 1956 • Ord. 35/1957 Land Development (Amendment) Ordinance 1957 • L.N. 332/1958 Federal Constitution (Modification of Laws) (Ordinances and Proclamations) Order 1958 • Ord. 56/1958 Land Development (Amendment) Ordinance 1958

settlement, for making funds available thereof.	• L.N. 297/1959 Federal Constitution (Modification of Laws) (Supplementary) Order 1959 • Act 10/1962 Land Development (Amendment) Act 1962 • L.N. 477/1965 National Land Code (Repeals and Amendments) Order 1965 • Act 47/1967 Income Tax Act 1967—Schedule 8 • P.U. 645/1967 Modifications of Laws (Land Development) (Modification and Extension to Borneo States) Order 1967 • Act A72 Land Development (Amendment) Act 1971 • Act A425 Land Development (Amendment) Act 1978 • Act A818 Land Development (Amendment) Act 1992 • Act 478 Revocation of Exemption From Payment of Stamp Duties Act 1992
Fees (Marine Parks Malaysia)(Validation) Act 2004 *Department of Marine Park Malaysia*	

Protection of Wild Life Act 1972 (Act 76) *Department of Wild Life and National Parks Peninsular Malaysia*	
Incorporating amendments up to 10 January 2002 c.i.f. 1 January 1973 – P.U.(B) 510/72 An Act to consolidate the laws relating to and to further provides the protection of wild life.	*Am:* • P.U. (A) 159/74 Protection of Wild Life (Amendment) Order 1974 • P.U. (A) 390/74 Protection of Wild Life (Amendment) (No 2) Order 1974 • Act A337 Protection of Wild Life (Amendment) Act 1976 • Act A697 Protection of Wild Life (Amendment) Act 1988 • P.U. (A) 306/91 Protection of Wild Life (Amendment) Act 1991
Waters Act 1920 (Act 418) (Revised 1989) *Department of Irrigation and Drainage*	
Incorporating amendments up to 20 July 2001 c.i.f. 18 September 1920 (Negeri Sembilan, Pahang, Perak & Selangor); 4 August 1966 (Malacca); 10 August 1967 (Penang); 1 February 1974 (Federal Territory) An Act to provide for the control of rivers and streams.	*Am:* • Act/65 • Act 171 • P.U (A) 66/1974
Irrigation Areas Act, 1953 (Act 386) (Revised 1989) *Marine Department*	
All amendments up to 1 January 2006 c.i.f. Part I – 18 May 1967 , Part II – 31 January 1948, Part III – 30 September 1967 An Act to provide for the commencement, application, construction, interpretation and operation of written laws; to provide for matters in relation to the exercise of statutory powers and duties; and for matters connected therewith.	*Am:* • **PART 1** Act 40/1968 Interpretation (Amendment) Act, 1968 Act A 996 Interpretation (Amendment) Act, 1997 ▪ Long title, ss 15,20, 23, 25 and S27 ▪ S3 ▪ Ss 17A, 62A

	• **PART II** Act 17/1962 Interpretation and General Clauses (Amendment) Act 1962 Act 23/1967 Interpretation Act, 1967, s 65 • **PART III** PU(A) 102/1999 Revision of Laws (Rectification of Interpretation Acts 1948 and 1967) Order 1999
MINISTRY of HOME AFFAIRS	
Customs Act and Regulations (Act 235) *Immigration Department of Malaysia*	
Incorporating amendments up to 3 Nov 2008 c.i.f. 2 November 1967 [P.U. 503/67] An Act relating to customs.	*Am:* • Act A12, A147, A161, A187, A241, A313, A352, A783, A873, A921, A960, A1057, A1109, A1162 [P.U (B) 260/2002], A1181, A1282 [P.U (B) 108/2007] [P.U. (B) 214/2007], A1279 [P.U. (B) 430/2007]
Immigration Act 1959/1963(Act 155) (Revised 1975) *Immigration Department of Malaysia*	
Incorporating amendments up to January 2006. c.i.f. 1 May 1959 (Peninsular Malaysia) 16 September 1963 (Sabah and Sarawak) An Act relating to immigration.	*Am:* • Act 6/1961 Immigration (Amendment) Act 1961 • Act 27/1963 Immigration Act 1963 • Act 15/1965 Immigration (Amendment) Act 1965 • Act 7/1966 Immigration (Amendment) Act 1966

	• Act A82 Immigration (Amendment) Act 1971 • Act A191 Immigration (Amendment) Act 1973 • Act A719 Immigration (Amendment) Act 1989 • Act A885 Constitution (Amendment) Act 1994 • Act A985 Immigration (Amendment) Act 1997 • P.U. (A) 282/2002 Revision of Laws (Rectification of Immigration Act 1959/63) Order 2002 • Act A1154 Immigration (Amendment) Act 2002
Penal Code (Act 574) (Revised 1997)	
Incorporating amendments up to January 2008 c.i.f. 31 March 1976 (Throughout Malaysia) [Act A327; P.U.(B) 139/76] An Act relating to criminal offences.	*Am:* • F.M.S En 41/1936 Penal Code (Amendment) Enactment 1936 • F.M.S En 11/1937 Penal Code (Amendment) Enactment 1937 • F.M.S En 30/1938 Penal Code (Amendment) Enactment 1938 • F.M.S Ord. 32/1948 Penal Code (Amendment and Extended Application) Ordinance 1948 • F.M.S Ord. 25/1957 Penal Code (Amendment) Ordinance 1957 • Act 24/1965 Penal Code (Amendment) Act 1965 • Act 1/1966 Penal Code (Amendment) Act 1965 • Act 39/1967 Penal Code (Amendment) Act 1966 • Act A327 Penal Code (Amendment and Extended) Act1976 • Act 538 Penal Code (Amendment) Act 1982 • Act 549 Penal Code and Criminal Procedure Code (Amendment) Act 1985 • Act 614 Penal Code (Amendment) Act 1985 • Act 651 Penal Code (Amendment) Act 1986 • Act 727 Penal Code (Amendment) Act 1989 • Act A860 Penal Code (Amendment) Act 1993 • Act A1131 Penal Code (Amendment) Act 2001 • Act A1210 Penal Code (Amendment) Act 2003 • Act A1273 Penal Code (Amendment) Act 2006 • Act A1303 Penal Code (Amendment) (Amendment) Act 2007

Police Act 1967 (Act 344) (Revised 1988) *Royal Malaysia Police*	
Incorporating amendments up to 1 January 2006 c.i.f 29 August 1967 – Throughout Malaysia [P.U.(A) 385A/67] Federal Territory of Labuan see appendix An Act relating to the organisation, discipline, powers and duties of the Royal Malaysia Police	*Am:* • Act A45 Police (Amendment) Act 1971 • Act A347 Police (Amendment) Act 1976 • Act A516 Police (Amendment) Act 1981 • Act A685 Police (Amendment) Act 1987
MINISTRY of TRANSPORT	
Carriage of Goods by Sea Act, 1950 (Act 527) – (Revised 1994) *Marine Department Peninsular Malaysia*	
c.i.f. 23 May 1950 The law relating to carriage of goods by sea.	*Am:* Nil
Federation Light Dues Act, 1953 (Act 250) – (Revised 1981) *Marine Department, Peninsular Malaysia*	
c.i.f. 30 April 1953 An Act to impose Light Dues	*Am:* • Act A601
Free Zones Act, 1990 (Act 438) *Port Authority Malaysia*	

c.i.f. 5 September 1991 [PU(B) 455/91] An Act to provide for the establishment of free zones in Malaysia for promoting the economic life of the country and for related purposes.	*Am:* • P.U. (B) 466/92 Free Zones (Amendment) Notification 1992 • P.U. (B) 465/92 Free Zones (Declared Areas) Notification 1992 • P.U. (B) 467/92 Free Zones (Amendment) (No.2) Notification 1992 • P.U. (B) 468/92 Free Zones (Amendment) (No.3) Notification 1992 • Act A924 Free Zones (Amendment) Act 1995 • P.U. (B) 272/96 Free Zones (Amendment) Notification 1996 • P.U. (B) 420/96 Free Zones (Amendment) (No.2) Notification 1996 • P.U. (B) 199/97 Free Zones (Declared Area) Notification 1997 • P.U. (B) 200/97 Free Zones (Amendment) Notification 1997 • P.U. (A) 144/98 Free Zones (Amendment) Notification 1998 • P.U. (A) 246/98 Free Zones (Declared Area) Notification 1998 • P.U. (A) 245/98 Free Zones (Amendment) (No.2) Notification 1998 • P.U. (A) 419/99 Free Zones (Amendment) Notification 1999 • P.U. (A) 420/99 Free Zones (Declared Area) Notification 1999 • P.U. (A) 319/2000 Free Zones (Amendment) Notification 2000 • P.U. (B) 326/2000 Free Zones (Amendment) (No.2) Notification 2000 • P.U. (B) 18/2001 Free Zones (Amendment) Notification 2001 • P.U. (B) 55/2001 Free Zones (Amendment) (No.2) Notification 2001 • P.U. (B) 79/2001 Free Zones (Amendment) (No.3) Notification 2001 • P.U. (B) 162/2001 Free Zones (Declared Areas) (Amendment) (No.2) Notification 2001 • P.U. (B)163/2001 Free Zones (Amendment) (No.4) Notification 2001 • Act A1113 Free Zones (Amendment) Act 2001 • P.U. (B) 575/2001 Free Zones (Declared Areas) (Amendment) (No.3) Notification 2001 • P.U. (B) 576/2001 Free Zones (Amendment) (No.5) Notification 2001 • Act A1166 Free Zones (Amendment) Act 2002 [P.U. (B) 264/2002) • P.U. (B) 337/2002 Free Zones (Amendment) Notification 2002 • P.U. (B) 192/2003 Free Zones (Amendment) Notification 2003 • P.U. (B) 65/2004 Free Zones (Amendment) Notification 2004 • P.U. (B) 193/2005 Free Zones (Amendment) Notification 2005 • P.U. (B) 253/2006 Free Zones (Amendment) Notification 2006 • P.U. (B) 96/2007 Free Zones (Amendment) Notification 2007 • P.U. (A) 535/96 Free Zones (Amendment) Regulations 1996 • P.U. (A) 78/2001 Free Zones (Amendment) Regulations 2001 • P.U. (A) 512/2002 Free Zones (Amendment) Regulations 2002

	• P.U. (A) 343/2006 Free Zones (Amendment) Regulations 2006 • P.U. (A) 166/2007 Free Zones (Amendment) Regulations 2007
Penang Port Commission Act, 1955 (Act 140) – (Revised 1974) *Port Authority Malaysia*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 January 1956 An Act relating to the Port Commission for the Port of Penang. **By-Laws:** Penang Port Commission By-Laws 1957	*Am:* • Act A338 Penang Port Commission (Amendment) Act 1976 • Act A582 Penang Port Commission (Amendment) Act 1984 • Act A673 Penang Port Commission (Amendment) Act 1987 • Act 422 Ports (Privatisation) Act 1990 • Act A855 Penang Port Commission (Amendment) Act 1993 • Act A936 Penang Port Commission (Amendment) Act 1995 • Act A1238 Penang Port Commission (Amendment) Act 200
Declared of an Area in the Bintulu District to be a Federal Port Act, 1979 (Act 217) *Port Authority Malaysia*	
c.i.f 23 February 1979 To provide for the declaration of an area in the Bintulu District of Sarawak to be a Federal port for the transfer and vesting in the Federal Government of responsibility for the development, control and administration of such port.	*Am:* Nil
The Port Workers (Regulation of Employment) (Dissolution) Act 2000 (Act 607) *Port Authority Malaysia*	
Incorporating amendments up to 1 January 2006	*Am:* Nil

c.i.f. 1 January 2001, P.U. (B) 467/2000 An Act to repeal the Port Workers (Regulation of Employment) Act 1965, to dissolve the Pulau Pinang Port Labour Board established under the Act, and to provide for consequential and ancillary matters.	
Ports (Privatisation) Act 1990; (Amendment) 1991; (Act 422) *Port Authority Malaysia*	
Incorporating amendments up to 1 January 2006 c.i.f. 2 April 1990 - P.U. (B) 198/1990 To facilitate privatisation of the port undertakings of any port authority and for matters connected therewith.	*Am:* • Act A934 Ports (Privatization) (Amendment) Act 1995 • P.U. (A) 442/1999 Ports (Privatization) (Amendment of Schedule) Order 1999 • P.U. (A) 517/1996 Ports (Privatization) Kemaman Port Order 1996 • P.U. (A) 328/1999 Ports (Privatization) (Tanjung Pelepas Port) Order 1999
Port Authorities Act 1963 (Act 488) – (Revised 1992) *Port Authority Malaysia*	
Incorporating amendments up to 1 January 2006 c.i.f. 27 June 1963 – L.N 154/63 To provide for the establishment of port authorities, and for the functions of such authorities. **By-Laws:** • Factories and Machinery (Stream Boiler and Unfired Pressure Vessel) Regulations 1970 • Port Authorities By-Laws 1967 • Bintulu Port Authority By-Laws 1983 • Pilotage By-Laws 1983	*Am*: • Act 18/1965 Port Authorities (Amendment) Act 1965 • P.U. (A) 450/1969 Essential (Port Authorities) Regulations 1969 • Act A8 Port Authorities (Amendment) Act 1969 • Act A83 Port Authorities (Amendment) Act 1971 • Act A99 Port Authorities (Amendment) Act 1972 • Act A137 Port Authorities (Amendment) (No. 2) Act 1972 • P.U. (A) 248/1973 Port Authorities (Johore Port) Order 1973 • P.U. (A) 427/1974 Port Authorities (Kuantan Port) Order 1974 • Act A394 Port Authorities (Amendment) Act 1977 • P.U. (A) 286/1981 Port Authorities (Johore Port) (Amendment) Order 1981 • Act A560 Port Authorities (Amendment) Act 1983 • Act A618 Port Authorities (Amendment) Act 1985

• Kuantan Port Authority (Tenders and Contracts) By-Laws 1988	• Act 422 Ports (Privatization) Act 1990 • Act A784 Port Authorities (Amendment) Act 1990 • P.U. (A) 235/1992 Revision of Laws (Rectification of Port Authorities Act) Order 1992 • P.U. (A) 278/1993 Port Authorities (Kemaman Port) Order 1993 • Act A935 Port Authorities (Amendment) Act 1995 • P.U. (A) 252/1996 Revision of Laws (Rectification of Port Authorities Act) Order 1996 • P.U. (A) 290/1999 Port Authorities (Amendment of First Schedule) Order 1999
Merchant Shipping Ordinance, 1952 *Marine Department Peninsular Malaysia*	
Incorporating amendments up to 1 May 1999 c.i.f 1 March 1953 LN 72/53 and LN.311/53 An Ordinance to consolidate and amend the law with respect to Merchant Shipping.	*Am:* • Act A433, A792, A34/63, 15/66, A603, A792, A1014, 19/66, P.U.(B) 99/85, A561, A212, A49/55 **Regulations:** • Domestic Shipping Licensing Board Regulations 1981 • Merchant Shipping (Tonnage) Regulations 1985 • Merchant Shipping (Collision Regulations) Order 1984 • Boat Rules 1953 • Deck Exam Rules 1983 • Engineering Rules 1984
Merchant Shipping (Oil Pollution) Act, 1994 (Act 515) *Marine Department Peninsular Malaysia*	
Incorporating amendments up to 1 January 2006 c.i.f. 6 April 1995 – P.U.(B) 144/95 An Act to make provisions with respect to civil liability for oil pollution by merchant ships and for matter connected therewith.	*Am:* • Act A1248 Merchant Shipping (Oil Pollution) (Amendment) Act 2005

Bintulu Port Authority Act 1981 (Act 243) *Bintulu Port Authority*	
Incorporating amendments up to 1 January 2006 c.i.f. Section 93—1 May 1981, P.U. (B) 257/1981 All provisions except section 92—15 August 1981, P.U. (B) 458/1981; section 92—16 August 1981, Act A937 To provide for the establishment of the Bintulu Port Authority, for the transfer to and vesting in the Authority of responsibility for the development, control and administration of Bintulu Port	*Am:* • Act A680 Bintulu Port Authority (Amendment) Act 1987 • Act 422 Ports (Privatization) Act 1990 • Act A831 Bintulu Port Authority (Amendment) Act 1992 • Act A937 Bintulu Port Authority (Amendment) Act 1995 (See also Declaration of an Area in the Bintulu District to be a Federal Port)

SABAH STATE GOVERNMENT	
Sabah Ports Authority Enactment 1981 *Sabah Ports Authority*	
c.i.f. 11 July 1968 An Act as the regulatory authority responsible related to the port activities and will ensure the terminal operator who operates the server ports in Sabah with privatisation agreement fully and of standards plus benchmark for port operations compatible with ports in the region.	*Am:* Nil

The Merchant Shipping Ordinance, 1960 (Sabah, No. 11 of 1960) *Marine Department Sabah*	
	Am: • FLN 191/64 • Modification in its application to F.T Labuan PU (A) 31/85

SARAWAK STATE GOVERMENT

Merchant Shipping Ordinance, 1960 (Sarawak, No. 2 of 1960) *Marine Department Sarawak*	
	Am: • FLN 191/64 • PU (A) 247/72)

PRIME MINISTER'S DEPARTMENT

Continental Shelf Act 1996 (Act 83) Revised (1972)	
Incorporating amendments up to 1 January 2006 c.i.f. 28 July 1966 - Peninsular Malaysia	*Am:* • P.U. (A) 467/1969 Emergency (Essential Powers) Ord No. 10 of 1969

8 November 1969 - Sabah & Sarawak [P.U. (A) 467/1969] An Act relating to continental shelf of Malaysia, the exploration and the exploitation of its natural resources.	• Act 160 Malaysian Currency (Ringgit) Act
Extra- Territorial Offences Act, 1976 (Act 163)	
c.i.f 1 May 1976 – PU(B) 244/76 To deal with certain offences underwritten laws committed in any place without and beyond the limits of Malaysia and on the high seas on board any ship or on any aircraft registered in Malaysia or otherwise as if they were committed in Malaysia.	*Am:* Nil
Emergency (Essential Powers) Ordinance No. 22/1970	
Incorporating amendments up to 15 May 1999 c.i.f 21 February 1970 An ordinance promulgated by the Yang di-Pertuan Agong under Article 150(2) of the Federal Constitution.	*Am:* • PU (A) 73/1970
Malaysian Maritime Enforcement Agency Act 2004 (Act 633) *Malaysian Maritime Enforcement Agency*	
Incorporating amendments up to 1 January 2006 c.i.f. 15 February 2005, P.U.(B)67/2005 An Act to establish the Malaysian Maritime Enforcement Agency to perform enforcement functions for ensuring the safety and security of the Malaysian Maritime Zone with a view to the protection of maritime and other national interests in such zone and for matters necessary thereto.	*Am:* Nil

Exclusive Economic Zone Act 1984 (Act 311)	
Incorporating amendments up to 1 January 2006 c.i.f. 1 May 1985 – P.U.(B) 214/1985 An Act pertaining to the exclusive economic zone on certain aspects of the continental shelf of Malaysia providing for the regulation of activities in the zone and on the continental shelf. This Act gives Malaysia the sovereign rights to explore and exploit the resources of the EEZ.	*Am:* Nil
Petroleum Mining Act, 1966 (Act 95) (Revised 1972)	
Incorporating amendments up to 1 July 1999 c.i.f 1 December 1966 (West Malaysia & 8 November 1969 (East Malaysia) – P.U.(A) 467/69An Act to make provision with regard to mining petroleum and for matters connected therewith.	*Am:* P.U. (A) 467/1969
Petroleum Development Act, 1974 (Act 144)	
Incorporating amendments up to 1 January 2006 c.i.f. 1 October 1974 An Act to provide for exploration and exploitation of petroleum whether onshore or offshore by a Corporation in which will be vested the entire ownership in and the exclusive rights, powers, liberties and privileges in respect of the said petroleum, and to control the carrying on of downstream activities and development relating to petroleum and its products; to provide for the establishment of a Corporation under the Companies Act 1965 [Act 125] or under the law relating to the incorporation of companies and for the powers of that Corporation.	*Am:* • Act A290 Petroleum Development (Amendment) 1975 • Act A382 Petroleum Development (Amendment) Act 1977 • Act A613 Petroleum Development (Amendment) Act 1985 • Act A842 Petroleum Development (Amendment) Act 1993
Petroleum Regulations 1974	
c.i.f 13 December 1974 [P.U.(A) 432/74	*Am:* P.U.(A) 439/75 Petroleum (Amendment) Regulations 1975 P.U.(A) 10/81 Petroleum (Amendment) Regulations 1981

Petroleum and Electricity (Control of Supplies) Act 1974 (Act 128)	
Incorporating amendments up to 1 January 2006 c.i.f. not yet in force To make temporary provisions for the control of petroleum and electricity supplies.	*Am:* • Act 160 Malaysian Currency (Ringgit) Act 1975 • P.U. (A) 357/1980 Subordinate Courts Act (Extension) Order 1980
Petroleum (Safety Measures) Act, 1984 (Act 302)	
Incorporating amendments up to 1 January 2006 c.i.f. 1 March 1985 (Throughout Malaysia Parts I, III, IV, V, X & XII) – [P.U. (B) 96/1985] 1 July 1986 (Throughout Malaysia Parts II, VI, VII, & IX) – [P.U. (B) 279/1986] An Act to consolidate laws relating to safety in the transportation, storage and utilisation of petroleum	*Am:* • Act A663 Petroleum (Safety Measures) (Amendment) Act 1987 • Act A807 Petroleum (Safety Measures) (Amendment) Act 1991 • Act A843 Petroleum (Safety Measures) (Amendment) Act 1993
Petroleum (Income Tax) Act 1967	
Incorporating amendments up to 1 January 2006 c.i.f. 28 September 1987 An Act to impose a tax upon income from the winning of petroleum in Malaysia, to provide for the assessment and collection thereof.	*Am:* • Act 644 Finance Act 2005

MINISTRY of AGRICULTURE and AGRO BASED INDUSTRY

Fishermen's Association Act 1971 (Act 44)

Department of Fisheries

c.i.f. 4 May 1972 – PU(B) 172/72 To establish Fishermen's Associations in Malaysia.	*Am:* • Act A103, A261, 478
Lembaga Kemajuan Ikan Malaysia Act, 1971 (Act 49) *Department of Fisheries*	
c.i.f. 1 November 1971 – PU(B) 378/71 1 July 1973 – PU (B) 269/73 To incorporate the Lembaga Kemajuan Ikan Malaysia **Rules:** • Fisheries Development Authority of Malaysia (Fisheries Complexes and Harbours) (Amendment) Rules 1988	*Am:* • Act A201 Lembaga Kemajuan Ikan Malaysia (Amendment) Act 1973 • Act A261 Fishermen's Associations and the Lembaga Kemajuan Ikan (Amendment) Malaysia Act 1974 • Act A376 Lembaga Kemajuan Ikan (Amendment) Malaysia Act 1977 • Act A764 Lembaga Kemajuan Ikan (Amendment) Malaysia Act 1990 • Act A1051 Lembaga Kemajuan Ikan (Amendment) Malaysia Act 1999
Fisheries Act, 1985 (Act 317) *Department of Fisheries*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 January 1986, Except for Part IX in its application to the State of Sabah [P.U. (B) 627/1985] An Act relating to fisheries including the conservation, management and development of maritime and estuarine fishing and fisheries, in Malaysian fisheries waters, to turtles and riverine fishing in Malaysia	*Am:* • Act A854/1993 Fisheries (Amendment) Act 1993 **Regulations:** • Fisheries (Maritime) (Sarawak) Regulations 1976 - [P.U. (A) 401/76] *Am:* P.U. (A) 216/00 • Fisheries (Prohibition of Method of Fishing) Regulations 1980 - [P.U. (A) 314/80]

	Am: P.U. (A) 187/71 P.U.(A) 32/90 • Fisheries (Maritime) (Licensing of Local Fishing Vessel) Regulations 1985 - [P.U. (A) 567/85] • Fisheries (Marine Culture System) Regulations 1990 – [P.U. (A) 131/90] • Fisheries (Prohibition of Import, Etc., of Fish) Regulation 1990 – [P.U. (A) 441/90] • Fisheries (Prohibited Areas) (Rantau Abang) Regulations 1991 – [P.U. (A) 227/91] • Establishment of Marine Parks Malaysia Order 1994 – [P.U. (A) 401/94] • Fisheries (Prohibited Areas) Regulations 1994 – [P.U. (A) 402/94] *Am:* P.U (A) 444/98, 381/02 • Fisheries (Closed Season to Catch Kerapu Fry) Regulations 1996 – [P.U. (A) 619/96] • Fisheries (Prohibition of Method of Fishing for Kerapu Fry) Regulations 1996 - [P.U. (A) 620/96] • Fisheries (Control of Endangered Species of Fish) Regulation 1999 – [P.U. (A) 409/99] • Fisheries (Cockles Conservation and Culture) Regulations 2002 – [P.U. (A) 405/02]

MINISTRY of HIGHER EDUCATION

Education Act and Regulations (Act 550)

Department of Higher Education

Incorporating amendments up to January 2005 c.i.f. 31 December 1997 [P.U.(B) 541/97] An Act to provide for education and for matters connected therewith.	*Am:* • Act A1152 Education (Amendment) Act 2002

Universities and University Colleges Act, 1971 (Act 30) *Department of Higher Education*	
c.i.f. 30 April 1971 To provide for the establishment, maintenance and administration of Universities and University Colleges.	*Am:* • Act A80 Universities and University Colleges (Amendment) Act 1971 • Act A295 Universities and University Colleges (Amendment) Act 1975 • Act A550 Universities and University Colleges (Amendment) Act 1983 • Act A946 Universities and University Colleges (Amendment) Act 1996 ▪ (Para 2, P.U.(B)428/1996 – the Minister suspends the operation of the whole of Act A946 in respect of all Universities and University Colleges established under the Universities and University Colleges Act 1971). ▪ (See also P.U.(B) 102/1998 and P.U.(B) 163/1998 – the Minister revokes the suspension of operation of the whole of Act A946 in respect of the Universities mentioned in it)
Educational Institutions (Discipline) Act 1976 *Department of Higher Education*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 June 1976 An Act to provide for matters related to discipline in educational institutional.	*Am:* • P.U. (A) 73/1980 , P.U. (A) 247/1984, P.U. (A) 115/1985 , P.U. (A) 376/1986 , P.U. (A) 165/1991 , P.U. (A) 57/1995 , P.U. (A) 536/1997 , P.U. (A) 537/1997, P.U. (A) 538/1997, P.U. (A) 160/1998 , P.U. (A) 247/1999, P.U. (A) 345/2000, P.U. (A) 452/2000, P.U. (A) 484/2000 , P.U. (A) 102/2001, P.U. (A) 103/2001, P.U. (A) 104/2001 , P.U. (A) 423/2002 , P.U. (A) 468/2002 , P.U. (A) 484/2002 , P.U. (A) 23/2003, P.U. (A) 24/2003 , P.U. (A) 299/2003 , P.U. (A) 322/2006 .
Politeknik Ungku Umar Act, 1974 (Act 145) *Politeknik Ungku Omar*	
c.i.f. Not yet in force To provide for the establishment, maintenance, and administration of the Politeknik Ungku Omar.	*Am:* Nil

MINISTRY of FOREIGN AFFAIRS

Geneva Conventions Act, 1962 (Act 512) – (Revised 1993)	
c.i.f. 16 April 1962 – LN 111/62 To give effect to certain international conventions adopted in Geneva on 12 August 1949, which Malaysia ratified on 21 December 1960. Extended to Sabah and Sarawak by PU 100/66.	*Am:* Nil
Malaysian-Thailand Joint Development Authority Act, 1990 (Act 440)	
Incorporating amendments up to 1 January 2006 c.i.f. 23 January 1991 – PU(B) 36/91 To give effect to an agreement on the establishment and operation of the Malaysia-Thailand Join Authority and to make provisions connected therewith.	*Am:* Nil

MINISTRY of HOUSING and LOCAL GOVERNMENT

Street, Drainage and Building Act 1974 (Act 133) *National Housing Department*	
Incorporating amendments up to May 2007	*Am:*

c.i.f. Dates appointed by the respective State Authorities (*see* Schedule in P.U. (B) 84/1994) An Act to amend and consolidate the laws relating to street, drainage and building in local authority areas in Peninsular Malaysia.	• Act A435 Street, Drainage and Building (Amendment) Act 1978 • Act A867 Street, Drainage and Building (Amendment) Act 1993 • Act A903 Street, Drainage and Building (Amendment) Act 1994 • Act A1286 Street, Drainage and Building (Amendment) Act 2007
Sewerage Services Act & Regulations (Act 508) *Sewerage Service Department*	
Incorporating amendments up to 1 January 2006 c.i.f 8 December 1993 P.U.(B) 589/93 An Act to amend and consolidate the laws relating to sewerage systems and sewerage services throughout Malaysia for the purpose of improving sanitation and the environment and promoting public health.	*Am:* Nil
Town and Country Planning Act 1976 (Act 172) *Town and Country Planning Department*	
Incorporating amendments up to 1 April 2008 c.i.f. An Act for the proper control and regulation of town and country planning in Peninsular Malaysia and for the purposes connected therewith or ancillary thereto.	*Am:* • Act A866 Town and Country Planning (Amendment) Act 1933 [P.U.(B) 93/94 • Act A933 Town and Country Planning (Amendment) Act 1995 • Act A1129 Town and Country Planning (Amendment) Act 2001

MINISTRY of FINANCE

Insurance Act 1996 (Act 553)

Treasury Malaysia

Incorporating amendments up to 1 July 1999 c.i.f. 1 January 1997 [PU(B) 588/96] An Act to provide new laws for the licensing and regulation of insurance business, insurance broking business and adjusting business and for other related purposes	*Am:* **<u>Regulations:</u>** • Insurance Regulations 1996 - PU (A) 653/96 *Am:* PU (A) 182/99 Insurance (Amendment) Regulations 1999 • Insurance Guarantee Scheme (General Insurance Business) Fund Regulations 1990 – P.U. (A) 8/1990 *Am:* PU (A) 278/94 • Insurance Guarantee Scheme Fund (General Insurance Business) (Restriction on Payment) Regulations 1994 – P.U.(A) 377/94 • Insurance (Exemption) Order 1999 – PU (A) 161/99
Promotion of Investments Act 1986 (Act 327) *Treasury Malaysia*	
c.i.f. 16 May 1986 To make provision for promoting by way of relief from income tax, the establishment and development in Malaysia of industrial, agricultural and other commercial enterprises, for the promotion of exports.	*Am:* • Act A656, A715, 438, A862, A877, A900, 513, 531 • English text authoritative – PU (B) 561/86

MINISTRY of TOURISM

Tourism Industry Act 1992 (Act 482) *Department of Tourism & Culture*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 May 1992 – P.U(B) 199/92 An Act to provide for the licensing and regulation of tourism enterprises and for matters incidental thereto.	*Am:* • Act A1037 Tourism Industry (Amendment) Act 1998 • Act A1153 Tourism Industry (Amendment) Act 2002 **Regulations:** Tourist Guide Licensing and Supervision Regulations, 1992
Malaysia Tourism Promotion Board Act 1992 (Act 481) *Department of Tourism & Culture*	
Incorporating amendments up to 1 January 2006 c.i.f. 1 May 1992; P.U. (B) 198/1992 An Act to establish the Malaysia Tourism Promotion Board.	*Am:* Nil
MINISTRY of HUMAN RESOURCES	
Industrial Relations Act 1967 (Act 177) (Revised 1976) *Department of Industrial Relations Malaysia*	
Incorporating amendments up to 1 March 2000 c.i.f. 7 August 1967 An Act to provide for the regulation of the relations between employers and workmen and their trade unions and the prevention and settlement of any differences or disputes arising from their relationship and generally to deal with trade disputes and matters arising therefrom.	*Am:* • Act 50/1967, P.U.(A) 407/1969, P.U.(A) 33/1971, Act A92, Act A299, P.U(A) 78/1977, Act A484, Act A718, Act A779, P.U.(A) 489/1999 **Regulations:** • Industrial Court Rules 1967

	• Industrial Relations Regulations 1967 • Industrial Court (Fees for Documents) Regulations 1971 • Industrial Relations Regulations 1980
MINISTRY of CULTURE, ART and HERITAGE	
National Heritage Act 2005 (Act 645) *Department of National Heritage*	
Incorporating amendments up to 1 June 2006 c.i.f. 1 March 2006 - P.U. (B) 53/2006 An Act to provide for the conservation and preservation of National Heritage, natural heritage, tangible and intangible cultural heritage, underwater cultural heritage, treasure trove and for related matters.	*Am:* Nil
MINISTRY of HEALTH	
Food Act (Act 281) *Department of Public Health*	
Incorporating amendments up to August 2007 c.i.f 1 October 1985 [P.U.(B) 446/1985] An Act to protect the public against health hazards and fraud in the preparation, sale and use of food, and for matters incidental thereto or connected therewith.	*Am:* • A1117 Food (Amendment) Act 2001 • Act A1266 Food (Amendment) Act 2006 **Regulations:** • Food Regulations 1985 • Food (Extension of the Food Act 1983 to Tobacco and Others) Regulations 1993 • Control of Tobacco Products Regulations 2004
Pesticides Act (Act 149)	

Department of Public Health	
Incorporating amendments up to January 2005 **c**.i.f 15 April 1975 [P.U.(B) 118/75] (Throughout Malaysia) 1 December 1976 [P.U. (B) 637/76] (Throughout Malaysia) 1 February 1981 [P.U. (B) 48/81] (Throughout Malaysia) 1 April 1981 [P.U. (B) 49/81] (West Malaysia) 1 January 1982 [P.U. (B) 51/81] (West Malaysia) 1 January 1982 [P.U. (B) 52/81] (Sabah and Sarawak) 1 September 1982 [P.U. (B) 574/81] (Sabah and Sarawak) 1 April 1982 [P.U. (B) 127/82] (West Malaysia) 1 September 1982 [P.U. (B) 297/82] (Sabah and Sarawak) 1 September 1988 [P.U. (B) 353/88] (Throughout Malaysia) 1 October 1991 [P.U. (B) 466/91] (Sabah, Sarawak and Federal Territory of Labuan) An Act to control Pesticides.	*Am*: • Act A1226 Pesticides (Amendment) Act 2004 (not yet in force)

source: Project Management Summary, Progress Report 2 - Malaysia Ocean Policy , Appendix 2, Appendix 2-29p

APPENDIX 3-2: EXTRACT OF SPECIES IN SCHEDULE II OF THE WILDLIFE PROTECTION ACT, 2010

Family	*Scientific Name*	*Common Name*
CLASS REPTILIA (REPTILES)		
Alligatoridae (Alligators, caimans)	***Alligator sinensis***	China Alligator
	Caiman crocodilus apaporiensis	Apaporis River Caiman
	Caiman latirostris (except population of Argentina)	Broad-snouted Caiman
	Melanosuchus niger (except population of Brazil and Ecuador)	Black Caiman
Boidae (Boas)	***Acrantophis*** spp.	Madagascar Ground Boa
	Boa constrictor occidentalis	Argentine Boa Constrictor
	Epicrates inornatus	Yellow Tree Boa
	Epicrates monensis	Mona Island Boa
	Epicrates subflavus	Jamaican Boa
	Sanzinia madagascariensis	Madagascar Tree Boa
Bolyeriidae (Round Island boas)	***Bolyeria multocarinata***	Round Island Burrowing Boa
	Casarea dussumieri	Round Island Keel-scaled Boa
Chamaeleonidae (Chameleons)	***Brookesia perarmata***	Armoured Leaf Chameleon
Chelidae (Austro-American side-necked turtles	***Chelodina mccordi***	Roti Island Snake-necked Turtle
	Chelodina parkeri	Parker's Snake-necked Turtle
	Chelodina pritchardi	Pritchard's Snake-necked Turtle
	Pseudemydura umbrina	Western Swamp Turtle
Crocodylidae (Crocodiles)	***Crocodylus porosus***	Estuarine Crocodile
	Tomistoma schlegelii	False Gavial
	Crocodylus acutus (except population of Cuba)	American Crocodile
	Crocodylus cataphractus	African Slender-snouted Crocodile
	Crocodylus intermedius	Orinoco Crocodile
	Crocodylus mindorensis	Philippine Crocodile
	Crocodylus moreletii	Morelet's Crocodile
	Crocodylus niloticus (except populations of Botswana, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Namibia, South Africa, Ganda, The United Republic of Tanzania, Egypt, Zambia and Zimbabwe)	Nile Crocodile

Family	*Scientific Name*	*Common Name*
	Crocodylus palustris	Marsh Crocodile
	Crocodylus rhombifer	Cuban Crocodile
	Crocodylus siamensis	Siamese Crocodile
	Osteolaemus tetraspis	African Dwarf Crocodile
Geoemymdidae (Box turtles, freshwater turtles)	*Batagur affinis*	Common Batagur
	Batagur baska	Common Batagur
	Clemmys muhlenbergi	Bog Turtle
	Geoclemys hamiltonii	Black Pond Turtle
	Pangshura tecta	Dura Turtle
	Melanochelys tricarinata	Three-keeled Land Tortoise
	Morenia ocellata	Bengal Eyed Terrapin
	Terrapene coahuila	Aquatic Box Turtle
Gavialidae (Gavial)	*Gavialis gangeticus*	Gavial
Iguanidae (Iguanas)	*Brachylophus* spp.	Fijian iguanas
	Cyclura spp.	Ground iguanas
	Sauromalus varius	Piebald Chuckwalla
Lacertidae (Lizards)	*Gallotia simonyi*	Hierro Giant Lizard
Pythonidae (Pythons)	*Python brongersmai*	Blood Python
	Python molurus molurus	Indian Python
Sphenodontidae (Tuatara)	*Sphenodon* spp.	Tuataras
Testudinidae (Tortoises)	*Chelonoidis nigra*	Galapagos Giant Tortoise
	Astrochelys radiata	Radiated Tortoise
	Astrochelys yniphora	Madagascar Tortoise
	Gopherus flavomarginatus	Bolson Tortoise
	Psammobates geometricus	Geometric Tortoise
	Pyxis arachnoides	Spider Tortoise
	Pyxis planicauda	Flat-backed Spider Tortoise
	Testudo kleinmanni	Egyptian Tortoise
	Testudo werneri	Negev Tortoise
Trionychidae (Softshell turtles, terrapins)	*Apalone ater*	Cuatro Cienegas Softshell
	Aspideretes gangeticus	Indian Softshell Turtle
	Aspideretes hurum	Peacock Soft-shell Turtle
	Aspideretes nigricans	Black Softshell Turtle
Varanidae (Monitor lizards)	*Varanus bengalensis*	Bengal Black Lizard
	Varanus rudicollis	Harlequin Monitor
	Varanus dumerilli	Dumerl's Monitor
	Varanus flavescens	Yellow Monitor
	Varanus griseus	Desert Monitor
	Varanus komodoensis	Komodo Monitor
	Varanus nebulosus	Clouded Monitor

APPENDIX 3-3: LIST OF RELEVANT SABAH LAWS

1. Cultural Heritage (Conservation) Enactment 1997 (c.i.f. 01.09.1997)
2. Drainage and Irrigation Ordinance 1956 (c.i.f. 15.10.1957)
3. Environment Protection Enactment 2002 (c.i.f. 03.01.2006)
    a) Environment Protection (Amendment) Enactment 2004
    b) Environmental Protection (Prescribed Activities) Order 2005
    c) Environment Protection (Prescribed Activities) (Environmental Impact Assessment) Order 2005
    d) Environment Protection (Registration Of Environmental Consultants) Rules 2005
    e) Environment Protection (Environmental Fees) Rules 2005
    f) Environment Protection (Compounding Of Offences) Rules 2005
4. Forest (Constitution of Forest Reserves and Amendment) Enactment 1984 (c.i.f. 15.03.1984)
5. Forest Enactment 1968 (c.i.f. 01.01.1969)
6. Korporasi Kemajuan Perikanan Nelayan Sabah (Ko-Nelayan) Enactment 1981 (c.i.f. 01.05.1981)
7. Local Government Ordinance 1961
8. Merchant Shipping Ordinance 1960 (c.i.f. 01.04.1961)
9. Parks Enactment 1984
10. Pearl Oyster Shell Fishery Ordinance Cap.95 (c.i.f. 01.02.1961)
11. Ports and Harbours Enactment 2002 (c.i.f. 01.03.2004)
12. Sabah Biodiversity Enactment 2000 (c.i.f. 01.05.2002)
13. Sabah Economic Development Corporation Enactment 1981
14. Sabah Forestry Development Authority Enactment 1981 (c.i.f. 01.01.1982)
15. Sabah Inland Fisheries and Aquaculture Enactment 2003 (Not Yet In Force)
16. Sabah Ports Authority Enactment 1981 (c.i.f. 01.12.1981)
17. Sabah Ports (Privatisation) Enactment 1998 (c.i.f. 18.02.2001)
18. Sabah Tourism Promotion Corporation Enactment 1981 (c.i.f. 01.12.1981)
19. Sabah Water Resources Enactment 1998 (c.i.f. 01.06.2000)
20. Seed Pearls Ordinance Cap. 134 Vol. Iv (c.i.f. 01.06.1917)
21. Town and Country Planning Ordinance Cap. 141 Vol. Iv (c.i.f. 28.06.1950) (Mod: P.U. (A) 353/85)
22. Wildlife Conservation Enactment 1997
    a) Wildlife Conservation Regulations 1998
23. Customs (Prohibition of Exports) Order 1988
24. Customs (Prohibition of Imports) Order 1988

Source: Sabah State Attorney-General's Chambers official website
http://www.lawnet.sabah.gov.my/Lawnet/SabahLaws/StateLaws.aspx

and http://www.sabahlaw.com

APPENDIX 3-4: SABAH WILDLIFE CONSERVATION ENACTMENT, 1997 - SCHEDULE 1 AND 2

SCHEDULE 1

PART I: TOTALLY PROTECTED ANIMALS

Local Name: Badak Sumatra (My)
Common Name: Sumatran Rhinoceros
Scientific Name: *Dicerorhinus sumatrensis*
Order: Perissodactyla
Family: Rhinocerotidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I ; IUCN E
Threats To Survival: Habitat loss and poaching for its horn, which is believed to have medical properties.
Conservation Measures: Protection by legislation. Establish protected areas network. Established interagency collaboration and new approaches in monitoring and research. Conducting captive breeding program. Translocation of doomed animals from areas where loss of habitat and poaching are threatening its survival. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Orang Hutan (My); Kogiu (Kd)
Common Name: Orang Utan
Scientific Name: *Pongo pygmaeus*
Order: Primates
Family: Pongidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN E
Threats To Survival: Habitat loss and poaching.
Conservation Measures: Protection by legislation. Establish protected areas network. Established interagency collaboration and new approaches in monitoring and research. Conducting natural rehabilitation and breeding programs. Translocation of doomed animals from areas where loss of habitat and poaching are threatening to its survival. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Beruang (My)
Common Name: Sun Bear/Malay Bear/Honey Bear
Scientific Name: *Helarctus malayanus*
Order: Carnivore
Family: Ursidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN V
Threats To Survival: Habitat loss and poaching.
Conservation Measures: Protection by legislation. Establish protected areas network. Established interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Kera Belanda (My), Bangkatan (Kd)
Common Name: Proboscis Monkey
Scientific Name: *Nasalis larvatus*
Order: Primate
Family: Cercopitihecidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN V
Threats To Survival: Habitat loss and poaching.
Conservation Measures: Protection by legislation. Establish protected areas network. Established interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Harimau Dahan (My)
Common Name: Clouded Leopard
Scientific Name: *Neofelis nebolusa*
Order: Carnivora
Family: Felidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN V
Threats To Survival: Habitat loss and poaching.
Conservation Measures: Protection by legislation. Establish protected areas network. Established interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Duyung (My)
Common Name: Dugong
Scientific Name: *Dugong dugon*
Order: Sirenia
Family: Dugonidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN V
Threats To Survival: Habitat disturbance by fishing, poaching, accidental catch in fishing nets.
Conservation Measures: Protection by legislation. Establish marine protected areas network. Established interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Buaya Julung-Julung (My)
Common Name: False Gharial
Scientific Name: *Tomistoma schlegeli*
Order: Crocodylia
Family: Crocodylidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN E
Threats To Survival: Habitat loss and poaching.
Conservation Measures: Protection by legislation. Establish protected areas network. Establish interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Penyu Hijau (My)
Common Name: Green Turtle
Scientific Name: *Chelonia mydas*
Order: Testudinata
Family: Cheloniidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN E
Threats To Survival: Habitat loss, accidental catch in fishing nets and poaching of eggs and adults.
Conservation Measures: Protection by legislation. Establish marine protected areas network. Established interagency collaboration and new approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

Local Name: Penyu Sisik (My)
Common Name: Hawksbill Turtle
Scientific Name: *Eretmochelys imbricata*
Order: Testudinata
Family: Cheloniidae
Status: WCE 1997 Schedule I Part I; CITES Appendix I; IUCN E
Threats To Survival: Habitat loss, accidental catch in fishing nets and poaching of eggs and adults.
Conservation Measures: Protection by legislation. Establish marine protected areas networking. Intensive monitoring and research. Established interagency collaboration and approaches in monitoring and research. Government and NGOs working together in promoting public awareness for protection and conservation.

SCHEDULE 2

PART 1: PROTECTED ANIMALS - MAMMALS

1. Kinabalu Shrew *(Crocidura baluensis)* Cencurut Kinabalu
2. Dayak Roundleaf Bat *(Hipposideros dyacoru)* Kelawar Ladam-bulat Dayak
3. Coppery Pipistrelle *(Pipistrellus cuprosus)* Kelawar Hidung Pendek Tembaga
4. Gilded Tube-nosed Bat *(Murina rozendaali)* Kelawar Hidung Laras Emas
5. Flying Lemur *(Cynocephalus variegatus)* Kubung
6. Slow Loris *(Nycticebus coucang)* Kongkang
7. Tarsier *(Tarsius bancanus)* Kera Hantu
8. Maroon Leaf Monkey *(Presbytis rubicunda)* Monyet Merah
9. Grey Leaf Monkey *(Presbytis hosei)* Monyet Kikok
10. Silver Leaf Monkey *(Presbytis cristata)* Monyet Kelabu
11. Long-tailed Macaque*(Macaca fascicularis)* Kera
12. Pig-tailed Macaque *(Macaca nemestrina)* Beruk
13. Gibbon *(Hylobates muelleri)* Kelawat
14. Pangolin *(Manis javanica)* Tenggiling
15. Giant Squirrel *(Ratufa affinis)* Tupai Kerawak Putih-kuning
16. Kinabalu Squirrel *(Callosciurus baluensis)* Tupai Kinabalu
17. Giant Tufted Ground Squirrel *(Rheithrosciurus macrotis)* Babut
18. Hose's Pigmy Flying Squirrel *(Petaurillus hosei)* Tupai Terbang Kecil
19. Temminck's Flying Squirrel *(Petinomys setosus)* Tupai Terbang Dada Putih
20. Horsfield's Flying Squirrel *(Iomys horsfieldi)* Tupai Terbang Ekor Merah
21. Grey-cheeked Flying Squirrel *(Hylopetes lepidus)* Tupai Terbang Pipi Kelabu
22. Black Flying Squirrel *(Aeromys tephromelas)* Tupai Terbang Hitam
23. Smoky Flying Squirrel *(Pteromyscus pulverulentus)* Tupai Terbang Kotor
24. Whiskered Flying Squirrel *(Petinomys genibarbis)* Tupai Terbang Berjambang
25. Spotted Giant Flying Squirrel *(Petaurista elegans)* Tupai Terbang Bintang
26. Red Giant Flying Squirrel *(Petaurista petaurista)* Tupai Terbang Merah
27. Thomas's Flying Squirrel *(Aeromys thomasi)* Tupai Terbang Merah
28. Long-tailed Porcupine *(Trichys fasciculata)* Landak Padi
29. Thick-spined Porcupine *(Thecurus crassispinis)* Landak Borneo
30. Yellow-throated Marten *(Martes flavigula)* Mengkira
31. Malay Weasel *(Mustela nudipes)* Pulasan Tanah
32. Ferret-Badger *(Melogale personata)* Pulasan Lamri
33. Malay Badger *(Mydaus javanensis)* Teledu
34. Hairy-nosed Otter *(Lutra sumatrana)* Memerang Kumis
35. Smooth Otter *(Lutra perspicillata)* Memerang Licin
36. Oriental Small-clawed Otter *(Aonyx cinerea)* Memerang Kecil
37. Malay Civet *(Viverra tangalunga)* Musang Tanggalong
38. Otter Civet *(Cynogale bennettii)* Musang Memerang
39. Binturong *(Arctictis binturong)* Musang Binturong
40. Small-toothed Palm Civet *(Arctogalidia trivirgata)* Musang Akar

41. Masked Palm Civet *(Paguma larvata)* Musang Lamri
42. Common Palm Civet *(Paradoxurus hermaphroditus)* Musang Pulut
43. Hose's Civet *(Hemigalus hosei)* Musang Hitam Pudar
44. Banded Palm Civet *(Hemigalus derbyanus)* Musang Belang
45. Banded Linsang *(Prionodon linsang)* Musang Linsang
46. Collared Mongoose *(Herpestes semitorquatus)* Bambun Ekor Panjang
47. Short-tailed Mongoose *(Herpestes brachyurus)* Bambun Ekor Pendek
48. Leopard Cat *(Felis bengalensis)* Kucing Batu
49. Marble Cat *(Felis marmorata)* Kucing Dahan
50. Flat Headed Cat *(Felis planiceps)* Kucing Hutan
51. Bay Cat *(Felis badia)* Kucing Merah
52. Asian Elaphant *(Elephas maximus)* Gajah
53. Banteng *(Bos javanicus)* Tembadau
54. Sei Whale *(Balanopthera borealis)* Okan Paus Sei
55. Bryde's Whale *(Balanoptera edent)* Ikan Paus Bryde
56. Killer Whale *(Orcinus orca)* Ikan Paus Buding
57. Short-finned Pilot Whale *(Globicephala macrorhynchus)* Ikan Paus Pendek Sirip
58. Pygmy Sperm Whale *(Kogia breviceps)* Ikan Paus Nayan
59. Grey Dolphin *(Grampus griseus)* Dolfin Kelabu
60. Bottlenose Dolphin *(Tursiops truncatus)* Dolfin Hidung Botol
61. Indo-Pacific Hump-backed Dolphin *(Sousa chinensis)* Dolfin Bengkok Bernie
62. Irrawaddy Dolphin *(Orcaella brevirostris)* Dolphin Empesut
63. Finless Porpoise *(Neophocaena phocaenides)* Ikan Lumba-lumba Ambu
64. Fraser's Dolphin *(Lagenodelhis hosei)* Dolfin Fraser
65. Long Snouted Spinner Dolphin *(Stenella longirostra)* Dolfin Hidung Mancung

PART 1: PROTECTED ANIMALS - REPTILES

1. Estuarine Crocodile *(Crocodylus porosus)* Buaya
2. False Gharial *(Tomistoma schlegeli)* Buaya Julung-julung
3. Monitor Lizard *(Varanus spp.)* Biawak
4. Reticulated Python *(Python reticulatus)* Ular Sawah Panjang
5. Blood Python *(Python curtus)* Ular Sawah Darah
6. King Cobra *(Ophiophagus hannah)* Ular Tedung Selar
7. Forest Tortoise *(Tetsudo emys)* Kura-kura Bukit
8. Asian Giant Turtle *(Orlitia borneonsis)* Juku-juku Besar

Chapter IV: Socio Economic Characteristics

This chapter provides data and information in relation to the socio-economic characteristics of Malaysia especially near the coastal areas and its population. It includes demographic pattern; resource use patterns and issues relevant to marine and coastal related industries such as in fisheries, coastal tourism, minerals, oil & gas and transportation & shipping. Latest data is used where available.

Top-right: Emma-class containership berthed at Port of Tanjung Pelepas, Johor, Peninsular Malaysia by Faris Jamaluddin; ; Top-left: Paragliding on Feringgi Beach of Penang, Peninsular Malaysia; source: http://goseasia.about.com/od/malaysiastopattractions/ig/Images-of-Penang/Batu-Ferringhi-.htm ; Bottom-right: Fish left to dry as salted fish at Penarik Village, Terengganu, Peninsular Malaysia by Choo Tse Chien, source: http://www.pbase.com/tsechien/image/23664930 ; Bottom-left: Night market in Kota Kinabalu, Sabah, source: http://travelerfolio.com/filipino-night-market-kota-kinabalu/

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AET	American Eagle Tanker
AMIM	Association of Marine Industries of Malaysia
APEC	Asia-Pacific Economic Cooperation
CLC	Civil Liability Convention
DSLB	Domestic Shipping Licensing Board
DWT	Deadweight tonnage
EPP	Entry Point Projects
ES	Ecosystem services
ETP	Economic Transformation Plan
GBH	Global Biodiversity Hub
GDP	Gross Domestic Product
GNI	Gross National Income
GRT	Gross Register Ton
HIS	Household Income Survey
ICZM	Integrated Coastal Zone Management
IMP2	Second Industrial Master Plan
(IMP3	Third Industrial Master Plan
LNG	Liquefied Natural Gas
MARA	Majlis Amanah Rakyat
MDG	Millennium Development Goals
MIGHT	Malaysian Industry-Government Group for High Technology
MISC	Malaysia International Shipping Corporation
MISF	Malaysian Iron and Steel Federation
MMHE	Malaysian Marine Heavy Engineering
MoT	Ministry of Transport
MRC	Marine Resource Conservation
MSY	Maximum sustainable yield
NKEA	National Key Economic Areas
PES	Payment for Ecosystem Services

PES	Payment for Ecosystem Services
PETRONAS	Petroliam Nasional Berhad
PSC	Production Sharing Contracts
RIMP	Redang Island Marine Park
RINA-IMarEST	Royal Institution of Naval Architects and the Institute of Marine Engineering, Science and Technology
STMP	Sabah Tourism Master Plan
TEU	Twenty foot equivalent container units
TARP	Tunku Abdul Rahman Park
TIMP	Tioman Island Marine Park
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UPM	Universiti Putra Malaysia
VLCC	Very Large Crude Carriers

DEMOGRAPHY

As in many South East Asian countries, multiple ethnic groups represent the demographics of Malaysia. The three main groups are Malay, Chinese and Indians. The statistical data in this report derived from the 2010 Population and Housing Census of Malaysia (Census 2010) and the fifth decennial census to be conducted after the 1970, 1980, 1991 and 2000 census.

Malaysia's general population is estimated to be 28.3 million, which makes it the 44th most populated country in the world (DSM, 2010). Of these, 74.1% (22.5million) lives in Peninsular Malaysia and the remaining 20.59% (5.72million) resides in East Malaysia (Sabah, Sarawak and Federal Territory of Labuan). A further breakdown of the population based on administrative States is presented in Table 4-1.

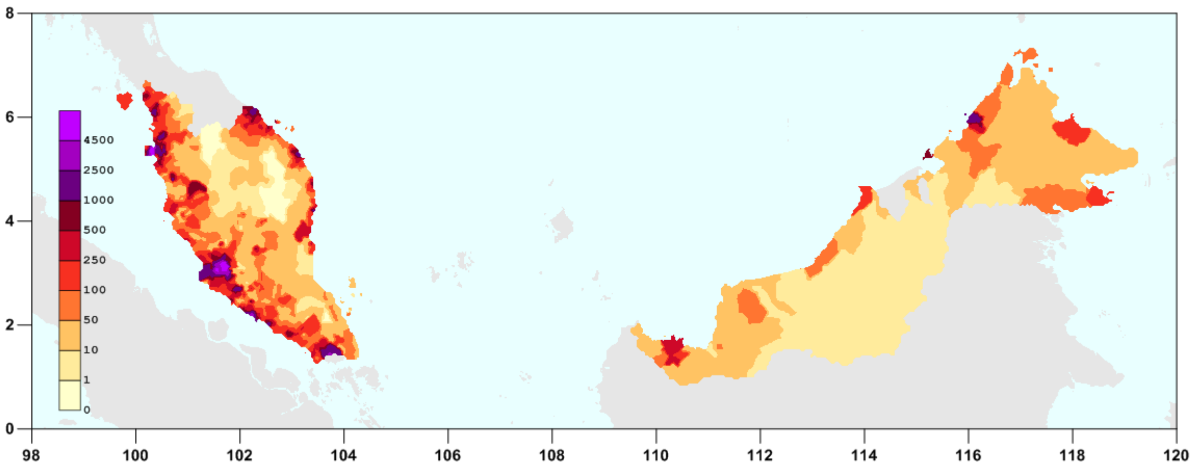
The Malays makes up the majority of the population with 53.3%, excluding other *bumiputra*[1] group which comprises of another 11.8%. According to the constitutional definition, the Malays are Muslims who practice Malay customs and culture. The *bumiputra* status is also accorded to a certain non-Malay indigenous group of people; this includes the Thais, Khmers, Chams and the natives of Sabah and Sarawak. Non-Malay *bumiputra* makes up of more than half of Sarawak's population and over two-thirds of Sabah's population. There are other aboriginal groups in smaller numbers in the Peninsular Malaysia, where they are known as the *Orang Asli*.

The other minorities who are non-*bumiputras* are of Chinese descent (26%), Indians (7.7%) and others (1.2%). The Chinese have been dominant in the business and commerce community and forms the majority of the population of Penang. The Indians are mostly from the Tamil community who migrated to Malaysia in the early 19th century.

The majority of the population are Muslims (60.4%) and Islam is the official religion of the country. Other religions include Buddhism (19.2%), Christianity (9.1%), Hinduism (6.3%) and others (5%).

The official language is Bahasa Melayu (Malay); however, most are fluent in English in addition to other languages such as the various dialects of Chinese, Tamil and other indigenous dialects.

FIGURE 4- 1: MALAYSIA 2010 ESTIMATED POPULATION DENSITY. DATA SHOWN AS PERSONS PER KM2



source: Socioeconomic Data and Applications Center (SEDAC)

[1] *Bumiputera* or *Bumiputra* is a Malay term widely used in Malaysia, embracing indigenous people of the Malay Archipelago

FIGURE 4- 2: MAP OF MALAYSIA

source: http://www.i-google-map.com/gfx/maps/big/my-map.gif

Growth Rate

Census 2010 revealed the average annual population growth rate of Malaysia is at 2% for the period 2000-2010. The rate was lower compared to that of 2.6% from the previous census (1991-2000). However, the average growth rate between 2009 and 2010 is at 1.3% for the whole country (please refer to Table 4-1). The highest growth rate is in the State of Kelantan with 1.9% and the lowest growth rate is in Sabah at 1%.

Population Distribution

Population distribution by state indicated that Selangor is the most populous state (5.1 million), followed by Johor (3.3 million) and Sabah (3.2 million). The population share of these three states to the total population of Malaysia is 42.4%. The least populated state is Federal Territory of Labuan at 94.2million. Interestingly, as a coastal nation, only three cities located along the coastline are in the top 10 most populated cities category. These capital cities are Johor Bahru (Johor), Kuching (Sarawak) and Kota Kinabalu (Sabah). Although Klang is not the capital city of the state of Selangor, it is the Royal Capital of the state. Both Klang and Johor are located along some of the major shipping route and operate several major ports in the region such as the NorthPort, WestPort and Port of Tanjung Pelepas.

As at 2003, approximately 98% of the total population resides within 100km of the coast (PEMSEA, 2003).

Population Density

Population density of Malaysia stands at 85 persons per square kilometre in 2010 compared with 71 persons in 2000. Unlike population distribution, the population density revealed a different scenario. As the most populous state, Selangor is fifth in terms of population density with 674 persons per square kilometre. Among the most densely populated states are Federal Territory Kuala Lumpur (6,891persons) and Pulau Pinang (1,490 persons) and Putrajaya (1,478) (Pelase refer to Figure 4-3).

TABLE 4- 1: BASIC POPULATION CHARACTERISTICS BASED ON ADMINISTRATIVE STATES

State / District	Area (sq. km)	Population ('000) (revised)		Population density (per sq. km)		Average Annual Population Growth Rate (%)	*Sex Ratio	
		2009	2010	2009	2010	2009-2010	2009	2010
MALAYSIA	**330,803**	**27,895.3**	**28,250.5**	**84**	**85.00**	**1.3**	**104**	**104**
Johor	19,210	3,269.1	3,305.9	170	172	1.1	107	107
Kedah	9,500	1,942.6	1,966.9	204.0	207.0	1.2	98	98
Kelantan	15,099	1,639.0	1,670.5	109.0	111.0	1.9	100	100
Melaka	1,664	761.6	771.5	458	464	1.3	101	101
Negeri Sembilan	6,686	1,000.3	1,011.7	150	151	1.1	106	106
Pahang	36,137	1,516.7	1,534.8	42.0	42.0	1.2	114	114
Pulau Pinang	1,048	1,580.0	1,596.9	1,508.0	1,524.0	1.1	97	96
Perak	21,035	2,427.6	2,460.8	115.0	117.0	1.4	101	101
Perlis	821	237.0	240.1	289.0	292.0	1.3	96	96
Selangor	8,153	5,033.5	5,102.6	617.0	626.0	1.4	103	103
Terengganu	13,035	1,035.8	1,050.0	79.0	81.0	1.4	106	106
Federal Territory Kuala Lumpur	243	1,703.1	1,722.5	7,009	7,089	1.1	103	103
Sarawak	124,450	2,470.8	2,506.5	20.0	20.0	1.4	104	104
Sabah	73,631	3,183.8	3,214.2	43.0	44.0	1	107	107
Federal Territory Labuan	91	94.2	95.5	1,035.0	1,049.0	1.3	28.1	28.5

*Sex ratio is the ratio of the number of males for every 100 females.

source: http://www.statistics.gov.my/portal/download_Population/files/BPD/population_quarters_2010.pdf

TABLE 4- 2: LARGEST CITIES IN MALAYSIA

Rank	City name	State	Population	Rank	City name	State	Population
1	Subang Jaya	Selangor	1 553 589	11	Cheras	Selangor	601 534
2	Kuala Lumpur	Federal Territory	1 435 337	12	Sandakan	Sabah	501 195
3	Klang	Selangor	1 113 851	13	Kajang	Selangor	448 243
4	Johor Bahru	Johor	916 409	14	Seremban	Negeri Sembilan	439 296
5	Ampang Jaya	Selangor	804 901	15	Kuantan	Pahang	422 020
6	Ipoh	Perak	704 572	16	Tawau	Sabah	381 736
7	Shah Alam	Selangor	671 282	17	Kuala Terengganu	Terengganu	286 317
8	Kuching	Sarawak	658 549	18	Miri	Sarawak	280 518
9	Petaling Jaya	Selangor	638 516	19	Kota Bahru	Kelantan	272 647
10	Kota Kinabalu	Sabah	604 078	20	Selayang Baru	Selangor	265 297

source: http://www.statistics.gov.my/portal/download_Population/files/BPD/population_quarters_2010.pdf

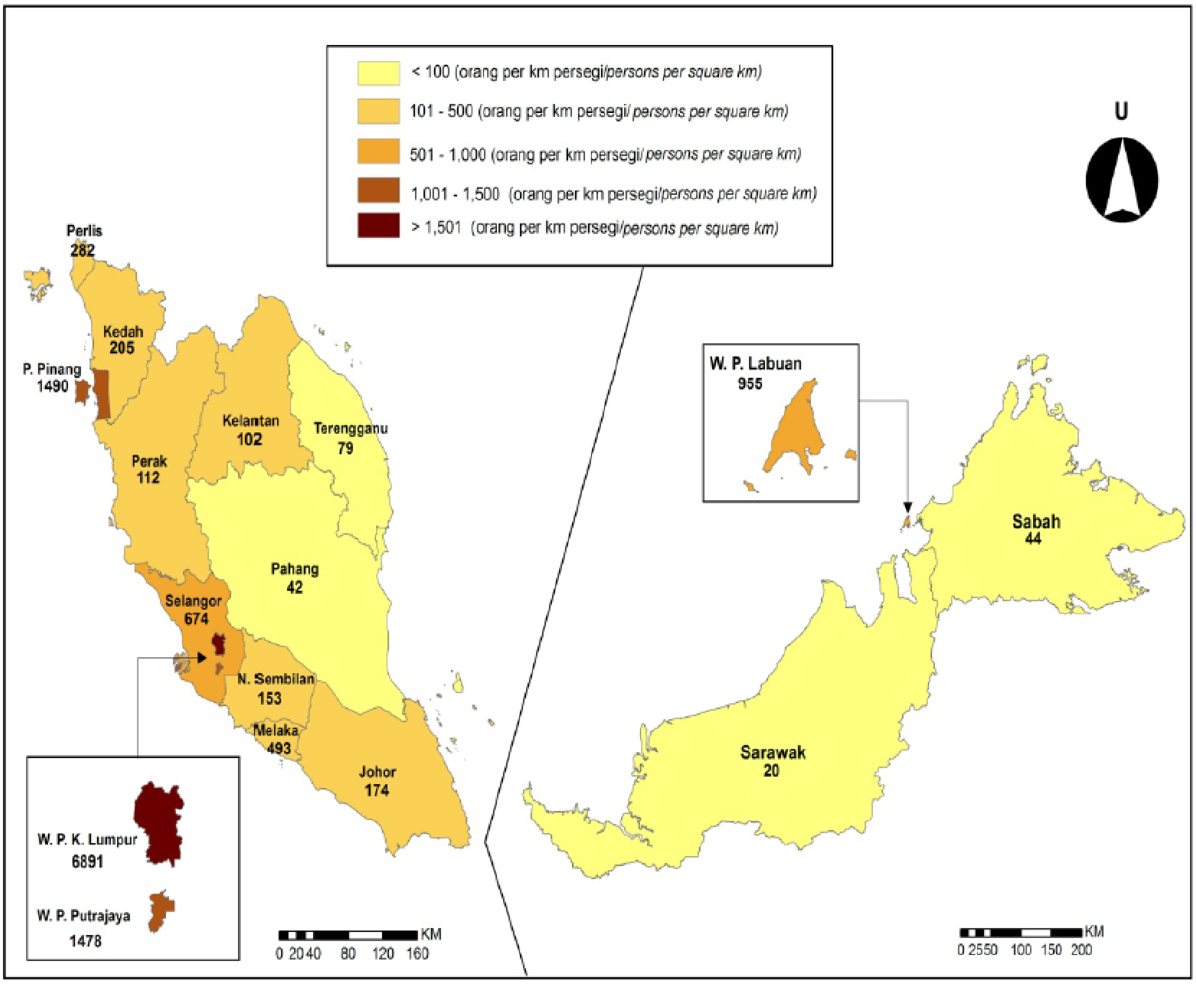
SEX RATIO

On average, the sex ratio has been fairly unchanged between 2009 and 2010 at 104 males over 100 females. Similar pattern was observed in year 2000 (104). The ratio of males to females is relatively high for Pahang (114), Johor (107), W. P. Labuan (110), Sabah (107), Negeri Sembilan (106), and Sarawak (104). On the other hand, women in Kedah, Pulau Pinang and Perlis outnumbered the men.

URBAN POPULATION

In tandem with Malaysia's rapid development, the proportion of urban population has increased to 71.0% in 2010 compared with 62.0% in 2000 (2010 Census). Apart from Federal Territory Kuala Lumpur with 100 % level in urbanisation, other states with high level of urbanisation are Selangor and Pulau Pinang with 88.45% and 80.93% respectively. Conversely, the states with lower urbanisation levels are Perlis (35.69%), Kelantan (36.14%) and Kedah (40.77%). Please refer to Table 4-3 for rural and urban population statistics and Figure 4-4 for the percentage of urban population in 2010.

FIGURE 4- 3: POPULATION DENSITY BY STATE, 2010



source: Census, 2010

TABLE 4- 3:URBAN AND RURAL POPULATION

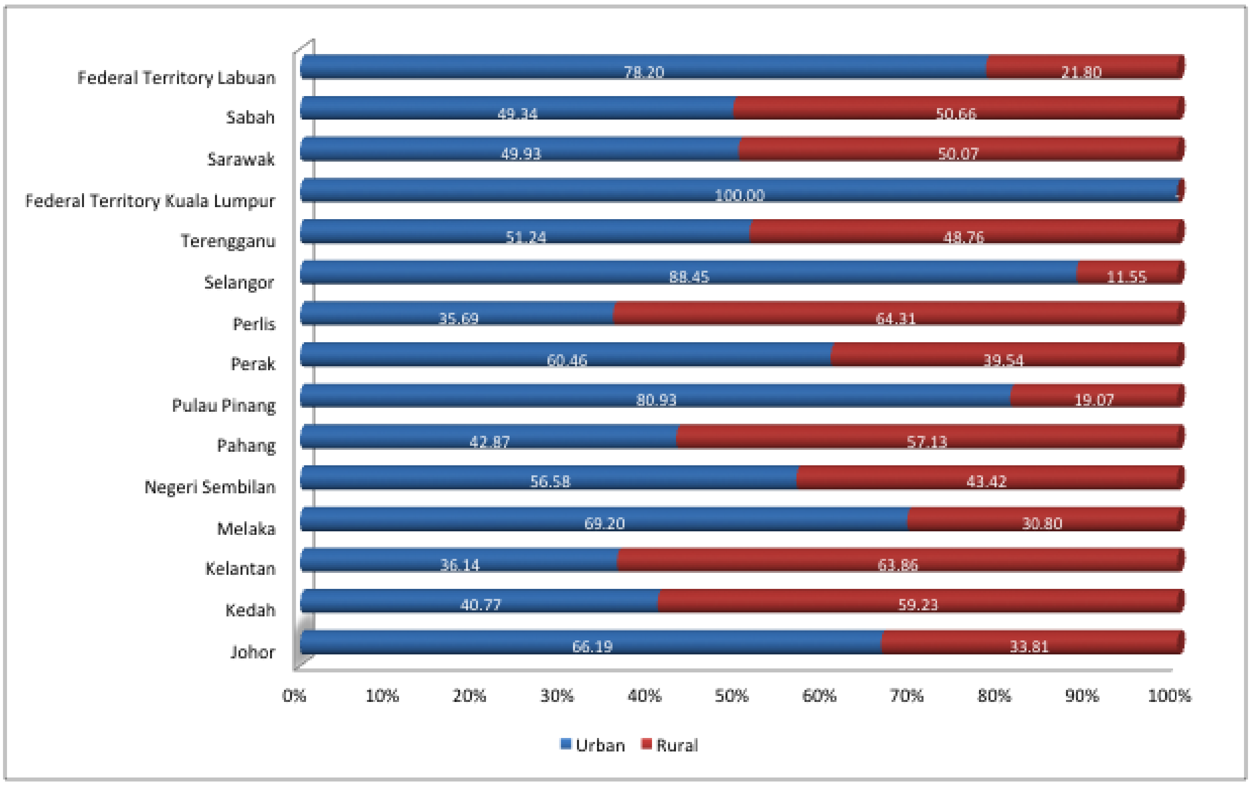
State / District	Urban ('000)		Rural ('000)		Total ('000)	
	2000	2010	2000	2010	2000	2010
MALAYSIA	**14,567.0**	**17,909.5**	**8,928**	**10,340.90**	**23,494.9**	**28,250.40**
Johor	1,790.7	2,188.2	971.9	1,117.7	2,762.6	3,305.9
Kedah	653.1	801.8	1,018.8	1,165.0	1,671.9	1,966.8
Kelantan	456.0	603.8	905.4	1,066.7	1,361.4	1,670.5
Melaka	436.3	533.9	210.3	237.6	646.6	771.5
Negeri Sembilan	475.5	572.4	390.5	439.3	866.0	1,011.7
Pahang	544.3	657.9	751.5	876.9	1,295.8	1,534.8
Pulau Pinang	1,062.8	1,292.3	269.9	304.6	1,332.7	1,596.9
Perak	1,235.7	1,487.8	856.1	973.0	2,091.8	2,460.8
Perlis	70.6	85.7	137.0	154.4	207.6	240.1
Selangor	3,673.6	4,513.1	515.2	589.4	4,188.8	5,102.5
Terengganu	446.2	538.0	456.4	512.0	902.6	1,050.0
Federal Territory Kuala Lumpur	1,416.0	1,722.5			1,416.0	1,722.5
Sarawak	996.5	1,251.6	1,075.0	1,255.0	2,071.5	2,506.6
Sabah	1,251.7	1,585.8	1,351.8	1,628.4	2,603.5	3,214.2
Federal Territory Labuan	58.0	74.6	18.0	20.8	76.0	95.4

source: http://www.statistics.gov.my/portal/download_Population/files/BPD/population_quarters_2010.pdf

AGE

The proportion of the population of Malaysia below the age of 15 years decreased to 27.6% compared to 33.3% in 2000. In contrast, the proportion of working age population (15 to 64 years) increased to 67.3% from 62.8 %. The proportion of population aged 65 years and over also increased to 5.1% as compared with 3.9% in 2000. Consequently, the median age increased from 23.6 years in 2000 to 26.2 years in 2010, while the dependency ratio dropped from 59.2 % to 48.5 %. The trend of these indicators is in line with the transition of age structure towards aging population of Malaysia (Census, 2010).

FIGURE 4- 4: PERCENTAGE OF URBAN POPULATION BY STATE, 2010



RESOURCE USE PATTERNS AND ISSUES

INTRODUCTION

Traditional economic measurements of the production and industrial economy of the marine economies such as the Gross Domestic Product (GDP) are not generally presented in a way that is relevant for the examination of coastal and marine related issues (McIlgorm, A., 2009). Information on economic drivers, the nature and the size of industries in the marine economy is essential for national and coastal planning.

There is no one generally-accepted definition of the marine economy as it is both a measure of economic activity related to ocean industries and activities; it also includes economic goods and services in coastal region (McIlgorm, A., 2009). One definition describes the *ocean economy* as -

> *"that portion of the economy which relies on the ocean as an input to the production process or which, by virtue of geographic location, takes place on or under the ocean. It is a function of both industry and geography...while most of the ocean economy is located in coastal regions, some of the ocean economy (e.g. boat-building, seafood retailers and many ocean instrumentation, equipment and surveying industries) may be located in non-coastal region," ...it is that "portion of economic activity which takes place on or near the coast (whether defined as coastal watershed, coastal zone, or near shore areas). The coastal economy consists of all economic activity in the coastal region, and is thus the sum of employment wages, and output in the region." - Colgan ,2004*

In 2005, the Asia-Pacific Economic Cooperation (APEC) Marine Resource Conservation (MRC) Working Group published a report in which it attempted to identify several sectors that qualifies as marine-related industries. Table 4-4 reflects these categories.

TABLE 4- 4: APEC/MRC ROUNDTABLE ON EASTER ISLAND

1.	Oil & gas (i.e. minerals)
2.	Fisheries / Aquaculture (i.e. living resources including sea plants)
3.	Shipping (i.e. transportation and shipbuilding)
4.	Defence /Government (i.e. government services)
5.	Marine Construction (i.e. coastal defences and restoration)
6.	Marine Tourism (i.e. leisure services)
7.	Manufacturing (i.e. equipment, medicines, etc)
8.	Marine Services (e.g. mapping, surveying, consulting); and
9.	Marine Research and Education

source: McIlgorm, 2004

The first three categories are easily identifiable as ocean industries and the marine data can be readily identified. The remaining categories have issues delineating between land and sea components of an economic activity. There is also a differing capacity among countries to provide data for each category. In a recent study, a survey has been made to identify the different ocean industry sector data that is available for six international member APEC economies. Please refer to Table 4-5.

TABLE 4- 5: OCEAN ECONOMY INDUSTRY SECTORS PROPOSED BY APEC FOR SIX DIFFERENT NATIONAL STUDIES

Ocean economy - APEC industry sectors	Australia	Canada	France	New Zealand	United Kingdom	USA
Oil and gas (minerals)	•	•	•	•	•	•
Fisheries/aquaculture (living resources)	•	•	•	•	•	•
Shipping (marine transportation and ship building)	•	•	•	•	•	•
Defense/government		•	•		•	n/a
Marine construction		•	•	•	•	•
Marine tourism (leisure services)	•	•	•	•	•	•
Manufacturing (equipment)		•		•	•	
Marine services (mapping, surveying, consulting)		•	•	•	•	
Marine research and education			•		•	

* n/a - data not available.

source: Kildow and Mcllgorm, 2009

In addition to the traditional economic measures such as the Gross Domestic Product (GDP), rate of employment and taxation revenues, non-market values are also vital especially in estimation of marine and coastal related economies. Non-market estimates, are quite separate from GDP measures that indicate changes over time (Mcllgorm, A., 2009). Their purpose is to estimate recreational and environmental asset and service values, which are not measured in the market place, but have unmeasured values, or consumer surplus values that provide benefits . Estuaries, beaches, watershed and mangroves are a few of these natural assets. These areas provide pollution filtration, nursery grounds for fisheries, and buffers from strong storms - are some examples of natural assets providing environmental services. Please refer to '*Payment for Ecosystem Services (PES)*' section of this Chapter.

There are some preliminary investigations in East Asia that suggests the need for a consistent framework to enable accurate comparisons between countries to be made. The following countries have commenced studies through a PEMSEA[2] project.

Based on Table 4-6 above, for Malaysia, marine data for all categories are available except for those in relation to defence, marine services and marine research & education. However, these data are not easily available in public domain.

HOW INFORMATION ON MARINE ECONOMY MAY ASSIST POLICY MAKERS?

Information on marine economy is useful for policy-makers in several ways.

Policy-makers are able to identify and be made aware of potential policy impacts on producers and consumers in the marine economy. In many East Asian economies, large ports, coastal fishing communities, and marine tourism are located close to each other and have direct impact on one another. Information on the economic value and contribution of each industry should be made available in order for policy makers to make better informed-decisions. For example, a plan for a port expansion may impact on marine tourism given the proximity of both of these industries. Therefore, good economic information on both industries may assist policy-makers to decide on the best course of action for the benefit of both industries.

Having knowledge of the structure of the ocean economy can be used to evaluate how external events such as impact of climate change and environmental change may affect the ocean economy. The 2004 tsunami in Southeast Asia affected many coastal nations and requires substantial funding for rebuilding program. Due to the lack of previous studies on the economic value of the various marine and coastal industries, studies for impact assessments are more challenging to resource economist and policy makers to determine the magnitude of the economic losses suffered by the affected nations.

[2] Partnerships in Environmental Management for the Seas of East Asia

TABLE 4- 6: A COMPARISON OF APEC INDUSTRY CATEGORY DATA AVAILABLE AMONG SOUTHEAST ASIAN ECONOMIES

Ocean economy - APEC industry sectors	Indonesia	Japan	RO Korea	Malaysia	Philippines	Thailand	Vietnam
Oil and gas (minerals)	•	•	•	•	•	•	•
Fisheries/aquaculture (living resources)	•	•	•	•	•	•	•
Shipping (marine transportation and ship building)	•	•	•	•	•	•	•
Defense/government	n/a	n/a	Some	n/a	Some	•	•
Marine construction	•	•	•	n/a	n/a	•	•
Marine tourism (leisure services)	•	•	•	•	•	•	•
Manufacturing (equipment)	•	n/a	•	•	•	n/a	•
Marine services (mapping, surveying, consulting)	•	n/a	Some	n/a	n/a	•	n/a
Marine research and education	n/a	n/a	n/a	n/a	•	•	n/a

source: adaptation from the national marine economy studies in Volume 16 of the Tropical Coasts, 2009

Capture Fisheries

Background

Marine capture fisheries are an important economic sector for Malaysia, not only as a major food source but also a generator of foreign exchange and employment. In 2010, per capita fish consumption in the country was 56kg making fish a strategic food commodity (Abdullahi *et al.,* 2010). In 2010, the marine capture fisheries (comprised of inshore and deep-sea fisheries) produced 1,428,881 tonnes (70.93% of total national fish production) with a value of RM6.7billion, an increase of 2.56% from previous year (Department of Fisheries, 2010).

There are four major fishing grounds in the country i.e. the waters of the West and East Coasts of Peninsular Malaysia and off Sarawak and Sabah states. The government defines resources within 30 nautical miles from the shore as coastal and those beyond that as deep sea or offshore. The resources in these grounds can be further categorised as demersal and pelagic. Demersal catch revolves around a multitude of species, none of which are individually dominant. On the other hand, the pelagic species count is much smaller, some of which are of major economic concern.

In general, most of the fishing grounds in Peninsular Malaysia are located in the shallow waters of less than 40m and relatively near to the mangroves (Arshad *et al.*, 1997). Coastal resources are exploited by both commercial and traditional fishing gear while deep-sea fisheries are harvested mainly by larger commercial boats. Commercial gears consist of the trawl and purse seines, while traditional or artisanal fishing gear consist large of drift/gill nets, hook and line and bags nets. Though the number of artisanal gear outnumbers commercial gear, the latter lands almost 81% of the national catch.

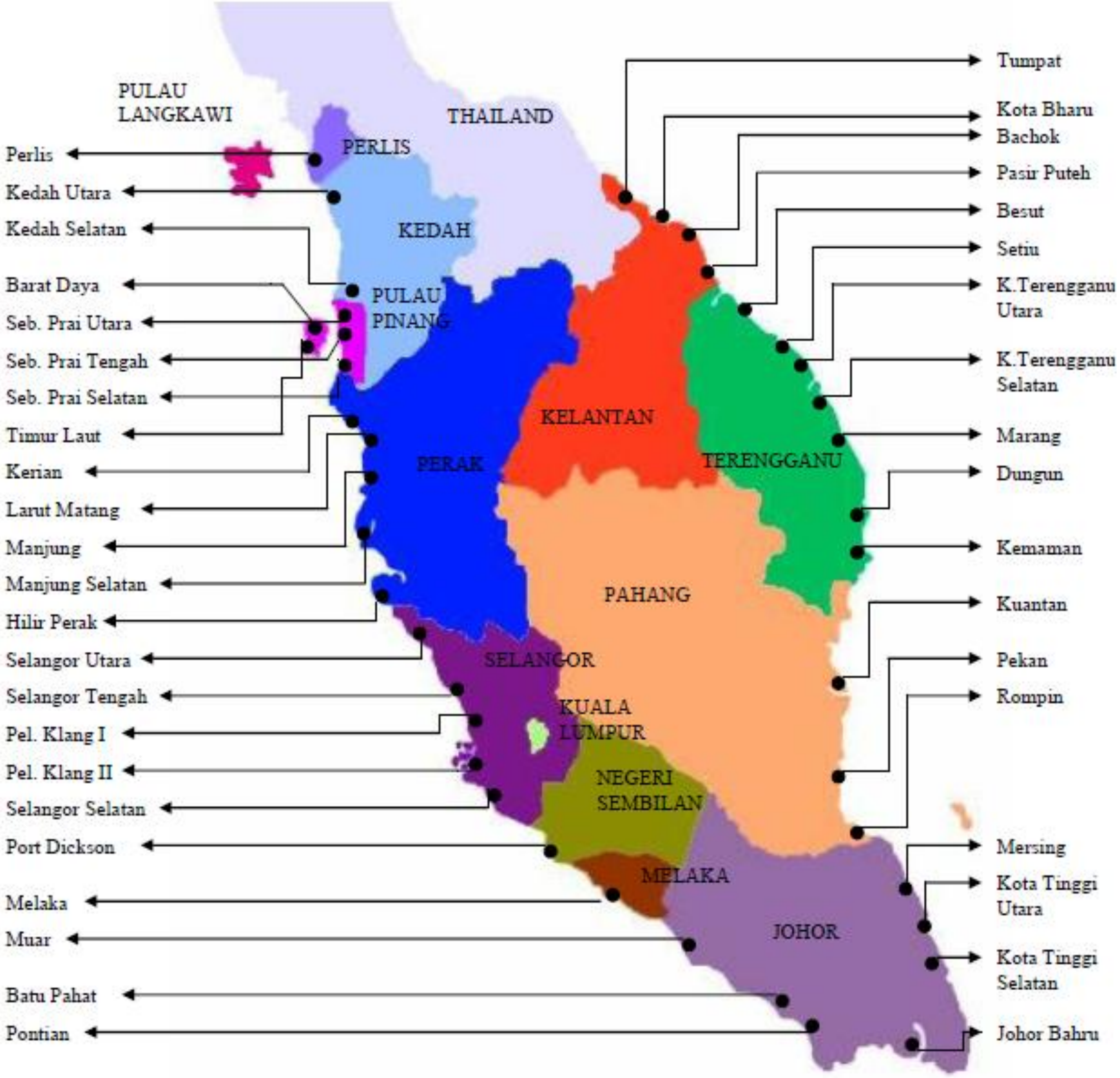
Approximately 75% of fish landed in Malaysia is for human consumption, mostly consumed fresh but also frozen and cured. The other 25% is processed into fertilizer and fishmeal (Department of Fisheries, 2009). There is also high demand for fish from fish brokers, fish assemblers, whole sellers, fish processors and the Fishermen's Associations (Jamaludin, 2004).

Government efforts generally focused on upgrading basic infrastructure and attracting new investments particularly the offshore fisheries. The offshore fishery is still relatively small but substantial government efforts are being invested in pushing for a "blue water" fisheries fleet. Various measures such as issuance of new permits and new licenses for deep-sea fishing as well as the training of fishermen have been implemented to ensure the expansion and development of the deep sea fishing industry but have yet proven to be successful.

Fisheries Districts

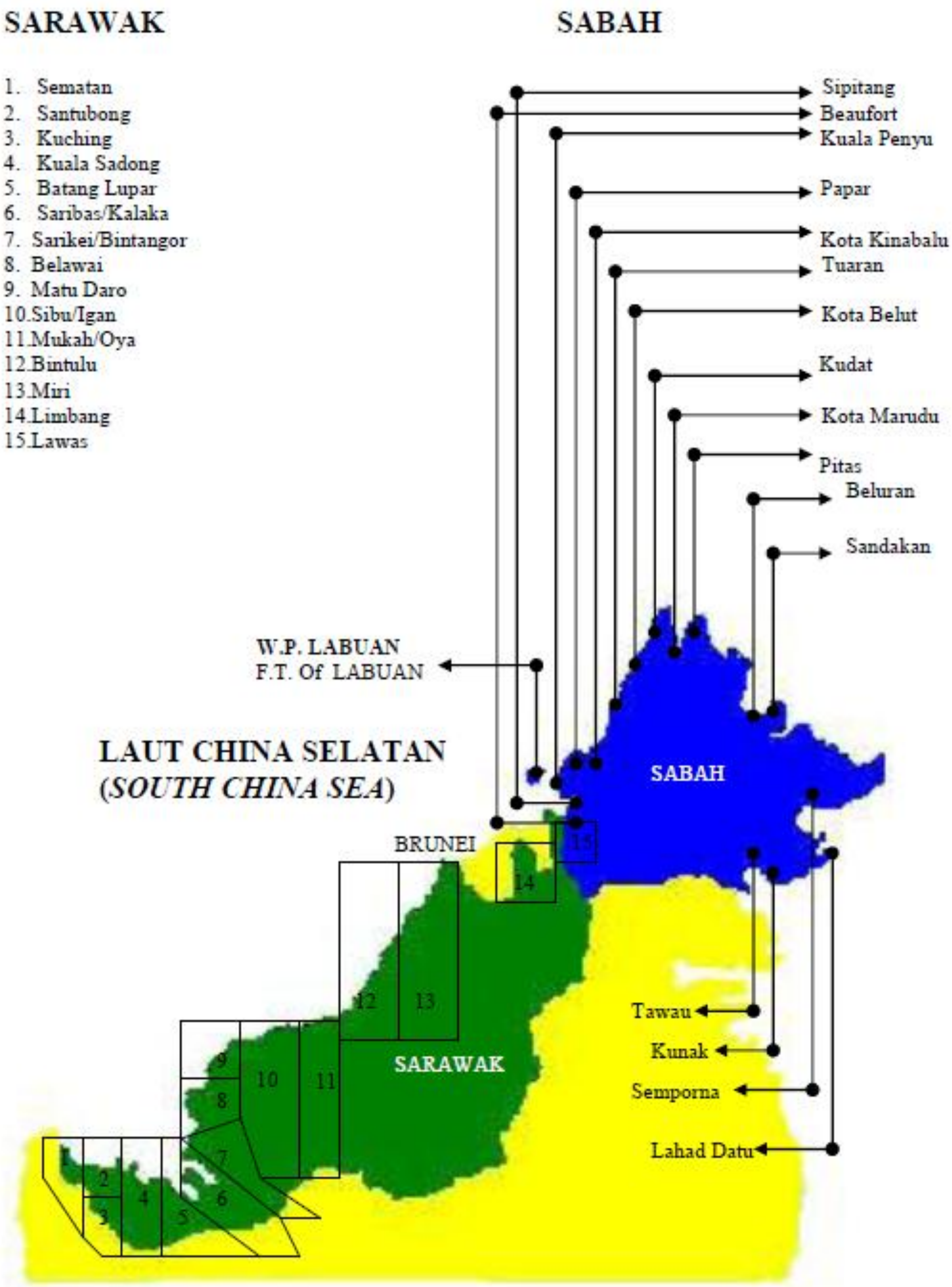
There are a total of 92 fisheries districts in Malaysia, of which 24 are located in west cost of Peninsular Malaysia, 17 in East Coast of Peninsular Malaysia, 16 in Sarawak and 16 in Sabah (included F.T of Labuan) (Figures 4-5 / 6).

FIGURE 4- 5: FISHERIES DISTRICT IN PENINSULAR MALAYSIA



source: Department of Fisheries, 2009

FIGURE 4- 6: FISHERIES DISTRICT IN SARAWAK AND SABAH (INCLUDE F.T LABUAN)

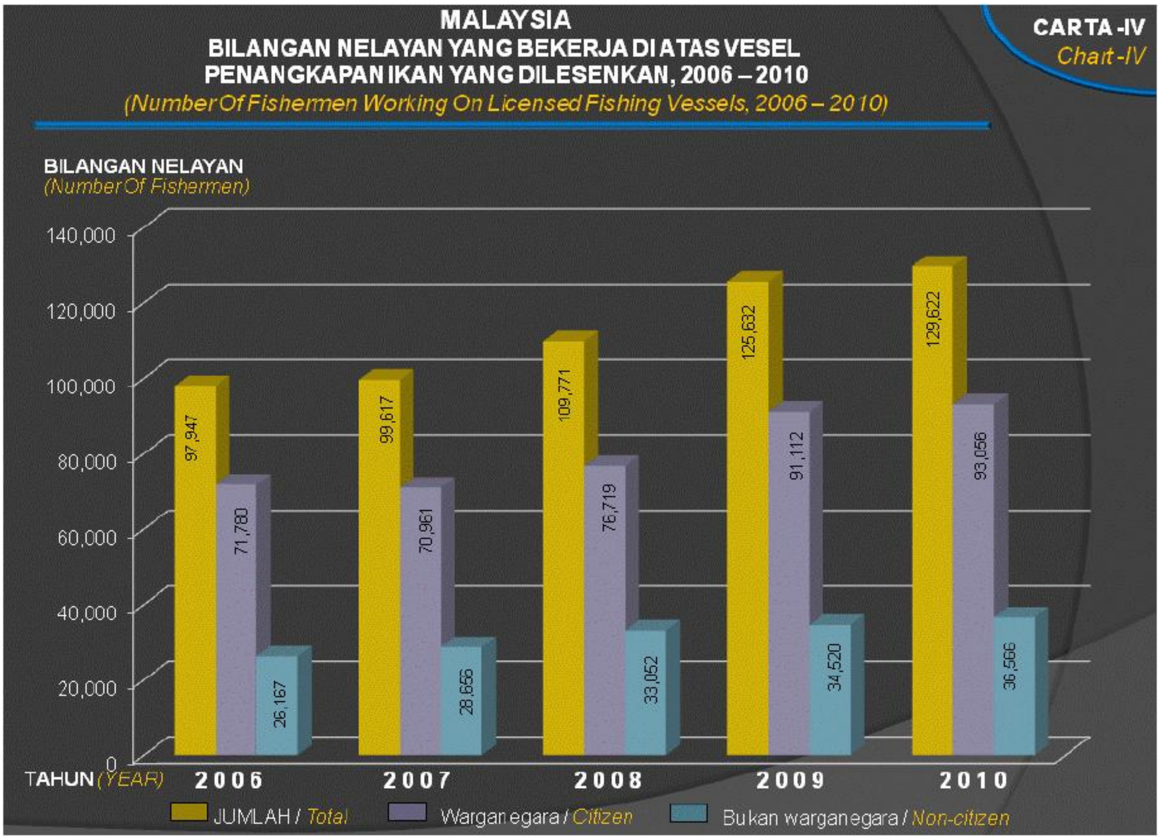


source: Department of Fisheries, 2009

FISHING POPULATION

Fishermen in Malaysia are defined as those who undertake fishing activities at least 120 days in a year. Those fishing less than 120 days are considered as part time fishers. A total of 129,622 fishermen were recorded working on licensed fishing vessels in 2010 compared to125,632 in 2009 - an increase by 3.18%[3]. Out of this total, 93,056 (72%) were local fishermen while 36,566 (28%) were foreign fishermen (non-Malaysian citizens) from Thailand, Vietnam and Indonesia. The number of local fishermen increased by 2.13% compared to a higher percentage increase of 6% of foreign fishermen. Figure 4-7 illustrates the number of fishermen working on different types of fishing vessels. A total of 54,334 (41.92%) fishermen worked on board commercial fishing vessels using trawl, fish purse seine and anchovies purse seine nets while the remainder 75,288 (58.08%) fishermen worked on board fishing vessels operating traditional fishing gears.

FIGURE 4- 7: NUMBER OF FISHERMEN WORKING ON LICENSED FISHING VESSELS (2006-2010)



source: Department of Fisheries, 2010

In spite of various policies and programs introduced by the government over the last 40 years, fishermen continue to be amongst the poorest communities in the country. Based on a 2004 Household Income Survey (HIS), a total of 26,576 poor and hardcore poor fishermen were recorded in the country. Of this number, 53.4% were from Sabah, where 10,647 categorised as poor, while 3,545 as hardcore poor. Second and third highest number of poor fishermen recorded was Terengganu-based fishermen (18.4%; 3,723 poor, 1,178 hardcore poor) and Kedah (5.4%; 1,151 poor, 288 hardcore poor) (Table 4-7). Based on a survey called "*E-kasih*" there were approximately 2,036 poor and hardcore poor fishermen in the east coast of Peninsular in 2006 (Table 4-7), of which highest numbers recorded from Kuala Terengganu (21.0%), followed by Marang (10.8%), Setiu (10.5%), Tumpat (9.3%) and Rompin (7.4%).

[3] Based on 2011 (estimated) data, there is an increase of 11.42% of total number of fishermen; from 129,622 to 144,424. However, there is no data on the segmentation of Malaysian and non-Malaysian fishermen. However, it is safe to assume that the percentage of non-Malaysian fishermen is higher compared to Malaysian fishermen. Source: Malaysian Agrofood Policy (2011-2020) Statistics Book, p.106

TABLE 4- 7 : NUMBER OF POOR AND HARDCORE POOR FISHERMEN IN MALAYSIA, 2004

State	No. of Poor Fishermen	No. of Hardcore Poor Fishermen
Perlis	-	122
Kedah	1,151	288
Penang	53	-
Perak	805	315
Selangor	833	-
Negeri Sembilan	-	-
Melaka	55	-
Johor	1,066	-
Kelantan	654	244
Terengganu	3723	1,178
Pahang	719	-
Sarawak	988	190
Sabah	10,647	3,545
Total	**20,694**	**5,882**

source: Household Income Survey (HIS), 2004

TABLE 4- 8: NUMBER OF POOR FISHERMEN BASED ON E-KASIH

State	District	Poor	Hardcore Poor	Near Poor	Total
Kelantan	Kota Bharu	22	9	12	**43**
	Pasir Puteh	32	16	29	**77**
	Bachok	21	20	30	**71**
	Tumpat	63	37	89	**189**
Terengganu	Besut	55	40	49	**144**
	Setiu	56	90	67	**213**
	Kuala Terengganu	160	95	173	**428**
	Marang	64	51	105	**220**
	Dungun	38	30	31	**99**
	Kemaman	57	36	55	**148**
Pahang	Kuantan	20	12	24	**56**
	Pekan	43	47	58	**148**
	Rompin	76	64	11	**151**
Johor	Mersing	15	10	24	**49**
Total		**722**	**557**	**757**	**2,036**

source: e- Kasih, JPM-ICU

It is important to note that the *E-kasih* statistics do not identify fishermen as such. The categorisation is "those who can fish" i.e. have fishing skills. This does not necessarily mean they are licensed fishermen. They could also be part time fishermen, or those who fished on a subsistence basis. Based on the Household Income Survey, only 20% are poor, while a further 6% are hardcore poor. The data, however, is eight years old and may no longer be valid. Notwithstanding that, the data clearly points to the Sabah and Terengganu as hotbeds of poverty in the fishing industry.

A major feature of the Malaysian fishing population is its relative age. Surveys at several fishing bases indicate to an aging population with low recruitment levels. The relative dominance of the various age ranges varies from base to base depending on the immediate economic environment. However, data from several fishing villages indicated that most fishermen are within the 41 to 64 year old age range, representing 50% - 70% of the total number of fishermen at their bases such as at Kuala Sg. Bharu (Melaka), Sg. Duyong (Melaka), Pulau Kambing (Terengganu), Paka (Terengganu) and Kuala Kemaman (Terengganu). However, at Setiu lagoon, most of the fishermen are within 26 to 40 years old (70%). The low population of fishermen within the 17- 25 years is mainly due to availability of alternative land-based job opportunities. This group are mainly located in Kuala Sg. Bharu, Sg. Duyong and Pulau Kambing, which is all located close to major urban areas, thus offers more interesting and less physically demanding jobs.

The impact of this trend is likely to be felt in the next 20 years when most of those in the 41 to 64 year old age range are retired. The low rate of recruitment would mean that there would be a serious lack of labour in the coastal fisheries, leading to abandonment of fishing activity or alternatively, increase in the employment rate of foreign labour. Though, the use of foreign labour is ostensibly limited to deep-sea vessels, the use of foreign labour in traditional vessels in developed states like Melaka is quite common. The foreign labours are not hired as employees, but operate the boats on a lease-basis from its owner and, being self-employed, do not require a work permit.

The practices of 'leasing' fishing boats to foreign operators are becoming a norm in the country and although it meets the 'tonnage' requirements, it does not contribute to the productivity of the local fishermen. Traditional practices will be used for quite some time, as the local fishermen are unable to invest in modern vessels and equipment due to poor credit rating.

West Coast of Peninsular Malaysia

The fisheries resources in the Straits of Malacca are the most exploited in the country. This can be attributed a greater intensity of fishing effort in these waters, a consequence of the dense populations that line its coastline as well as the rapid development of the trawl and purse-seine fishery from the mid-sixties (Khoo, 1976). In 2007, the waterway supports 40,831 fishermen, which is equivalent to 41% of the national fishing population. The highest number (10,580 fishermen; 20.9%) are from Perak, followed by Kedah (8,531; 20.9%) and Selangor (7078; 17.3%). Other states recorded less than 6,000 persons (Table 4-9). *Bumiputeras* constituted 38.1% of the fishing population, followed by Chinese (35.6%) and Thais (23.5%) (Department of Fisheries, 2009).

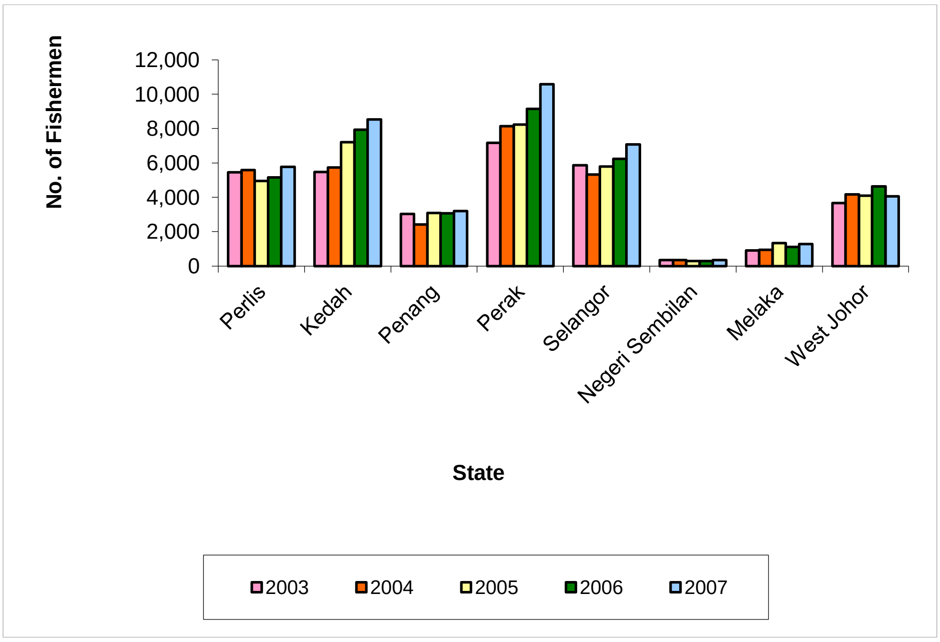
The number of fishermen in Perak and Selangor showed an increasing pattern from 2003 – 2007, while a similar pattern was observed in Perlis and Penang over the period of 2005 – 2007. In Negeri Sembilan, Melaka and West Johor, the number of fishermen fluctuated over the 2003 – 2007 period (Figure 4-8). Overall, the number of licensed fishermen increased by 27.8% from 31,939 in 2003 to 40,831 in 2007 (Figure 4-9).

TABLE 4- 9: NUMBER OF FISHERMEN IN WEST COAST OF PENINSULAR MALAYSIA, 2003- 2007

State	Year				
	2003	2004	2005	2006	2007
Perlis	5,464	5,577	4,960	5,156	5,766
Kedah	5,473	5,732	7,215	7,936	8,531
Penang	3,024	2,427	3,089	3,066	3,193
Perak	7,166	8,136	8,234	9,143	10,580
Selangor	5,868	5,328	5,799	6,241	7,078
Negeri Sembilan	358	353	295	300	353
Melaka	914	948	1,330	1,112	1,273
West Johor	3,672	4,165	4,097	4,638	4,057
Total	**31,939**	**32,666**	**35,019**	**37,592**	**40,831**

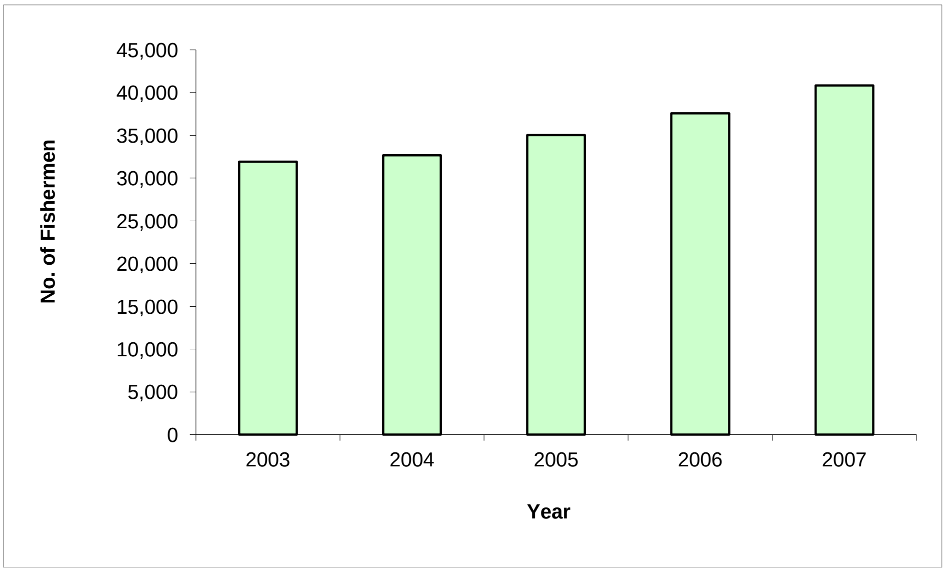
source: Department of Fisheries, 2005 - 2009

FIGURE 4- 8: NUMBER OF FISHERMEN IN WEST COAST OF PENINSULAR MALAYSIA, 2003 – 2007



source: Department of Fisheries, 2005 - 2009

FIGURE 4- 9: TRENDS OF THE NUMBER OF FISHERMEN IN WEST COAST OF PENINSULAR MALAYSIA, 2003 - 2007



source: Department of Fisheries, 2005 - 2009

EAST COAST OF PENINSULAR MALAYSIA

Although the waters off the east coast of Peninsular Malaysia cover a much larger area, catch per unit area is lower than the West Coast. However, fishing remains the mainstay of a significant rural economy and of critical importance in its many communities. In 2007, the east coast fishery supports over 25,901 fishermen (26% of national total).

Highest numbers of fishermen are from Terengganu (8,651), followed by Kelantan (6,714) and Pahang (5,559) (see Table 4-10). Most of the fishermen are *bumiputeras*, (55.9% of the fishermen in east cost of Peninsular Malaysia), followed by Thais (36.9%) and Chinese (6.0%) (Department of Fisheries, 2009).

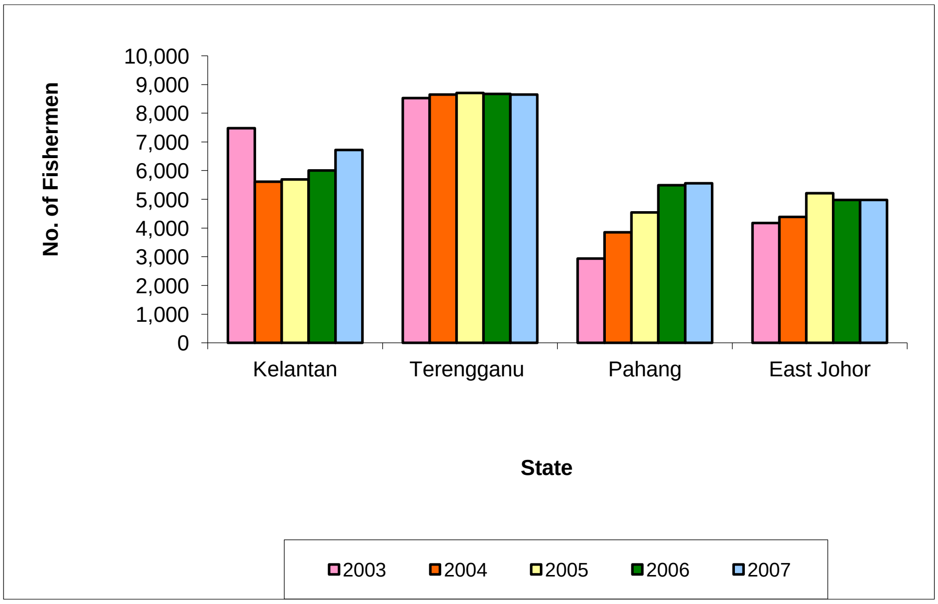
The number of fishermen in Kelantan decreased between 2003 to 2004, but, on an increasing trend since then. In Terengganu, the number of fishermen has been relatively stable over the years. In contrast, fishing population has grown steadily in Pahang over 2003 - 2007. In east Johor, the fishing population increased from 2003 to 2005, before decreasing slightly in 2007 (Figure 4-10). Overall, the total number of fishermen in east coast of Peninsular has decreased slightly (2.6%) from 2003 to 2004. Interestingly, the fishermen population has been on the rise 15.1% from 2004 to 2007 (Figure 4-11).

TABLE 4- 10: NUMBER OF FISHERMEN IN EAST COAST OF PENINSULAR MALAYSIA, 2003- 2007

State	Year				
	2003	2004	2005	2006	2007
Kelantan	7,481	5,616	5,695	6,007	6,714
Terengganu	8,529	8,654	8,706	8,670	8,651
Pahang	2,932	3,848	4,539	5,497	5,559
East Johor	4,174	4,386	5,213	4,982	4,977
Total	**23,116**	**22,504**	**24,153**	**25,156**	**25,901**

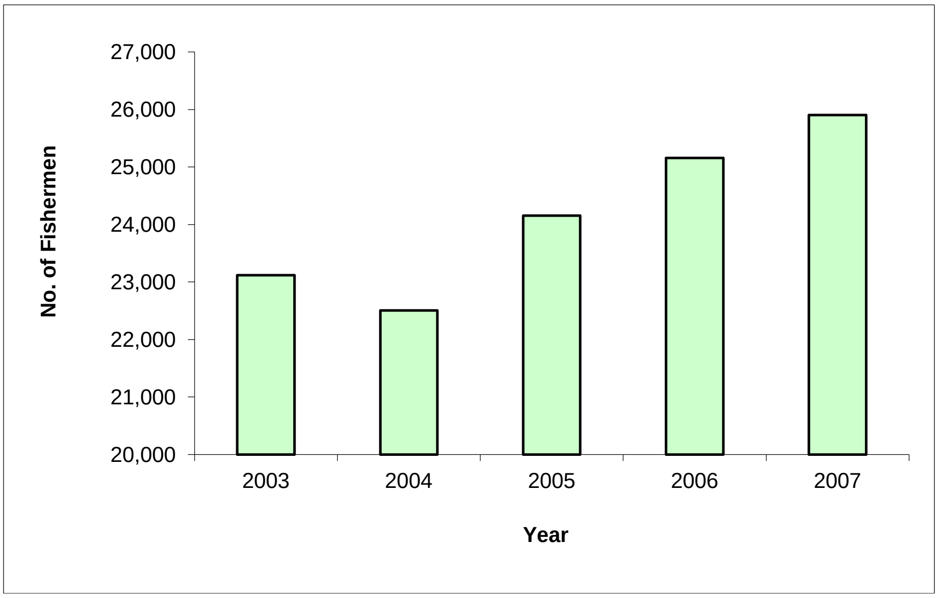
source: Department of Fisheries, 2005 - 2009

FIGURE 4- 10: NUMBER OF FISHERMEN IN EAST COAST OF PENINSULAR MALAYSIA, 2003 – 2007



source: Department of Fisheries, 2005 - 2009

FIGURE 4- 11: TRENDS OF THE NUMBER OF FISHERMEN IN EAST COAST OF PENINSULAR MALAYSIA, 2003 – 2007



source: Department of Fisheries, 2005 - 2009

SARAWAK

In 2007, there are approximately 11,440 fishermen in the state. 17.1% of the total fishermen are based in Tg. Manis; 1,449 (12.7%) in Kuching district; 1,235 (10.8%) in Belawa; and 1,148 (10.0%) in Mukah/ Oya (Table 4-11). The numbers of fishermen for the other districts are smaller, ranging from 136 – 891. Despite the economic dominance of the commercial gears, artisanal fishermen capture the major proportion of fishermen in the state.

Thus, from a socio-economic standpoint, the artisanal fishermen still represent a significant consideration in the industry. The total number of fisherman has fluctuated over the years, decreasing by 21.7% over period between 2003 - 2005, increased 34.5% in 2006, before decreasing back by 17.8% in 2007 (Figure 4-12).

The fluctuating number of fishermen was mainly influenced by inconsistent number recorded over the years by several districts such as Santubong, Sadong Jaya, Saribas/ Kalaka, Matu Daro and Limbang. Bintangor and Miri showed an increasing pattern from 2003 to 2005, then decreased slightly in 2006, before increasing back in 2007.

SABAH

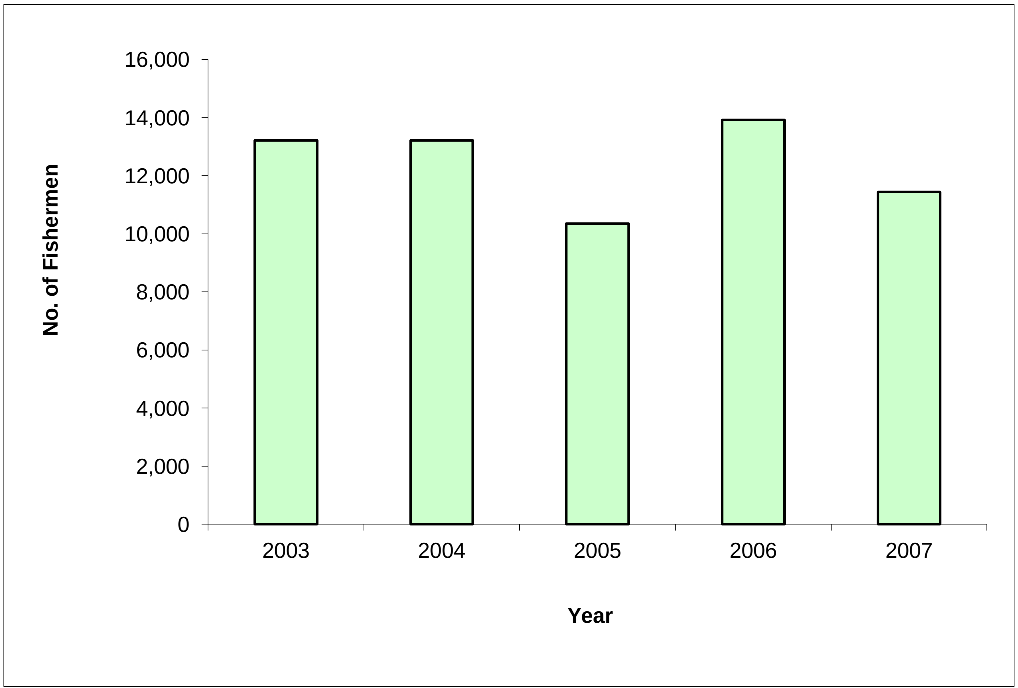
The Sabah fishery population has increased by 11% from 21,445 (2007) to 23, 763 (2008) fishermen. The *bumiputeras* comprised of the majority population with 73.7% followed by others (25%) and Chinese (1.3%). Based on 2007 figures, the highest number of fishermen are from Sandakan (3,987), followed by Kudat (2,915) and Tawau (2,036). A higher proportion of the fishermen work on gears such as gill nets, hook & line and trawl nets (Sabah Department of Fisheries, 2008).

TABLE 4- 11: NUMBER OF FISHERMEN IN SARAWAK, 2003- 2007

State	Year				
	2003	2004	2005	2006	2007
Kuching	1,646	1,646	1,484	1,497	1,449
Santubong	639	639	399	926	581
Sadong Jaya	623	623	178	346	287
Sematan	504	504	379	200	185
Batang Lupar	523	523	364	383	602
Saribas/Kalaka	563	563	351	593	542
Sibu/ Igan	825	825	609	447	374
Sarikei/ Bintangor	297	297	338	295	337
Mukah/ Oya	1,694	1,694	891	739	1,148
Belawai	2,597	2,597	2,907	364	342
Tg. Manis				4,691	1,957
Matu Daro	1,139	1,139	635	1,276	1,235
Bintulu	731	731	485	674	802
Miri	916	916	966	866	891
Limbang	109	109	76	155	136
Lawas	400	400	282	461	572
Total	**13,206**	**13,206**	**10,344**	**13,913**	**11,440**

source: Department of Fisheries, 2005- 2009

FIGURE 4- 12: TRENDS OF THE NUMBER OF FISHERMEN IN SARAWAK, 2003 – 2007



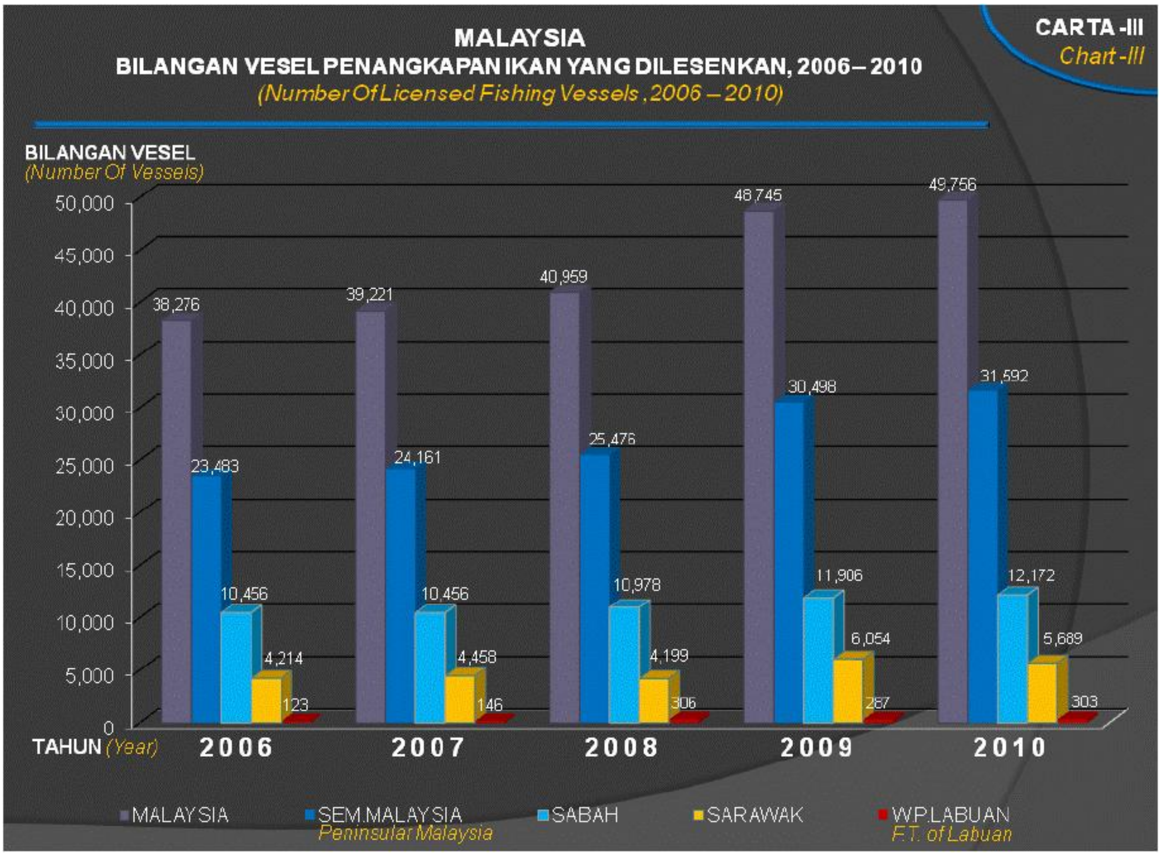
source: Department of Fisheries, 2005- 2009

Fishing Vessels

On the whole, the number of licensed fishing vessels in Malaysia has increased by 2.07% from 48,745 units in 2009 to 49,756 units in 2010. This was due to the increase in the licensing of traditional fishing vessels (Department of Fisheries, 2010).

In 2010, the number of licensed fishing vessels in Peninsular Malaysia was recorded at 31,592 units, which accounted for 63.49% of the total national fishing fleet. The number of fishing fleet recorded in the West Coast was 22,285 units contributing 70.54% of the total vessels in Peninsular Malaysia, while the East Coast recorded 29.46% of the total vessels which was 9,307 units. In the West Coast, the bulk of the fishing vessels were from the state of Perak which accounts for 25.23% of total licensed fishing vessels while the state of Terengganu recorded the highest number of fishing vessels in the East Coast with 3,107 units (33.38%). The number of deep-sea fishing vessels remained small compared to those operating in the inshore waters. Deep-sea fishing vessels are fishing vessels of sizes 70GRT and above which are licensed to fish in waters 30 nautical miles from the shore up to the Exclusive Economic Zone boundary. In 2010, there were 48,589 units of fishing vessels licensed to fish in the inshore waters. There were only 1,167 units of licensed deep-sea fishing vessels in 2010, increasing by 11.57% from 1,046 units in the year 2009. The said deep-sea fishing vessels do not include vessels of sizes 70GRT and above licensed to fish for tuna, anchovy purse seiner, anchovy processing vessels as well as vessels of 70GRT and above operating lift nets, tuna long line and fish traps.

FIGURE 4- 13: NUMBER OF LICENSED FISHING VESSELS (2006-2010)



source: Department of Fisheries, 2010

CATCH AND CATCH VALUE

In 2010, the total marine landings increased by 2.56% which amounted to 1,428,881 tonnes as compared with 1,393,226 tonnes in 2009. The inshore landings increased slightly by 1.12% from 1,096,663 tonnes in 2009 to 1,108,897 tonnes in 2010. Landings from the deep-sea fisheries sector also recorded an increase of 7.90% from 296,563 tonnes in 2009 to 319,984 tonnes in 2010. Please refer to Table 4-12 and Figure 4-15.

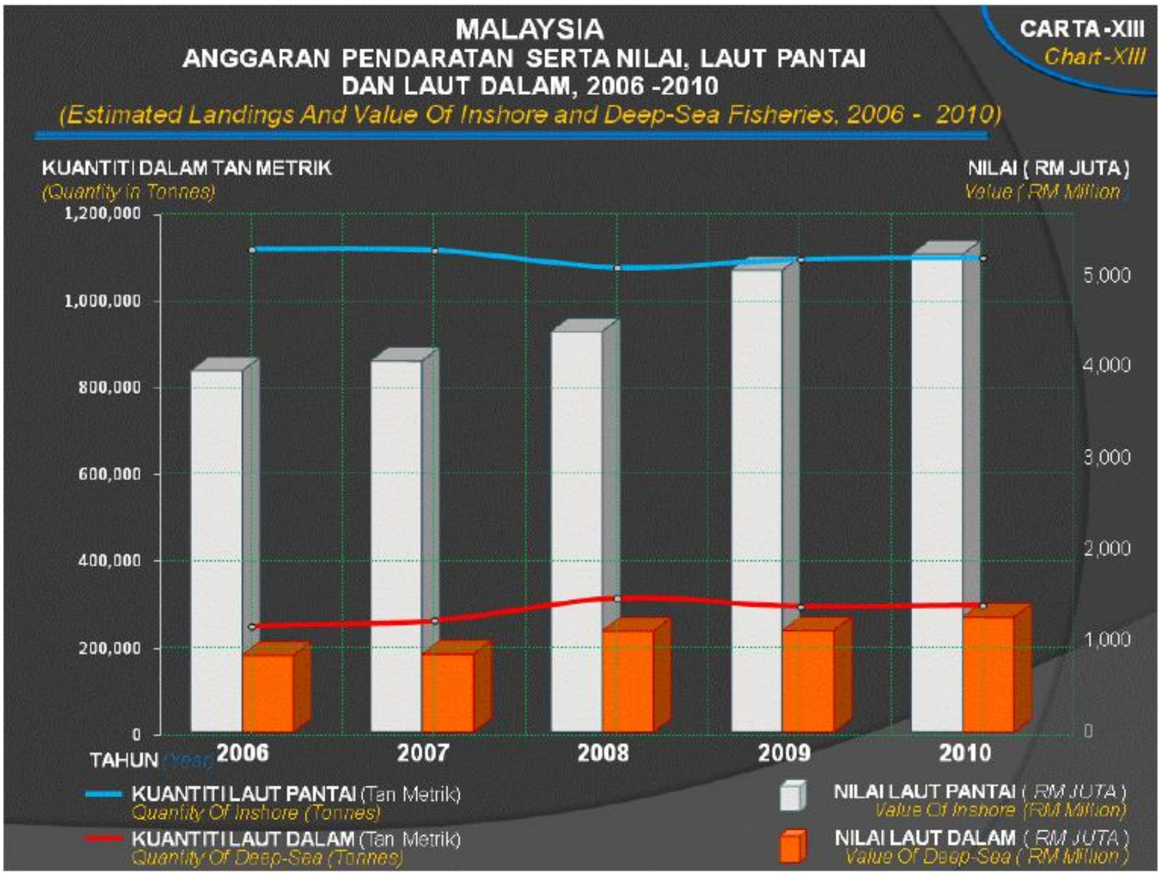
The total marine landings consisted of 37.28% pelagic fish amounting to 532.634 tonnes, 20.38% demersal fish amounting to 291,228 tonnes and 42.34% molluscs, crustacean and others which contributed 605,019 tonnes.

TABLE 4- 12: MARINE FISH LANDINGS AND VALUES BY STATE, 2010

State	Inshore Fishery		Deep-Sea Fishery		Total	
	Quantity (Tonnes)	Value (RM Million)	Quantity (Tonnes)	Value (RM Million)	Quantity (Tonnes)	Value (RM Million)
West Coast						
Perlis	125,082	542.44	40,216	168.66	165,298	771.10
Kedah	61,653	345.61	12,613	96.02	74,266	441.63
Penang	43,658	322.62	1,524	14.99	45,182	337.61
Perak	211,742	979.99	91,767	396.12	303,509	1,376.11
Selangor	144,098	508.13	342	1.34	144,440	509.47
N.Sembilan	690	9.19	0	0.00	690	9.19
Malacca	1,606	18.24	0	0.00	1,666	18.24
West Johor	20,775	173.22	0	0.00	20,775	173.22
Sub-Total	**609,364**	**2,899.44**	**146,462**	**677.13**	**755,826**	**3,576.57**
East Coast						
Kelantan	18,792	77.71	45,052	154.99	63,844	232.7
Terengganu	54,282	336.61	18,639	85.67	72,921	422.28
Pahang	93,728	500.64	27,191	120.76	120,919	621.40
East Johor	65,202	267.89	23,564	97.00	88,766	364.89
Sub-Total	**232,003**	**1,182.85**	**114,446**	**458.42**	**346,449**	**1,641.27**
Peninsular Malaysia	**841,367**	**4,082.30**	**260,908**	**1,135.55**	**1,102,275**	**5,217.85**
Sarawak	70,221	321.54	51,193	117.38	121,414	438.92
Sabah	169,342	709.29	5,237	11.16	174,579	720.45
W.P Labuan	27,967	249.84	2,646	24.83	30,613	274.67
Sub-Total	**267,530**	**1,280.67**	**59,076**	**153.37**	**326,606**	**1,434.04**
MALAYSIA	**1,108,897**	**5,362.97**	**319,984**	**1,288.92**	**1,428,881**	**6,651.89**

source: Department of Fisheries, 2010

FIGURE 4- 14: ESTIMATED LANDINGS AND VALUE OF INSHORE AND DEEP-SEA FISHERIES (2006-2010)



source: Department of Fisheries, 2010

In Peninsular Malaysia, the bulk of the landings are from trawlers with 569,415 tonnes (51.66%) followed by fish and anchovy purse seiners with 306,993 tonnes (27.85%) and vessels operating traditional fishing gears amounting to 225,866 tonnes (20.49%).

The West Coast contributed 755,826 tonnes (68.57%) whereby the state of Perak alone produced 303,509 tonnes (40.16%) followed by Perlis which produced 165,298 tonnes (21.87%). In the East Coast, the states of Pahang and East Johor are the main contributor with 120,919 tonnes (34.90%) and 88,766 tonnes (25.62%) respectively.

In terms of landings by trawlers in Peninsular Malaysia, it was observed that there was an increase in the landings of 3.46% on the West Coast from 379,326 tonnes in 2009 to 392,457 tonnes in 2010. On the East Coast, there was an increase of 3.99% registering 170,169 tonnes in 2009 to 176,958 tonnes in 2010.

The landings from fish purse seiners recorded an increase of 8.46% on the West Coast of Peninsular Malaysia from 168,574 tonnes in 2009 to 182,834 tonnes in 2010. Meanwhile, the landings from fish purse seiners on the East Coast showed a decline of 3.00% from 115,124 tonnes in 2009 to 111,673 tonnes in 2010. The state of Terengganu showed the highest decline of 17.61% to 35,010 tonnes as compared with 42,494 tonnes in 2009. This decline was due to the reduction in the number of licensed fish purse seine vessels by 9.43% from 265 units in 2009 to 240 units in 2010.

In 2010, a total of 3,318 tonnes of oceanic tuna valued at RM27.19 million were landed. This includes species such as the Yellow Fin Tuna, Big Eye Tuna and Albacore Tuna. The state of Sabah contributed 1,635 tonnes (49.28%) to the total oceanic tuna landings in Malaysia. Oceanic tuna landings from the state of Sabah showed an increase of 36.14% in 2010 as compared with 1,201 tonnes in 2009. Meanwhile, oceanic tuna landings from the state of Penang showed a decline of 40.84% from 2,282 tonnes in 2009 to 1,350 tonnes in 2010, which contributed 40.69% to the overall oceanic tuna landings in Malaysia.

In Peninsular Malaysia alone, 76.33% of the marine landings were contributed by the inshore fisheries sub-sector. The total landings had increased by 0.26% from 839,207 tonnes in 2009 to 841,367 tonnes in 2010. A large proportion which amounted to 73.06% was contributed by the commercial fishing vessels of sizes below 70 GRT operating trawl and fish purse seine gears. The landings from these fishing vessels decreased by 0.68% from 617,272 tonnes in 2009 to 613,099 tonnes in 2010.

The landings of the deep-sea fisheries in Peninsular Malaysia increased by 15.01% from 226,862 tonnes in 2009 to 260,908 tonnes in 2010. This figure constituted 81.54% of the nation's deep-sea fisheries landings. The value of the landings increased by 14.19% from RM994.41 million to RM1,135.55 million in 2010. A large portion of the deep-sea fisheries landings which amounted to 96.13% was contributed by trawlers and purse seiners of 70 GRT and above.

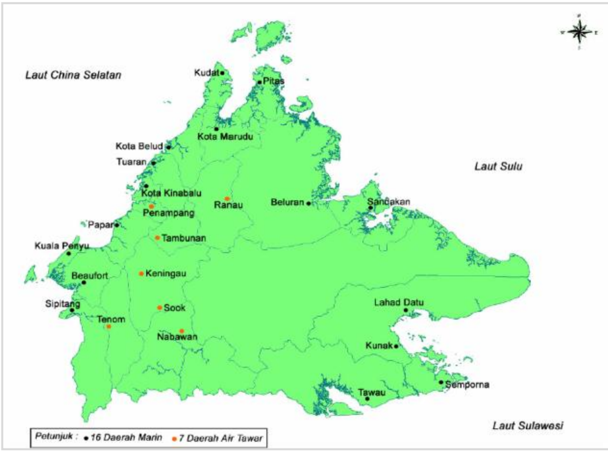
For Sabah, Sarawak and Federal Territory of Labuan, inshore fisheries landings increased by 3.91% from 257,456 tonnes in 2009 to 267,530 tonnes in 2010. However, the landings from the deep-sea fisheries decreased by 15.24% from 69,701 tonnes in 2009 to 59,076 tonnes in 2010. The state of Sabah showed the highest decline of 38.21% from 8,475 tonnes in 2009 to 5,237 tonnes in 2010. The bulk of the landings were contributed by fish purse seiners of 70 GRT and above.

SABAH

Landings in Sabah derived mainly from coastal fishery resources. Total marine landings in Sabah over the last 10 years has been a fluctuating one but has decreased from 1999 tonnage of over 202.2 thousand metric tonnes. In 2008, total marine fish landing in Sabah was recorded at 173.9 thousand metric tonnes, a 6% decrease from 2007 (Please refer to Figure 4-16 for illustration of the marine fish landing trend in Sabah).

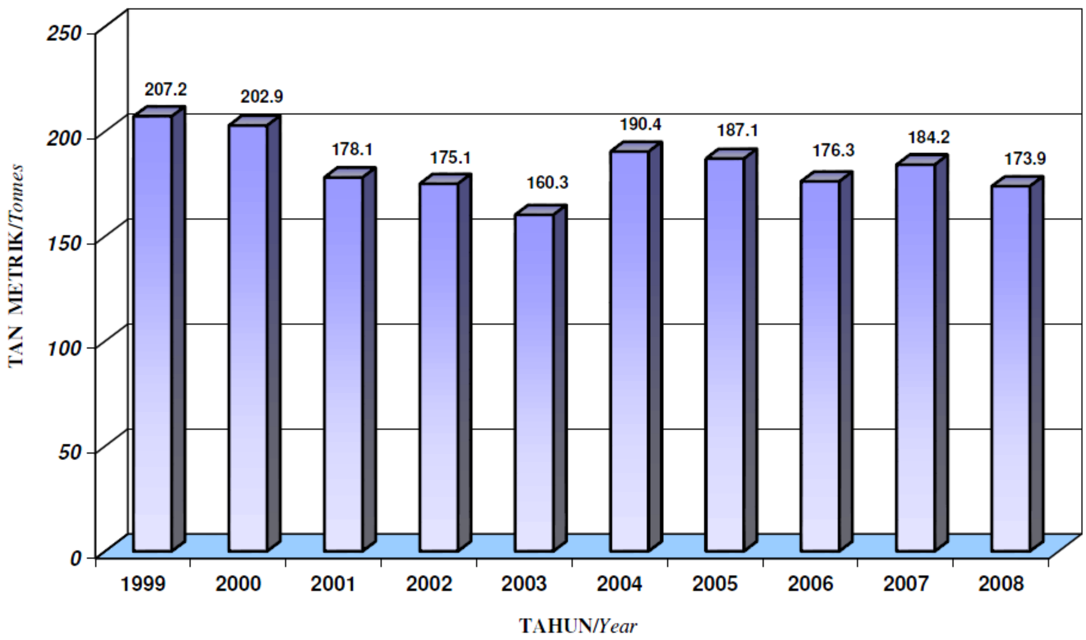
According to resources categories, based on 2007 statistics, both pelagic (37.9% or 80,407 tonnes) and demersal (35.7% or 75796 tonnes) contributed much on the total landings of Sabah. Shrimp, tunas, trash fish and others only comprised around 5 – 8.4% of total landings (Figure 4-17).

FIGURE 4- 15: SABAH FISHERIES DISTRICTS



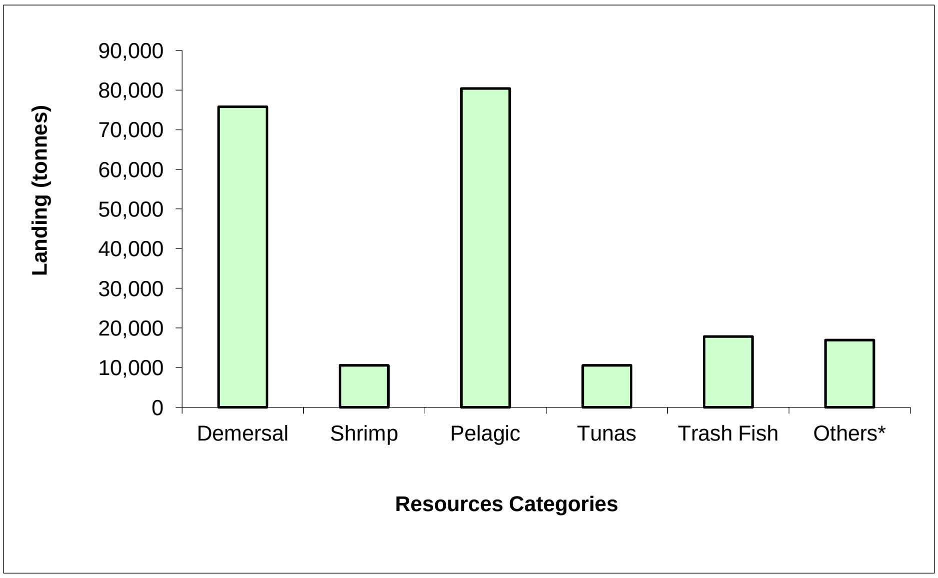
source: Department of Fisheries, Sabah (2009)

FIGURE 4- 16: SABAH MARINE FISH LANDING TREND (1999-2008)



source: Department of Fisheries, Sabah (2009)

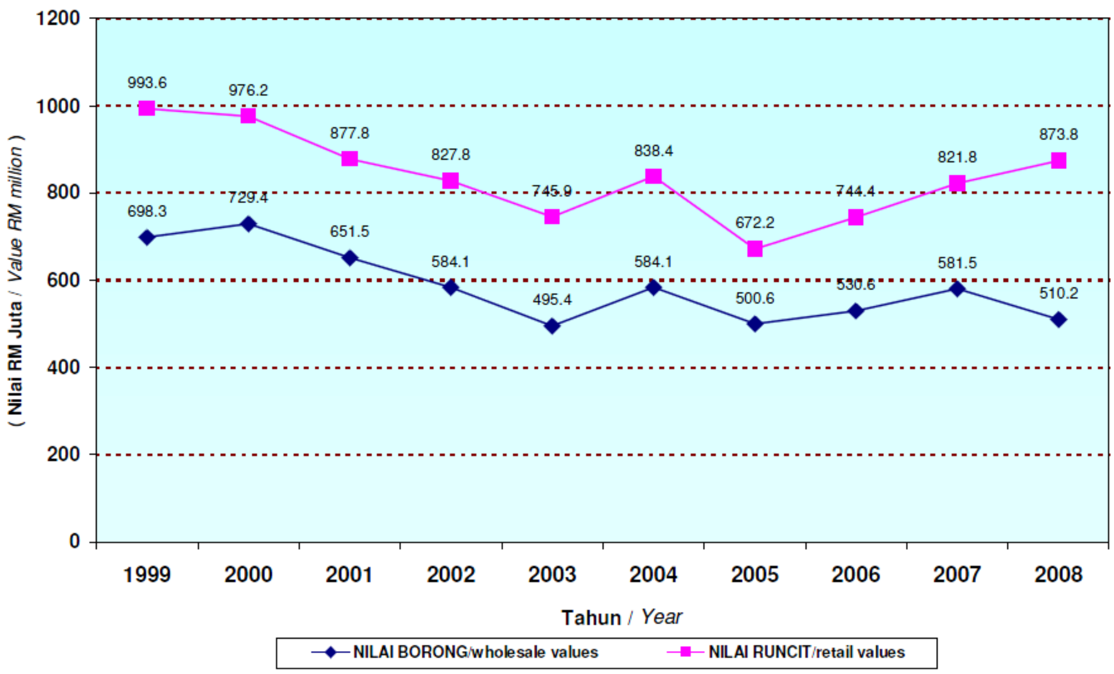
FIGURE 4- 17: LANDING BY RESOURCES CATEGORIES IN SABAH - 2007



source: Department of Fisheries, 2005 – 2009

From the economic standpoint, the wholesale values between 2005 to 2008 showed an increasing pattern in both wholesale and retail value, with the exception of a dip in 2008 wholesale value (Figure 4-18). An average catch value per boat per year was increased about 29.3% from RM66,428 to RM85,879 in 2003 and 2007 respectively (Table 4-13).

FIGURE 4- 18: SABAH MARKET VALUES OF MARINE FISH (1999-2008)



source: Department of Fisheries, Sabah (2009)

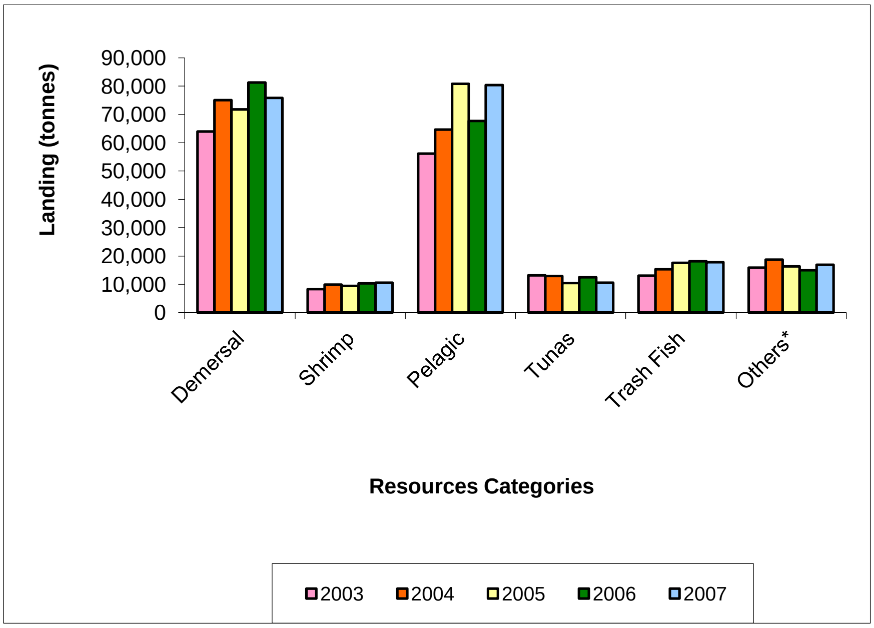
TABLE 4- 13: AVERAGE CATCH AND CATCH VALUE IN SABAH: 2003 – 2007

Year	No of Boat (Exclude Non Powered Vessels)	Total Catch (Tonnes)	Average Catch (Tonnes/Boat)	Total Catch Value (RM)	Average Catch Value (RM/Boat)
2003	8,064	170,641	21	535,674,774	66,428
2004	8,004	196,430	25	616,634,005	77,041
2005	8,049	206,376	26	687,683,896	85,437
2006	8,055	204,800	25	713,885,704	88,626
2007	8,078	212,107	26	693,727,713	85,879

source: Department of Fisheries, 2005 – 2009

As for resource categories, landings of demersal, shrimp, pelagic, tunas and others fluctuated 2003 – 2007 (Figure 4-19 and Table 4-14). In terms of value, the wholesale value for all resources categories generally increased (25.4 – 59%) from 2003 – 2007 excluding tunas which generally decreased (3.7%). From 2003 – 2007, in general, the retail value of demersal (91%), trash fish (226.7%) and others (53.6%) increased while the values of pelagic (10.2%), shrimp (7.6%) and tunas (25.2%) decreased (Table 4-16).

FIGURE 4- 19: TREND OF THE LANDINGS BY RESOURCES CATEGORIES IN SABAH (2003 – 2007)



source: Department of Fisheries, 2005 – 2009

TABLE 4- 14: LANDING BY RESOURCES CATEGORIES (2003 – 2007) – SABAH

Resources Category	Year				
	2003	2004	2005	2006	2007
Demersal	63,940	75,017	71,729	81,211	75,796
Shrimp	8,363	9,857	9,426	10,341	10,577
Pelagic	56,199	64,619	80,857	67,731	80,407
Tunas	13,181	12,917	10,415	12,459	10,563
Trash Fish	13,096	15,281	17,641	18,103	17,850
Others*	15,862	18,739	16,308	14,955	16,914
Total (Tonnes)	**170,641**	**196,430**	**206,376**	**204,800**	**212,107**

* Include Squids, Crabs, Jellyfish and Shellfish

source: Department of Fisheries, 2005 – 2009

TABLE 4- 15:WHOLESALE VALUE BY RESOURCES CATEGORIES (2003 – 2007) – SABAH

Resources Category	Year				
	2003	2004	2005	2006	2007
Demersal	364,012	437,232	398,423	447,802	454,864
Shrimp	131,663	157,061	151,442	154,526	165,146
Pelagic	252,653	299,540	341,996	301,101	374,661
Tunas	48,899	49,837	40,489	51,992	47,097
Trash Fish	4,715	5,196	6,880	7,060	7,497
Others*	90,293	108,808	101,565	101,133	120,192
Total (RM)	**892,234**	**1,057,674**	**1,040,795**	**1,063,614**	**1,169,457**

* Include Squids, Crabs, Jellyfish and Shellfish

source: Department of Fisheries, 2005 – 2009

TABLE 4- 16:RETAIL VALUE BY RESOURCES CATEGORIES (2003 – 2007) – SABAH

Resources Category	Year				
	2003	2004	2005	2006	2007
Demersal	376,410	444,596	484,172	485,538	718,843
Shrimp	88,142	76,706	75,494	100,440	81,484
Pelagic	690,445	663,924	580,946	756,040	619,810
Tunas	119,961	73,774	84,914	96,095	89,735
Trash Fish	45,288	47,238	35,969	41,482	147,969
Others*	201,160	202,863	87,187	325,137	308,922
Total (RM)	**1,521,406**	**1,509,102**	**1,348,682**	**1,804,733**	**1,966,762**

* Include Squids, Crabs, Jellyfish and Shellfish

source: Department of Fisheries, 2005 – 2009

The potential yield of coastal demersal finfish has been estimated at 130,000 tonnes (MIER, 2000), which compares well with present catch levels. Coastal demersal finfish resources are thought to be moderately exploited, mainly by trawlers. On the other hand, coastal shrimp resources are intensively exploited possibly beyond maximum sustainable yield (MSY) levels (MIER, 2000). The potential yield from the coastal small pelagic resources is estimated at about 80,000 tonnes, while that of neretic tunas about 20,000 tonnes (MIER, 2000).

Offshore demersal resources are limited to the continental shelf area off the west coast of Sabah. A potential yield for these waters off west Sabah was estimated at 11,000 tonnes (Anon., 1987). The presence of many shoals and shallows, however, has limited commercial fishing in these areas. Currently, the landings of deep-sea trawlers are reported from Labuan F.T. where around 530 tonnes of fish landings were recorded from trawlers 70 GRT and above in 2000.

Offshore/deep sea small pelagic resources are in a similar position. These resources have been estimated to provide a potential yield of around 18,000 tonnes in the waters 30 nautical miles off the west coast of Sabah (Anon., 1987). With the current landings of only around 3,700 tonnes from the deep-sea vessels, the health of the resource appears sound. Offshore tuna stocks are estimated to be about 20,000 tonnes (MIER, 2000), comparing well with current landings of around 10,000 tonnes. However, the offshore tunas, as in Sarawak, are mainly juveniles.

Challenges in marine capture fisheries

The current scenario where fish stocks are concerned points to a seriously reduced fisheries resource base. It is clear that the marine fishery resources of all the fishing grounds in the country are currently being exploited beyond their maximum sustainable levels, and while catch levels continue to broadly sustain in volume terms, there has been major shifts in the species profile.

In the West Coast, the catch profile has heavily shifted to invertebrates such as jelly fish and squid. In the case of the East Coast of Peninsular Malaysia, the coastal marine fish resources are also exploited at their maximum levels. A resource assessments undertaken by the Department of Fisheries itself indicated that demersal stocks had declined from 80 -96% since the 1970s (Stobutski, 2006).

However, resource managers have continued to pursue a policy of increasing landings despite the situation. This is because current fish landings appear to be significant enough to engender a degree of comfort among resource managers. The problem with multi-species fishery (as is of many tropical fisheries) is that overall volume figures often mask collapses of sub-fisheries that are often too small to make an impact. The shifts in species profiles that have been picked up through long term studies in both the west and east coast of Peninsular Malaysia is testimony to the fact that there have been serious diminutions in specific populations.

Though deep sea fisheries appeared at one time to offer some scope for further development, recent studies point to a significant decline possibly due to poaching. There is still some scope for development of the offshore fishery in Sabah and Sarawak, though the extent of poaching undertaken in those waters also makes the situation very risky. It is likely that foreign poachers have exploited what resource that is thought to remain.

While a comprehensive fisheries management regimen is in place, it is still inadequate to address many issues of resource health. The health of the fisheries resources cannot be divorced from that of the overall marine environment in which the activity is undertaken. For instance, current management regimes have tended to focus on controlling fishing effort through licensing and access limitations to sustain present stock levels. The complexity of the marine environment, however, precludes such a uni-dimensional management approach.

Fisheries resource management cannot be seen in isolation of issues such as habitat degradation and pollution. In this respect, the present regimen is still strongly lacking in fundamentals. For instance, habitat conservation has been limited to establishment of marine parks and protection of coral reefs. While the parks have to a large extent managed to limit the kind of degradation seen elsewhere in the region (McManus, 1988), the dichotomy in jurisdiction between the federal government and the state governments means that while the latter is in charge of the marine parks, land matters (and land based development on the islands) largely remains under the jurisdiction of the state governments. The dangers of coral reef ecosystem destruction posed by water quality degradation associated with unsustainable land development on the island adjacent to the marine park is very much still a concern.

As a consequence of various legal and administrative issues, there are no mangroves or seagrass reserves that have been declared exclusively for marine environmental or fisheries purposes.

The degradation of the environmental health of the marine environment, and the fisheries resources that depend on it, have strong socio-political implications. Fish is a staple protein in the local dietary intake and is a major feature of national cuisine. In addition, increasing affluence accompanying economic growth has led to an escalation in fish consumption. Forecasted total consumption of fish is expected to reach 56 kg/capital in 2010 based on annual income growth rate of 1% (MoA, 1999). This represents an 18% increase over current consumption levels.

Though some of this increase can and will undoubtedly come from aquaculture, traditional consumer preferences will dictate that the marine fisheries will have to cope with much of this increased demand.

Thus changes in the availability of fish supplies can have far reaching effects. In this regard, it is significant to note that retail fish prices, have risen precipitously during the 1990s. The retail price of Grade 1, 2 and 3 fish, for instance, rose 46.4%, 59.4% and 61.4% over the 1991-2000 time period, while shrimp prices climbed 46.9% over the same time frame. For the years of 1998-2007, the retail price of Grade 2 fish, Grade 3 fish and shrimp increased by 15.2%, 34.1% and 3.9% while the retail price of Grade 1 fish declined about 10%.

Existing regimes can only work in an environment where stakeholders are willing make short term sacrifices to ensure long term sustainability. In the case of the Malaysian coastal fisheries, however, fishers are increasingly unwilling to accommodate short-term constraints because the continuing deterioration of the coastal marine environment (over which they have no control) will impact on future fisheries stocks.

In short, there is greater economic imperative to harvest the fish now than wait for some future time when conditions will most likely to become untenable for the fish to survive anyway. In this view, any downslide in catch is expected to be compensated by the higher marker prices that such shortages would eventually engender. Balancing this purely economic imperative would be the pressure to ensure security of supply for increased demand brought about by population increases and increasing affluence and the need for conservation of natural biodiversity.

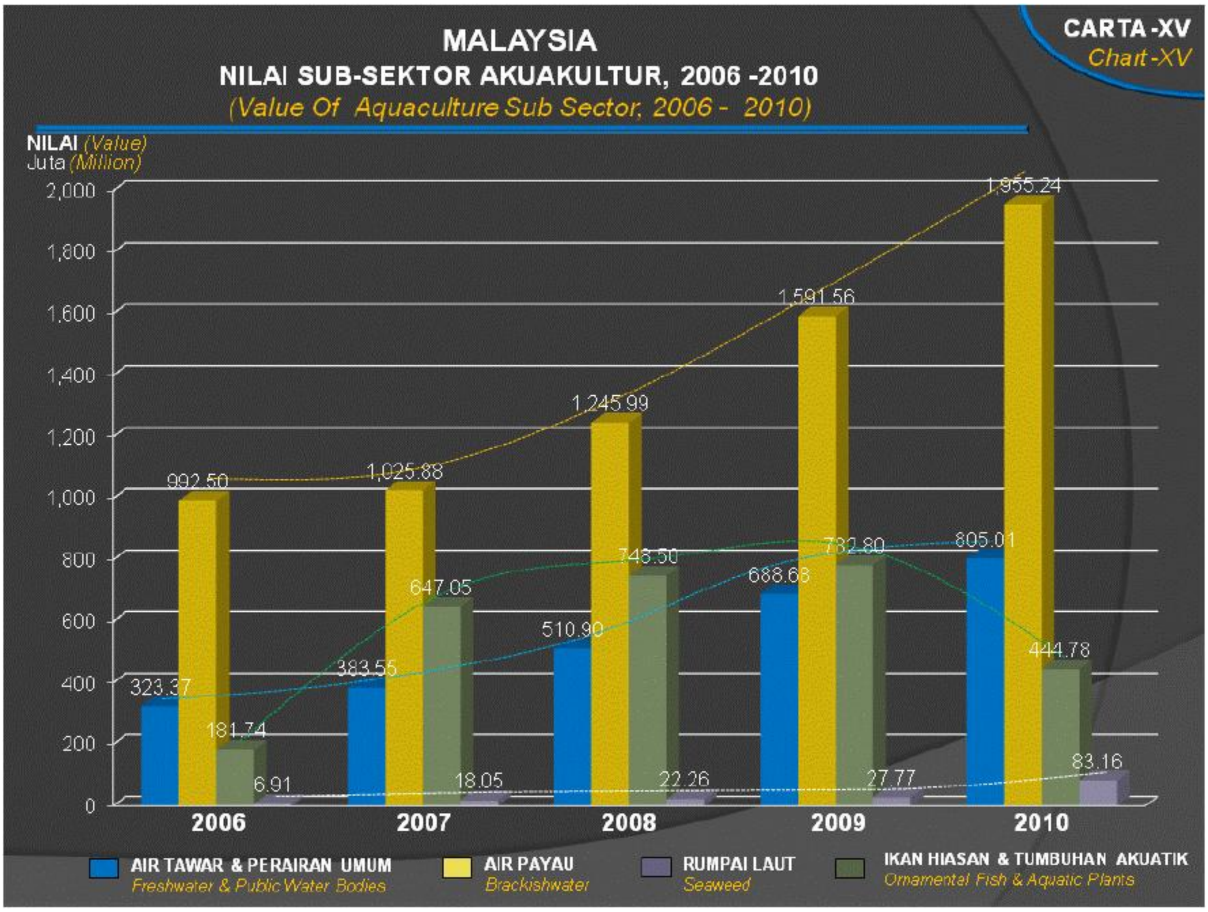
Domestic demand needs are likely to take an increasingly critical profile in coming years. Malaysia has long had to import fish (particularly from Thailand and Indonesia) to augment local supply. However, the export value of fish and fisheries products outweighed imports, accruing a net benefit value to country.

For instance, in 1991, the country imported 246,257 tonnes of fish and fishery products valued at RM480 million. However, it exported 175,216 tonnes amounting to RM739.70 million. By 1997, however, the balance had totally shifted, with an importation of 297,776 tonnes valued at RM979.2 million as compared with imports of 107,622 tonnes (RM939.6 million).

AQUACULTURE

The national production from the aquaculture sector was recorded at 581,048.41 tonnes valued at RM2.8million. The bulk of the contribution is from the production of seaweed, brackish-water ponds and freshwater ponds. This represent an increase in production and value by 28.02% and 23.36% respectively compared to 2009 which was 453,860.13 tonnes valued at RM2.3million. On the whole, the aquaculture sector contributed 28.84% to the overall fish production in the country.

FIGURE 4- 20: VALUE OF AQUACULTURE SUB-SECTOR (2006-2010)



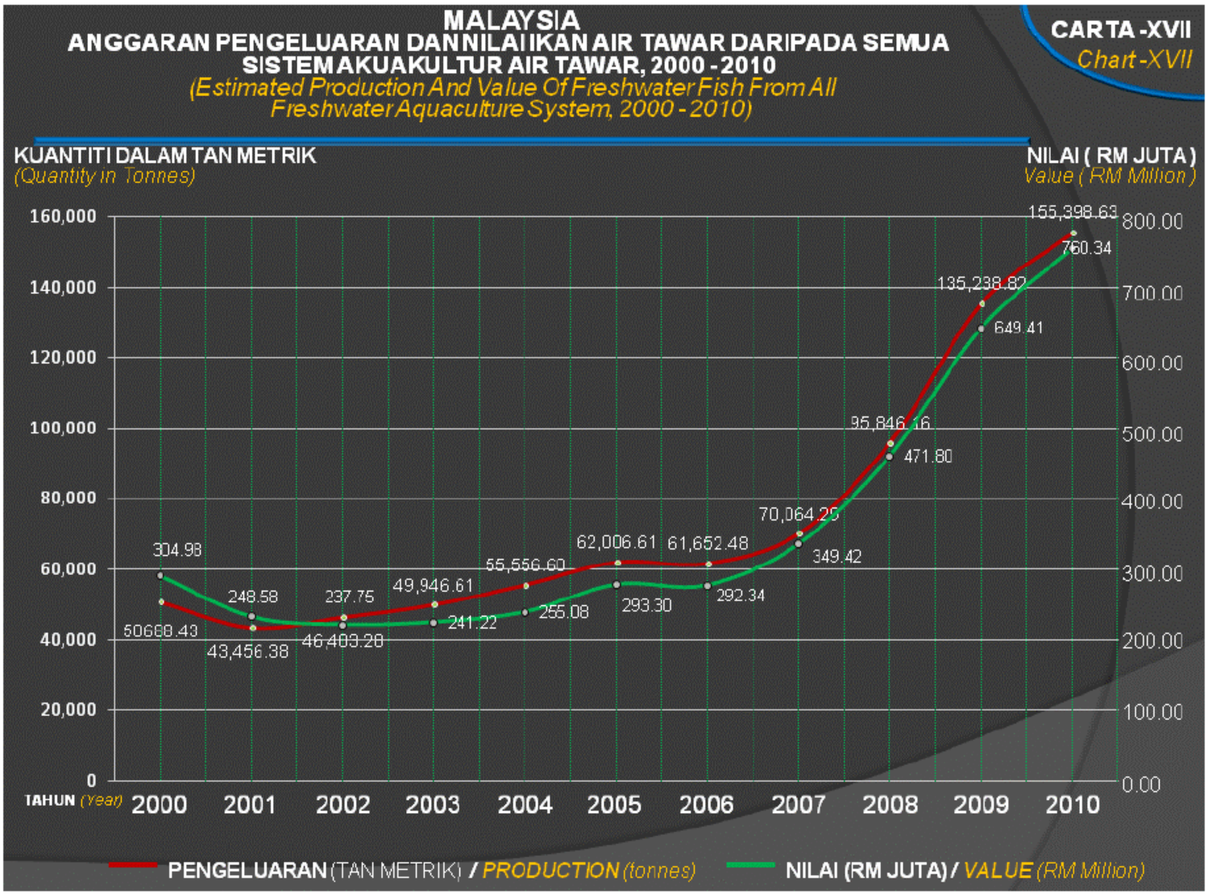
source: Department of Fisheries, 2010

Working population in this sector was recorded at 26,291 fish farmers and culturist, an increase of 9.61% (2009 ; 23,986 persons). The majority of the workforce of 19,946 (75.87%) persons was involved in the freshwater aquaculture, the remaining 6,345 (24.13%) fish farmers/culturists were involved in the brackishwater aquaculture industry. The ornamental fish & aquatic plants sub-sector is one of the main player in the aquaculture sector and this is reflected in various requests for data compilation specifically for this sub-sector for varied purposes; e.g. legally, institutionally, economically and socially.

FRESHWATER AQUACULTURE

In 2010, freshwater fish culture sub-sector produced 155,398.63 tonnes valued at RM760.34 million which was 26.74% and 27.17% of aquaculture total production and value of the overall aquaculture sub-sector respectively. Its production and value indicated an increase of 14.91% and 17.08% compared to 2009 with 135,238.82 tonnes valued at RM649.41 million.

FIGURE 4- 21: ESTIMATED PRODUCTION AND VALUE OF FRESHWATER FISH FROM ALL FRESHWATER AQUACULTURE SYSTEM (2000-2010)



source: Department of Fisheries, 2010

POND CULTURE SYSTEM

The culture of fish in ponds produced 92,833.45 tonnes or 59.74% of the total freshwater fish production. The production decreased by 3.70% as compared with 2009 which amounted to 96,398.81 tonnes. Its value also decreased to RM430.85 million from RM435.34 million in 2009 decreasing by 1.03%.

The main species of fish cultured were Freshwater Catfish (60,255.49 tonnes valued at RM184.29 million), Red Tilapia (16,923.89 tonnes valued at RM117.58 million) and River Catfish (4,003.55 tonnes valued at RM26.30 million). Under this culture system, a total of 5,025.37 hectares of ponds were in operation showing a decrease of 0.09% compared with 5,029.95 hectares the previous year (Department of Fisheries, 2010).

TABLE 4- 17: AQUACULTURE PRODUCTION & VALUE, 2010

	Quantity (Tonnes)	Value (RM Million)
Freshwater Aquaculture		
Ponds	92,833.45	430.85
Ex-Mining Pools	20,758.18	104.13
Cages	9,828.61	79.18
Cement Tanks	4,196.59	20.25
Pen Culture	27,371.72	124.47
Canvas Tanks	410.09	1.44
Total Freshwater Aquaculture	**155,398.63**	**760.34**
Brackishwater/Marine Aquaculture		
Ponds	103,943.21	1,372.08
Cages	24,326.31	480.02
Cockles	78,024.70	91.60
Mussels	10,529.06	5.05
Oysters	812.75	3.73
Seaweeds	207,892.40	83.16
Marine Tanks	121.35	2.76
Total Brackishwater /Marine Aquaculture	**425,649.77**	**2,038.40**
Total Aquaculture	**581,048.41**	**2,798.74**
Total Marine Capture Fisheries and Aquaculture Production	**2,009,929.41**	**9,450.63**
Landing of Freshwater Fisheries (Public Water Bodies)	4,605.43	44.67
Total National Fish Production	**2,014,534.84**	**9,495.30**
Total Food Fish*	**1,806,642.44**	**9,412.14**
**Ornamental Fish ** **	**341,757,064**	**430.31**
Aquatic Plants* **	**143,651,684**	**14.47**

* - Excluding Seaweeds
** - Quantity in Pieces
*** - Quantity in Bundles

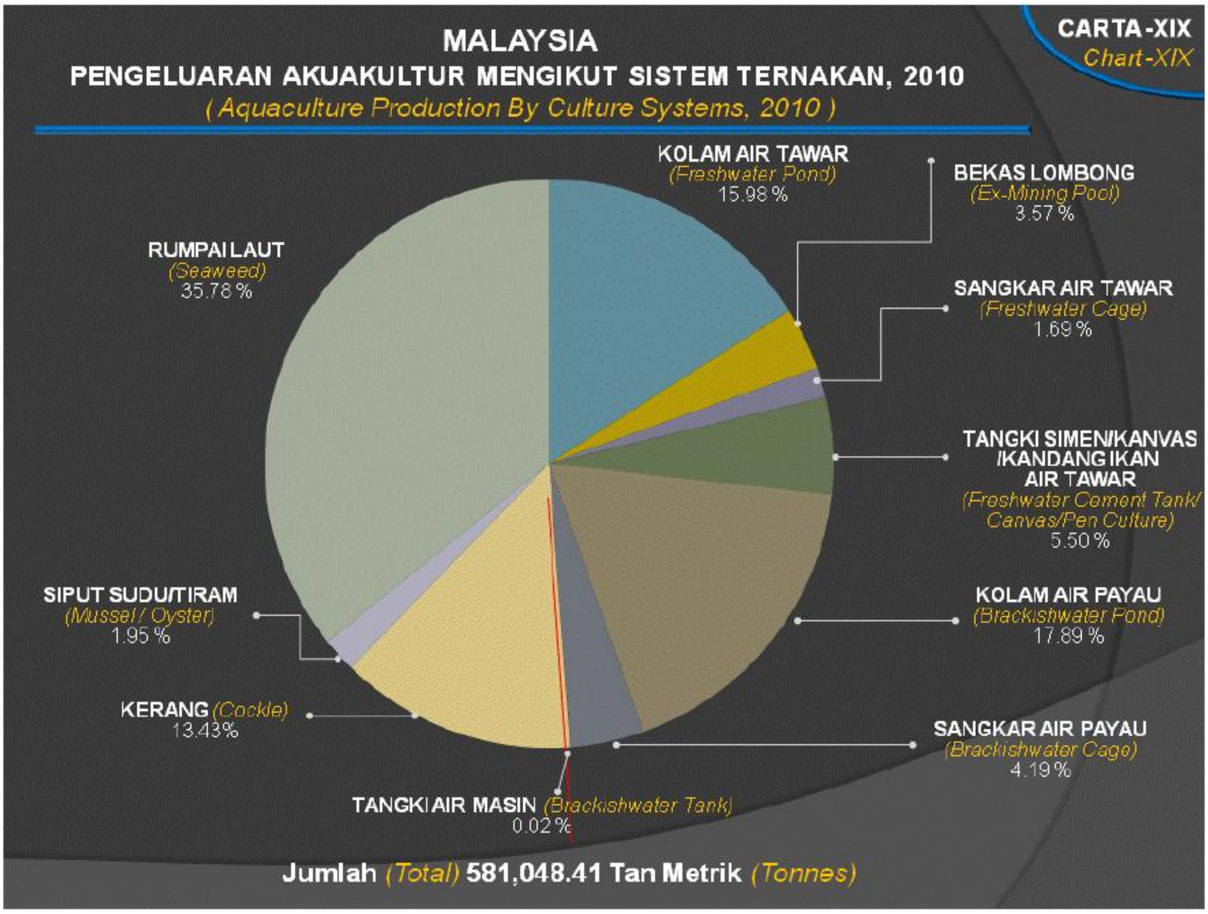
source: Department of Fisheries, 2010

EX-MINING POOL CULTURE SYSTEM

Production from ex-mining pools increased by 14.79% from 18,083.72 tonnes in 2009 to 20,758.18 tonnes in 2010. Its value also increased by 25.90% from RM82.71 million in 2009 to RM104.13 million in 2010. The total area of ex-mining pools recorded for the purpose of fish culture in 2010 was 1,311.13 hectares, decreasing by 37.69% from 2,104.17 hectares in 2009.

The main fish species cultured were Black Tilapia (5,716.06 tonnes valued at RM23.25 million), Red Tilapia (4,371.87 tonnes valued at RM26.00 million) and River Catfish (3,671.37 tonnes valued at RM16.64 million).

FIGURE 4- 22: AQUACULTURE PRODUCTION BY CULTURE SYSTEMS, 2010



source: Department of Fisheries, 2010

Freshwater Cage Culture System

The freshwater cage culture system contributed 6.32% to the overall freshwater fish culture production increasing by 24.37% to 9,828.61 tonnes in 2010 from 7,902.61 tonnes in 2009. Its value also increased by 7.58% from RM73.60 million in 2009 to RM79.18 million in 2010. The areas under this culture system in 2010 were 472,446.50 square metres increasing by 25.28% from 377,123.71 square metres in 2009. Red Tilapia was the main species cultured with a production of 5,664.42 tonnes valued at RM36.38 million followed by River Catfish with 2,990.05 tonnes valued at RM32.87 million.

Cement Tank Culture System

The cement tank culture system contributed 4,196.59 tonnes increasing by 26.06% from 3,328.96 tonnes in 2009. In terms of value, it increased by 34.73% from RM15.03 million in 2009 to RM20.25 million in 2010. The main species cultured was Freshwater Catfish with a production of 2,150.01 tonnes valued at RM7.26 million. The state of Selangor was the main producer in this category with 1,442.71 tonnes valued at RM7.36 million. The overall area for cement tank culture was 398,186.88 square metres in 2010 from 190,288.54 square metres in 2009.

Canvas Tank System

In 2010, the canvas tank culture system recorded a production of 410.09 tonnes valued at RM1.44 million, compared to 515.62 tonnes valued at RM1.80 million in 2009 showing a decrease of 20.47% and 20.00%. The state of Terengganu recorded the highest production from this system with 181.82 tonnes valued at RM0.64 million. The culture area for the canvas tank system decreased by 33.06% in 2010 to 21,236.79 square metres from 31,725.48 square metres in 2009. The main species cultured was Freshwater Catfish with a production of 405.76 tonnes valued at RM1.41 million.

FRESHWATER PEN CULTURE SYSTEM

In 2010, production from the fish pen culture increased to 27,371.72 tonnes valued at RM124.47 million, compared to 9,009.10 tonnes valued at RM40.94 million in 2009. The total area for freshwater pen culture decreased by 3.98% from 55.97 hectares in 2009 to 53.74 hectares in 2010. The main species cultured were River Catfish with a production of 27,211.34 tonnes valued at RM123.57 million, followed by Red Tilapia, 117.18 tonnes valued at RM0.69 million. The highest production from this system was from the state of Perak with a production of 27,200.79 tonnes valued at RM123.62 million. The increase in production, especially in Perak was due to the harvesting of all their livestock as the area is no longer suitable for breeding fish in the pen.

BRACKISHWATER AQUACULTURE

In 2010, brackishwater aquaculture contributed 73.26% of the total aquaculture production. This contribution went up by 33.59% to 425,649.77 tonnes in 2010 from 318,621.32 tonnes the previous year. The value for the overall brackishwater aquaculture also rose by 25.88% to RM2,038.40 million in 2010 from RM1,619.33 million in 2009.

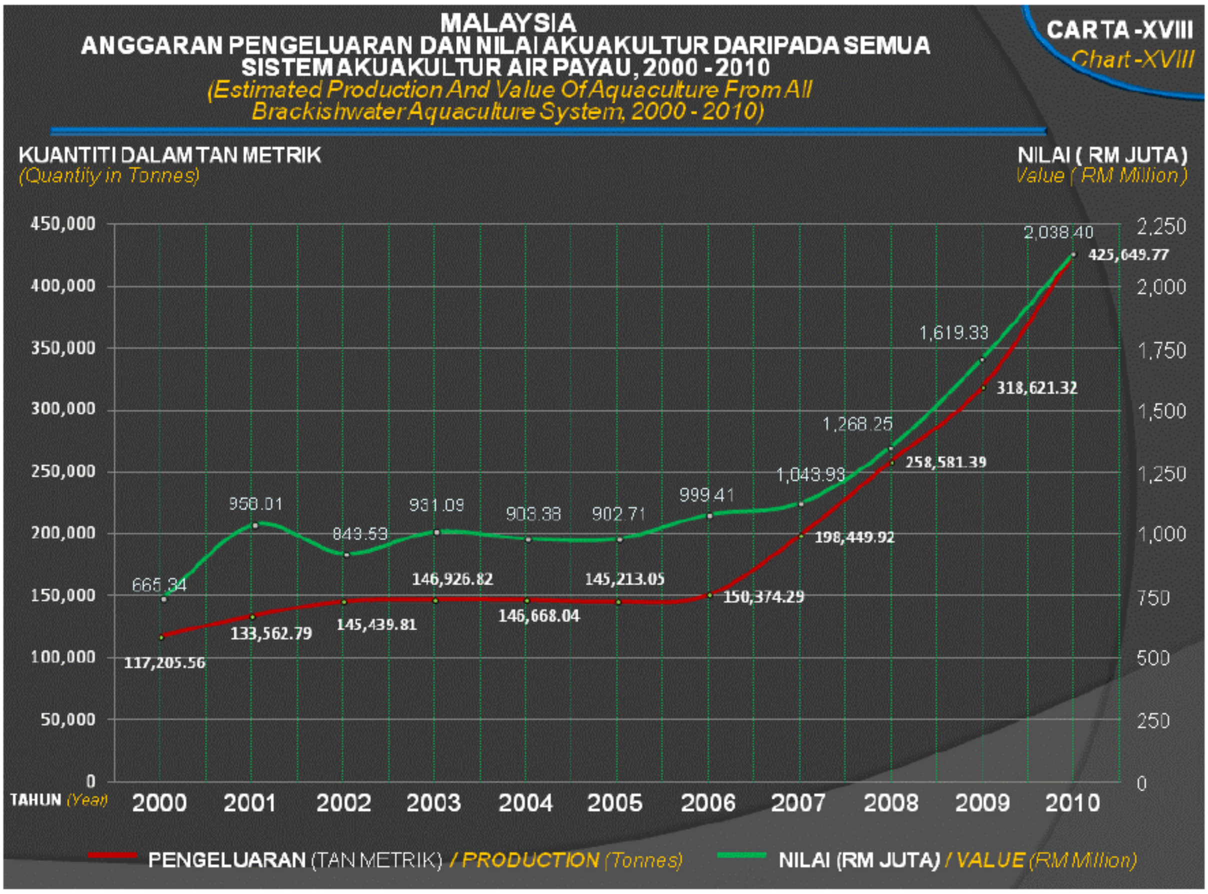
BRACKISHWATER POND CULTURE SYSTEM

The brackishwater pond culture production went up by 28.99% from 80,582.99 tonnes in 2009 to 103,943.21 tonnes in 2010. Its value also increased by 25.46% from RM1,093.61 million in 2009 to RM1,372.08 million in 2010. The total culture area recorded in 2010 was 7,722.82 hectares, an increase of 5.16% compared to 7,344.21 tonnes in 2009. The main species cultured were White Prawns (69,084.10 tonnes valued at RM789.38 million), Tiger Prawns (18,118.51 tonnes valued at RM389.58 million) and Barramundi (11,919.58 tonnes valued at RM164.51 million).

BRACKISHWATER CAGE CULTURE SYSTEM

In 2010, production from the brackishwater cage culture in Malaysia was 24,326.31 tonnes, increasing by 8.03% compared with 22,519.06 tonnes in 2009. Its value also increased by 15.48% to RM480.02 million in 2010 from RM415.67 million the previous year. The total area for brackishwater cage culture rose by 14.21% to 1,988,744.33 square metres in 2010 from 1,741,333.87 square metres in 2009. The main species of fish cultured were Barramundi (7,992.09 tonnes valued at RM108.38 million), Red Snapper (4,844.92 tonnes valued at RM75.00 million) and Grouper (4,521.63 tonnes valued at RM188.32 million). The state of Johor was the top producer of fish from this culture system contributing 7,164.27 tonnes valued at RM118.14 million.

FIGURE 4- 23: ESTIMATED PRODUCTION AND VALUE OF AQUACULTURE FROM ALL BRACKISHWATER AQUACULTURE SYSTEM (2000-2010)



source: Department of Fisheries, 2010

Brackishwater Tank Culture System

In 2010, production from the brackishwater tank culture system increased by 126.27% to 121.35 tonnes from 53.63 tonnes in 2009. Its value also increased from RM0.91 million the previous year to RM2.24 million in 2010. The total area under this culture system also increased to 182,097.82 square metres in 2010 from 5,691.00 square metres in 2009.

On-Bottom Culture System

The cockle production constitutes 18.33% of the total production from brackishwater culture systems. In 2010, cockle production increased by 20.15% to 78,024.70 tonnes from 64,938.51 tonnes in 2009. Its value also increased by 33.53% to RM91.60 million in 2010 from RM68.60 million the previous year. The state of Selangor produced the most cockles amounting to 41,410.05 tonnes valued at RM51.87 million.

The overall area under cockle culture also increased by 4.44% to 10,383.09 hectares in 2010 as compared to 9,941.76 hectares in 2009.

The Rack Culture System

Mussels

The production of mussels decreased by 0.63% to 10,529.06 tonnes in 2010 from 10,596.08 tonnes in 2009. Its value also decreased to RM5.05 million in 2010 from RM6.23 million the previous year, decreasing by 18.94%. The state of Johor remained as the top producer of mussels amounting 10,407.70 tonnes valued at RM4.79 million. However, in terms of area under mussel culture, there was an increase of 57.89% from 180,851.23 square metres in 2009 to 285,540.29 square metres in 2010.

Oysters

In 2010, production from oysters decreased to 812.75 tonnes compared with 1,075.15 tonnes in 2009. Its value also decreased to RM3.73 million in 2010 from RM6.54 million the previous year. The total acreage under oyster culture increased by 8.13% to 364,908.08 square metres compared with 337,461.67 square metres in 2009.

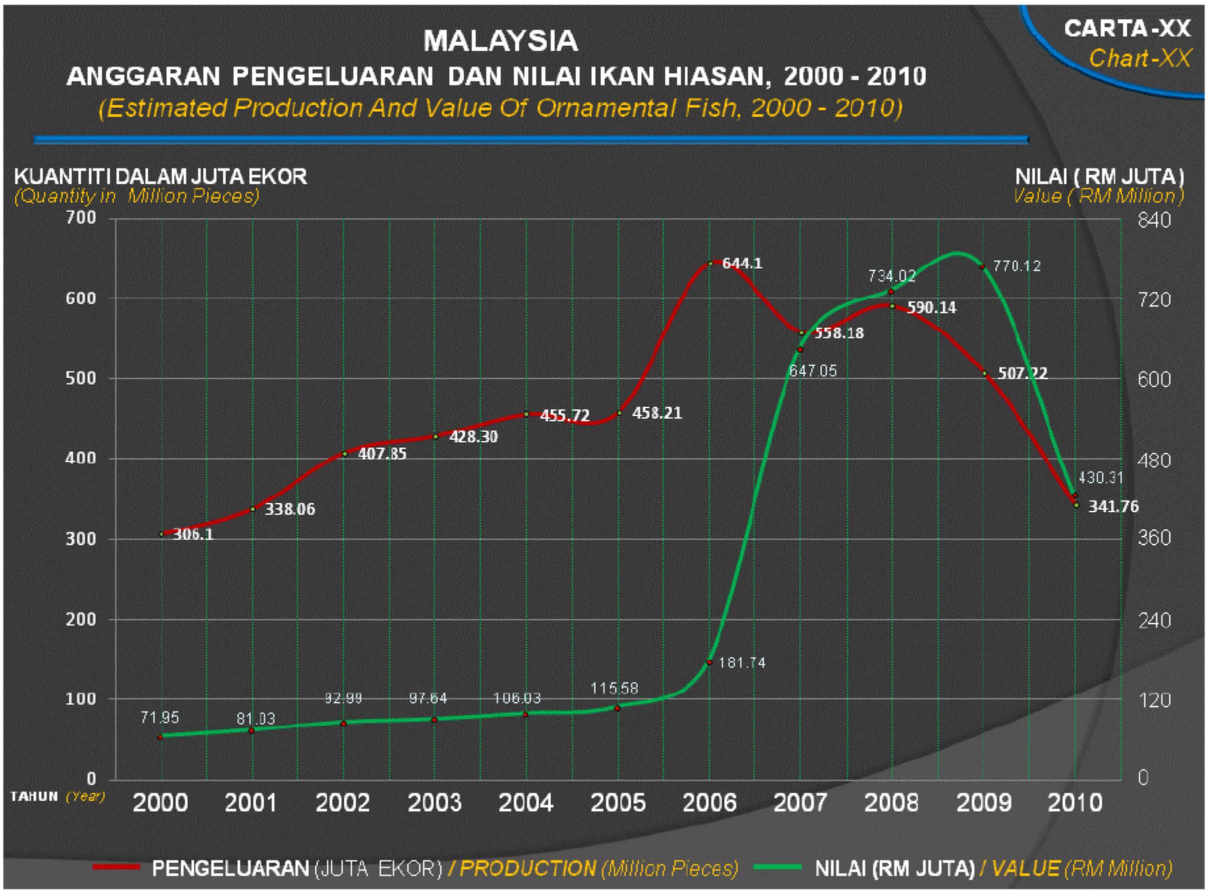
Seaweeds

The seaweed production increased this year by 49.72% to 207,892.40 tonnes (wet weight) from 138,855.90 tonnes in 2009. Its value also showed an increase of RM83.16 million from RM27.77 million the previous year. Meanwhile, the total acreage under seaweed culture recorded an increase of 5.33% to 7,940.50 hectares in 2010 compared to 7,538.46 hectares in 2009.

Ornamental Fish Culture

Production of ornamental fish for the year 2010 showed a decline of 32.62% to 341,737,654 pieces compared with 507,216,127 pieces in 2009. This decline was influenced by the restrictions imposed on the export of ornamental fish by the European Union countries. The aquatic plants also showed an increase of 15.11% from 124,792,872 bundles in 2009 to 143,651,684 bundles in 2010. Its value showed a decrease of 44.12% to RM430.26million in 2010 from RM770.12 million the previous year. The value of the aquatic plants increased by 14.12% to RM14.47 million in 2010 compared to RM12.68 million in 2009. The state of Johor is the largest producer of ornamental fish (including aquatic plants) contributing 233,396,440 pieces of ornamental fish valued at RM317.89 million and 143,575,044 bundles of aquatic plants valued at RM14.36 million. This is followed by the State of Perak and Selangor with total value of RM106.11mill.

FIGURE 4- 24: ESTIMATED PRODUCTION AND VALUE OF ORNAMENTAL FISH (2000-2010)



source: Department of Fisheries, 2010

TABLE 4- 18: PRODUCTION OF ORNAMENTAL FISH BY STATE, 2006-2011

NEGERI *State*	2006 Kuantiti (Ekor) *Quantity (Pieces)*	2006 Nilai (RM) *Value (RM)*	2007 Kuantiti (Ekor) *Quantity (Pieces)*	2007 Nilai (RM) *Value (RM)*	2008 Kuantiti (Ekor) *Quantity (Pieces)*	2008 Nilai (RM) *Value (RM)*
Johor	504,363,981	116,003,715	379,197,300	580,053,506	325,926,940	646,785,377
Kedah	49,355	13,384	52,920	115,792	81,820	97,463
Kelantan	84,075	16,815	68,600	194,052	106,060	428,287
Melaka	701,270	148,895	385,605	2,660,131	383,040	2,665,579
Negeri Sembilan	12,300	16,881	n.a	n.a	10,480	48,080
Pahang	126,000	100,800	169,500	508,500	243,000	1,215,000
Pulau Pinang	413,258	535,184	421,245	2,897,374	310,190	3,110,329
Perak	124,686,387	26,820,000	164,829,214	44,501,346	251,773,140	65,693,404
Perlis	n.a	n.a	n.a	n.a	n.a	n.a
Selangor	13,281,030	37,650,304	12,768,330	15,910,453	11,121,950	13,856,538
Terengganu	n.a	n.a	5,930	8,2450	19,850	25,725
Sem. Malaysia *Pen.Malaysia*	**643,717,656**	**181,305,981**	**557,898,644**	**646,849,401**	**589,976,470**	**733,925,783**
Sabah	92,595	324,080	30,237	105,829	10,530	37,970
Sarawak	289,532	112,080	249,413	99,765	152,150	60,860
MALAYSIA	**644,099,783**	**181,742,141**	**558,178,294**	**647,054,995**	**590,139,150**	**734,024,613**

NEGERI *State*	2009 Kuantiti (Ekor) *Quantity (Pieces)*	2009 Nilai (RM) *Value (RM)*	2010 Kuantiti (Ekor) *Quantity (Pieces)*	2010 Nilai (RM) *Value (RM)*	2011p Kuantiti (Ekor) *Quantity (Pieces)*	2011p Nilai (RM) *Value (RM)*
Johor	325,465,398	651,680,516	233,396,440	317,891,742	236,218,467	689,548,597
Kedah	45,781	162,747	12,960	159,274	37,657	230,072
Kelantan	77,255	65,180	220,910	282,664	189,732	352,000
Melaka	744,456	2,574,810	463,530	2,100,050	659,891	3,591,601
Negeri Sembilan	6,600	33,000	n.a	n.a	n.a	n.a
Pahang	249,000	1,245,000	210,640	1,048,520	319,582	1,708,058
Pulau Pinang	237,470	2,363,916	309,350	2,515,003	826,270	4,447,173
Perak	169,193,220	82,309,727	99,420,327	96,818,930	122,744,581	110,950,063
Perlis	n.a	n.a	n.a	n.a	n.a	n.a
Selangor	10,986,180	29,575,159	7,379,000	9,291,503	9,850,246	7,425,466
Terengganu	28,310	25,966	14,460	11,900	30,288	28,401
Sem. Malaysia *Pen. Malaysia*	**507,033,670**	**770,036,024**	**341,427,617**	**430,119,587**	**370,876,714**	**818,281,435**

p – perangkaan (estimated value)

Source: Malaysian Agrofood Policy (2011-2020) Statistics Book, p.112

However, based on recent data published by the Department of Fisheries Malaysia (DOFM), the industry is estimated to experience an increase of 8.61% in 2011 with total value of RM818.55million.

COASTAL TOURISM

BACKGROUND

Tourism is the world's biggest industry with the number of international tourists worldwide growing from 170 million in 1971 to 635 million in 1998. Malaysia is no exception to this trend.

Malaysia is recognised globally as one of the leading tourism destinations, ranking in the top 10 in arrivals and top 15 in global receipts (ETP, 2010). The tourism industry is also an important contributor to its economy, generating RM36.9 billion in gross national income (GNI) in 2009. This makes tourism the fifth largest industry after oil, gas and energy, financial services, wholesale and retail, and palm oil. By 2020, the tourism industry is envisaged to contribute RM103.6 billion in GNI, with arrivals increasing from 24 million in 2009 to 36 million in 2020 (ETP, 2010). Table 4-19 and 4-20 illustrates the statistics on international tourist arrivals over the last ten years and in accordance to countries of origin. Singaporeans (53.7%, 2010) logged the highest number in terms of visitors into Malaysia being a neighbouring country with several options for travelling. In addition to countries within the South East Asia region such as Indonesia (10.2%, 2010), Thailand (5.94%, 2010) and Brunei (4.57%, 2010), visitors from Australia (2.36%, 2010), United Kingdom (1.75%, 2010), Japan (1.69%, 2010) and South Korea (1.07%, 2010) contributes to a substantial percentage of visitors into the country.

However, these figures do not include domestic tourism, which has also seen huge increases in recent years. For instance, annual visitor flow to Port Dickson, a small resort area catering mainly for domestic tourists in the state of Negeri Sembilan, is thought to amount to 600,000 visitors annually.

TABLE 4- 19: TOURIST ARRIVALS AND RECEIPTS IN MALAYSIA

Year	Arrivals (Million)	Value (RM million)
2000	10.2	17.3
2001	12.7	24.2
2002	13.2	25.8
2003	10.5	21.2
2004	15.7	29.7
2005	16.4	32.0
2006	17.5	36.3
2007	20.9	46.1
2008	22	49.6
2009	23.6	53.4
2010	24.6	56.5

source: Tourism Malaysia

TABLE 4- 20: MALAYSIA TOURIST ARRIVALS, 2010

Country of Residence	2010	Percentage	2009	Growth (%)	Percentage2
Singapore	13,042,004	53.07%	12,733,082	2.4%	53.8%
Indonesia	2,506,509	10.20%	2,405,360	4.2%	10.2%
Thailand	1,458,678	5.94%	1,449,262	0.6%	6.1%
China	1,130,261	4.60%	1,019,756	10.8%	4.3%
Brunei	1,124,406	4.57%	1,061,357	5.9%	4.5%
Others	778,723	3.17%	760,579	2.4%	3.2%
India	690,849	2.81%	589,838	17.1%	2.5%
Australia	580,695	2.36%	533,382	8.9%	2.3%
Phillippines	486,790	1.98%	447,470	8.8%	1.9%
United Kingdom	429,965	1.75%	435,091	-1.2%	1.8%
Japan	415,881	1.69%	395,746	5.1%	1.7%
South Korea	264,052	1.07%	227,312	16.2%	1.0%
U.S.A	232,965	0.95%	228,571	1.9%	1.0%
Taiwan	211,143	0.86%	197,869	6.7%	0.8%
Vietnam	159,271	0.65%	149,685	6.4%	0.6%
Germany	130,896	0.53%	128,288	2.0%	0.5%
Iran	116,252	0.47%	101,664	14.3%	0.4%
Netherlands	114,887	0.47%	111,139	3.4%	0.5%
France	111,175	0.45%	110,054	1.0%	0.5%
Canada	91,701	0.37%	88,080	4.1%	0.4%
Saudi Arabia	86,771	0.35%	77,082	12.6%	0.3%
New Zealand	66,152	0.27%	63,004	5.0%	0.3%
Sweden	48,971	0.20%	49,509	-1.1%	0.2%
Cambodia	48,618	0.20%	43,146	12.7%	0.2%
Italy	47,068	0.19%	46,352	1.5%	0.2%
Russia	32,075	0.13%	29,202	9.8%	0.1%
Switzerland	27,894	0.11%	28,523	-2.2%	0.1%
South Africa	26,395	0.11%	23,556	12.1%	0.1%
UAE	25,645	0.10%	22,108	16.0%	0.1%
Denmark	24,869	0.10%	25,916	-4.0%	0.1%
Norway	22,773	0.09%	22,487	1.3%	0.1%
Findland	21,355	0.09%	20,912	2.1%	0.1%
Poland	12,358	0.05%	12,544	-1.5%	0.1%
Turkey	9,149	0.04%	8,265	10.7%	0.0%
Total Arrival	**24,577,196**		**23,646,191**		

source: Research Division, Tourism Malaysia with the cooperation of the Immigration Department, Malaysia

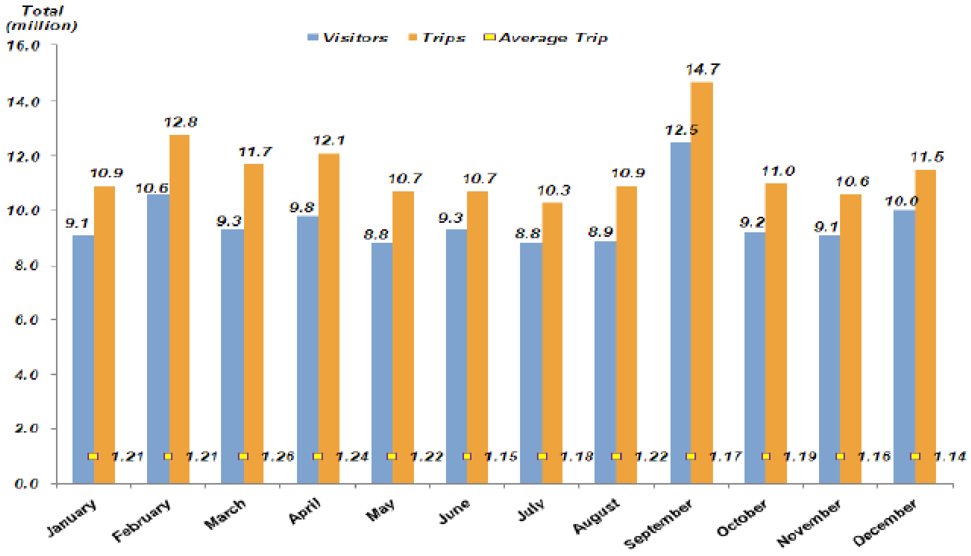
DOMESTIC TOURISM SURVEY

Domestic tourism in Malaysia is largely seasonal (e.g. public holidays and school holidays) and influenced by the organisation of large-scale events. In 2010, on an average, 46.8% of Malaysian residents aged 15 years and above have had domestic holidays (DTS, 2010).

Figure 4-25 below indicates some fluctuations in the number of domestic visitors during the year 2010. The highest number of visitors was in September 2010 due to the *Hari Raya* celebrations as trips were made for holidays and going back to home towns. The second highest number of visitors was in February 2010 coincidental with the Chinese New Year holidays.

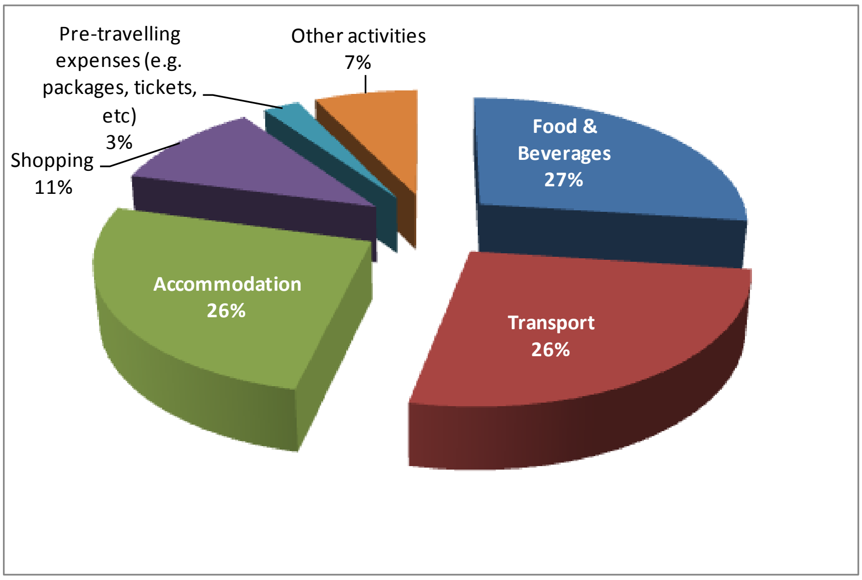
In 2010, domestic visitors spent a total of RM34.7billion, a 33% increase against RM26.0billion spent in 2009. However, the average expenditure per trip of a domestic visitor declined by 12.3% from RM287.00 in 2009 to RM252.00 in 2010. Food & beverages; travel and accommodation expenses forms the majority of the expenditure expenses. Shopping expenses represent 11% from the total expenses spent during each trips.

FIGURE 4- 25: NUMBER OF DOMESTIC VISITORS AND TRIPS BY MONTH, 2010



source: Department of Statistics, Malaysia

FIGURE 4- 26: EXPENDITURE COMPONENTS OF DOMESTICS TOURISTS (IN PERCENTAGE), 2010



source: adapted from Department of Statistics, Malaysia

TABLE 4- 21: PERCENTAGE ARRIVAL OF DOMESTIC TOURISTS BY STATE, 2010

State	Number of Tourist ('000)	Percentage (%)
Sarawak	8,911	22.5
Pahang	4,009	10.1
Johor	3,310	8.4
Sabah	3,272	8.3
Perak	3,074	7.8
Selangor	2,465	6.2
Kelantan	2,456	6.2
Kedah	2,383	6.0
W.P. Kuala Lumpur	2,192	5.5
Terengganu	1,884	4.8
Pulau Pinang	1,564	4.0
Negeri Sembilan	1,488	3.8
Melaka	1,143	2.9
W.P. Labuan	664	1.7
Perlis	385	0.9
W.P. Putrajaya	340	0.9
Total	39,539	100.0

source: Department of Statistics, Malaysia

Sabah Tourism Industry

Sabah services sector is a major contributor to its GDP, at 48.9% in 2005. According to the Yearbook of Statistics Sabah 2006, Department of Statistics Malaysia, Sabah, this sector provides the highest number of employment with 639,000 (2005) which accounted for 53.3% of total employment in Sabah. Tourism has been earmarked as the key driver for this sector.

Leveraging on its diverse biodiversity as one of the most important tourism product, Sabah has recognised this valuable resource as a potential economic contributor very early. It is among the few states in the country that has a Tourism Master Plan. The first Plan was developed in 1995 and a second Sabah Tourism Master Plan (STMP) shall continue to provide comprehensive strategies for the sector for 2011 through to 2025. A new agenda shall be incorporate commercial investment opportunities which require significant capital expenditure from the private sector for development activities. This approach follows closely the New Economic Transformation Plan (ETP) introduced by the Prime Minister in 2010.

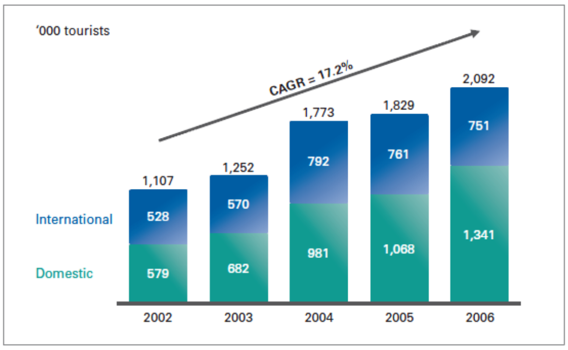
Given the fragility of Sabah's ecosystem and the government's target to attract 445m tourists by 2020, the new plan will prioritise growth management to achieve a balance between development and environmental preservation. The new STMP is also expected to address key sector weaknesses, including human resource shortages and a poor road network that prevents tourists from easily accessing much of Sabah's territory.

Perhaps the most interesting investment area highlighted in the new plan is a coastal development project to be implemented north-west of Kota Kinabalu. The project is divided into two phases, the first of which is between Tuaran and Kota Belud and the second between Kota Belud and Kudat. The venture, which will require funding of up to $3bn, is intended to create a string of shoreline resorts to satisfy demand for upscale beaches in Sabah. This project will support the broader industry objective of attracting high-yield, long-stay travellers. The second STMP will identify other development initiatives to reposition Sabah as an upscale destination. Along with a dedicated cruise terminal, the plan is expected to recommend the construction of a sophisticated performing arts venue, a major cultural centre and convention facilities supported by an internationally branded hotel. Also, the Plan identified the lack of transportation infrastructure as a fundamental weakness in the sector and thus Sabah has been unable to create an integrated transport system due to the state's rugged terrain in addition to the issue of shortage of funds for public works. This has made it difficult for visitors to travel and thus increased risks for tourism-related developers, many of which are reluctant to open businesses in areas that are potentially isolated from visitors.

Sabah recorded 2.09 million visitors with total receipts of over RM2.8billion (2006). Growth continues to be strong with compounded annual growth rate of 17.2% over the last five years (2001-2005) in comparison to the national average growth rate of 7.2% over the same period.

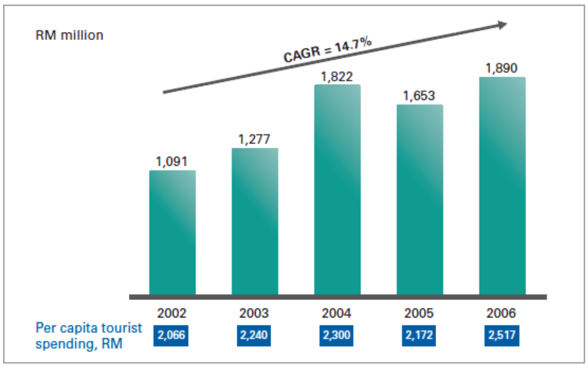
According to Malaysia Tourism Promotion Board - Sabah Tourism Board data, tourism receipts grew at an annual compounded growth rate of 27.4% (both domestic and international) over the same period. Per capital international tourist spending of RM2,517.00 is higher than the national average of RM2,067. In general, international tourists spend twice as much as domestic tourists. Main expenditure components are shopping, food and beverages, accommodation, entertainment and recreation.

FIGURE 4- 27: SABAH NUMBER OF TOURIST ARRIVALS (2002-2006)



Source: Sabah Tourism Board

FIGURE 4- 28: SABAH INTERNATIONAL TOURISM RECEIPTS



Source: Sabah Tourism Board

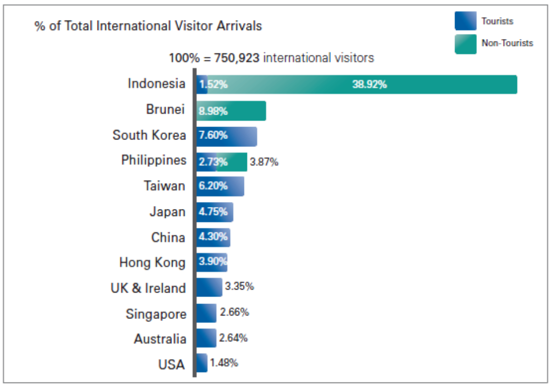
Sabah enjoys good air links with major cities in Asia-Pacific. Availability of direct flights as well as transit flights via Bangkok, Brunei, Hong Kong, Taipei, Kaohsiung, Manila, Cebu, Seoul, Shenzhen, Macau, Singapore and Tokyo offer frequent and easy access.

There is also an increasing trend in cruise tourism. In 2005, six cruise ships arrived in Sabah with 3,673 excursionists compared to 13 cruise ship arrivals in 2006 with 13,591 excursionists (SDC Blueprint, 2008 - 2025). The main port of call is Kota Kinabalu, with the main ports of origin being Singapore and Hong Kong.

Direct connectivity has contributed to the high number of tourist arrivals from these countries.

According to the World Tourism Organisation, modern travellers want 'activity-based' attractions as opposed to 'destination' travel. Sabah is already a destination for nature, cultural and activity-based tourism, and has tremendous potential to grow by leveraging on its appeal as an ecological and adventure wonderland.

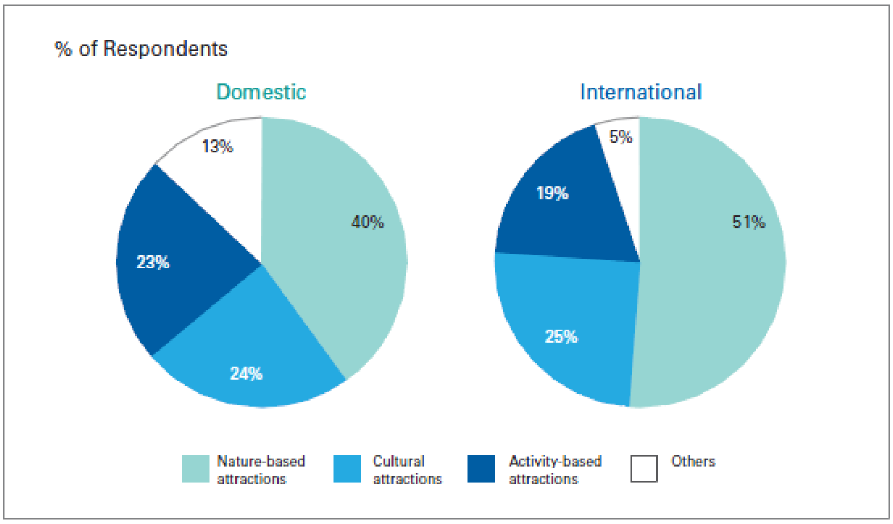
FIGURE 4- 29: TOP 12 INTERNATIONAL VISITOR ARRIVALS BY NATIONALITY



Source: MASB, Sabah/Immigration Dept, Sabah/Malaysia Airlines, KL/Air Asia/ FAX

According to a survey by Sabah Tourism Board conducted in September 2004, a substantial majority of both international (76%) and domestic (64%) visitors to Sabah looks forward to nature-based and adventure-based activities. Please refer to Figure 4-30 for the break-down of the visitors' intentions for visiting Sabah and Table 4-22 for the various types of attraction categories for Sabah.

FIGURE 4- 30: PURPOSE OF VISIT



Source: Tourist Expenditure Survey, Sabah Tourism Board (September 2004)

TABLE 4- 22: TOURIST ATTRACTION CATEGORIES IN SABAH

Main tourist attraction	Sub-group
Nature-based attractions	• Coastal attractions • Wildlife viewing • Kinabalu Park • Rainforest • Nature-based events
Activity-based attractions	• Scuba-diving • Sailing, boating, fishing • River rafting and river activities • Trekking, Horse riding and mountain biking • Mount Kinabalu summit climb • Golf • Activity-based events
Cultural attractions	• Museum and cultural events • Historical sites • Local markets • Handicrafts • Long-houses, village visits and local people • Cultural events
Other attractions	• Shopping • Entertainment • Food & beverage related activities

source: Sabah Tourism Master Plan (1996)

Trends in Marine / Coastal Tourism Industry

The coast, which extends from the inland seashore to the first major change in terrain features, is a necessary component of any beach resorts. Coasts include not only those facing the open sea, but also those of inland seas or large lakes. The major difference between them is the absence of tides affecting the coasts in lakes and inland waters. The coasts have distinctive ecosystems, or communities in which the various living forms are functionally related. There are largely three major world coastal ecosystems and these are well-represented in Southeast Asia; mangrove-dominated coasts, open beaches and dunes with two subtypes (narrow exposed beach, and wider and sheltered beach), and coral reefs (Odum, 1976). Currently, nearly all of Southeast Asia's beach resorts are located in the open beach and dunes; and coral reef ecosystems.

Much of Malaysia's promotion efforts centre on marine tourism. The country is touted as a major marine tourism destination, which includes on a wide range of activities such as recreational fisheries, boating/sailing, beachfront hotel-related activities, cruises, wreck diving and reef diving. In 2002, beachfront hotel-related activities were the third most popular activity among foreign tourists, scuba diving, the fifth and boating/sailing, sixth (ICZM, 2004).

Domestic Visitors

The precise magnitude of foreign and domestic tourism in the coastal and marine areas is not clear, since no separate statistics are kept for foreign or domestic tourists to these areas. Detailed information on the economic impact of domestic tourism has been difficult to find, but growth in all forms of recreation in coastal areas in which both foreign and domestic tourists partake is readily apparent. Such activities include beach going, recreational boating, cruises, marine mammal watching, recreational fishing, underwater recreation, bird watching, nature appreciation, and the like.

Certainly, over the years, the development of marine-based tourism in the Malaysian coastal zone has not only had positive effects on the national economy, but also at the local level. In particular, it has opened up numerous employment and entrepreneurial opportunities for local communities. Such opportunities include small-scale village resorts, restaurants, and handicraft/souvenir shops. Coastal villagers are often able to find employment as boatmen and guides. At the opposite end of the scale, massive tourist development has led to large-scale infusions of capital into local economies. The construction of hotels, marinas and other leisure-based facilities have had a strong ripple effect through the economy, sustaining a wide spectrum of economic activity and influencing land prices and service costs. Such developments have also expanded the revenue base of the local authorities and State Governments through service and land taxes (ICZM, 2004).

This section shall attempt to justify the importance of the marine / coastal tourism industry to the nation based on relevant official statistical data compiled by the Malaysian Statistical Department.

Data on tourism in coastal areas cannot easily be disaggregated from national-level statistics, but impressionistic evidence as well as a number of recent works on the subject suggest continued growth of tourism in coastal and marine areas in the country

The Department of Statistics, Malaysia has summarised the top five destinations most visited by domestic visitors. These places are located in the states of Sarawak, Sabah, Perak, Federal Territory of Kuala Lumpur and Kelantan.

With the exception of Federal Territory of Kuala Lumpur, all of the States has at least one marine coastal related destination (e.g. beaches of Tanjung Aru in Sabah, Cahaya Bulan in Kelantan and Batik Bay in Perak; Pangkor Island is also one of the more favoured island destination) favoured by domestic visitors.

Figure 4-32 indicates that marine / coastal tourism related activities are categorised under the *'Holiday / leisure / relaxation / getting away'* category. Eighteen percent of the visitors cited *'beach / sea activities'* as reasons for visiting the various destinations. The top category for making the trip is *'visiting friends and relatives'* at 70.6% However, this is just an indicative fact that marine / coastal tourism related activities are included in the overall activities for visiting these destination sites and reflect its economic importance over the total tourism industry.

FIGURE 4- 31: TOP FIVE DESTINATIONS IN EACH STATE MOST VISITED BY DOMESTIC VISITORS, 2010

FIGURE 4- 32: DOMESTIC TOURIST TRIPS BY PURPOSE OF VISIT AND MAIN ACTIVITIES UNDERTAKEN, 2010

source: Department of Statistics, Malaysia

Trends in Islands Tourism Industry:

Marine Parks

As one of 17 megadiverse countries in the world, Malaysia is home to an extensive network of coral reefs and globally significant marine biodiversity. Malaysia has established a system of marine parks, which aims to protect and manage its marine biodiversity in the waters surrounding 42 islands. Marine Park is a protected area of the sea that is zoned 2 nautical miles measured from the low tide point (Mohd Salleh, N.H, 2010).

Research into the socio-economic impacts of the island inhabitants are very limited as most of the researches that have been done are scientific in nature or focused on carrying capacities of the islands.

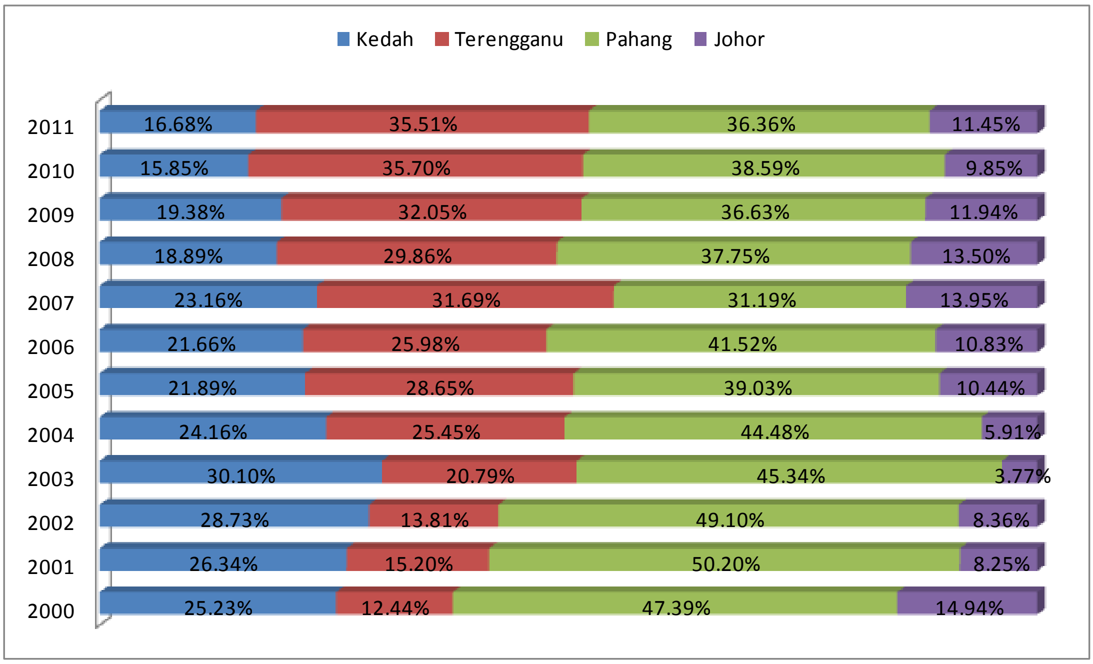
Peninsular Malaysia

The first marine protected area in Peninsular Malaysia was the Fisheries Prohibited Area established in the waters 8km from the island of Redang in 1983. Subsequently, the waters 3km off twenty-one islands in the state of Kedah, Terengganu, Pahang and Johor were added. These areas were gazetted as Fisheries Prohibited Areas before it being gazetted as Marine Parks in 1994. Since then, the waters off 39 islands have been declared as marine parks in Peninsular Malaysia under the Fisheries Act 1985. Please refer to Table 2-3 in Chapter II of this Report for the breakdown of the islands in accordance to States. Overall, the state of Kedah has four (4) marine parks, followed by Terengganu (13 islands), Pahang (9 islands), and Johor (13 islands).

Although the state of Johor has the same number of marine parks as Terengganu, it did not draw many visitors compared to the east coast states of Pahang and Terengganu. Total number of visitors to the marine parks in Peninsular Malaysia has maintained within the 500,000 to 600,000 range since 2004 to 2011 (Table 4-23).

Over the last ten years, marine parks in Terengganu have gained popularity amongst the domestic visitors with 23% to 25% share of total visitors. Nevertheless, the percentage of total visitors (domestic and international) remained strong over the past ten years in Pahang-based marine parks.

FIGURE 4- 33: PERCENTAGE OF VISITORS TO MARINE PARKS (2000-2011) IN PENINSULAR MALAYSIA



source: adapted from Department of Marine Park Malaysia

TABLE 4- 23: NUMBER OF VISITORS (BY ORIGIN) TO MARINE PARKS IN PENINSULAR MALAYSIA

Year	State / Type of visitors	Kedah	Terengganu	Pahang	Johor	Grand Total
2000	Domestic	19,944	43,390	72,383	44,824	423,229
	International	86,836	9,244	128,206	18,402	
2001	Domestic	38,027	65,539	127,675	27,963	484,121
	International	89,514	8,041	115,377	11,985	
2002	Domestic	56,259	56,263	127,675	27,235	465,587
	International	77,516	8,041	100,925	11,673	
2003	Domestic	44,291	71,654	128,676	10,016	381,072
	International	70,393	7,563	44,111	4,368	
2004	Domestic	36,282	111,225	184,238	24,444	559,862
	International	98,990	31,251	64,787	8,645	
2005	Domestic	19,607	98,863	77,570	32,440	429,880
	International	74,492	24,296	90,191	12,421	
2006	Domestic	26,043	93,546	104,602	41,210	520,015
	International	86,605	41,552	111,334	15,123	
2007	Domestic	24,580	112,844	73,688	51,558	477,682
	International	86,049	38,553	75,312	15,098	
2008	Domestic	23,298	129,532	124,673	41,199	508,488
	International	72,773	22,292	67,256	27,465	
2009	Domestic	25,454	99,434	105,867	38,025	530,758
	International	77,412	70,692	88,525	25,349	
2010	Domestic	26,429	130,174	170,580	35,839	606,155
	International	69,668	86,230	63,343	23,892	
2011	Domestic	25,410	109,331	121,660	40,185	584,934
	International	72,162	98,378	91,020	26,788	

source: adapted from Department of Marine Park Malaysia

TABLE 4- 24: PERCENTAGE OF VISITORS (BY ORIGIN) TO MARINE PARKS IN PENINSULAR MALAYSIA

Year	State / Type of visitors	Kedah	Terengganu	Pahang	Johor	Grand Total
2000	Domestic	4.71%	10.25%	17.10%	10.59%	100%
	International	20.52%	2.18%	30.29%	4.35%	
2001	Domestic	7.85%	13.54%	26.37%	5.78%	100%
	International	18.49%	1.66%	23.83%	2.48%	
2002	Domestic	12.08%	12.08%	27.42%	5.85%	100%
	International	16.65%	1.73%	21.68%	2.51%	
2003	Domestic	11.62%	18.80%	33.77%	2.63%	100%
	International	18.47%	1.98%	11.58%	1.15%	
2004	Domestic	6.48%	19.87%	32.91%	4.37%	100%
	International	17.68%	5.58%	11.57%	1.54%	
2005	Domestic	4.56%	23.00%	18.04%	7.55%	100%
	International	17.33%	5.65%	20.98%	2.89%	
2006	Domestic	5.01%	17.99%	20.12%	7.92%	100%
	International	16.65%	7.99%	21.41%	2.91%	
2007	Domestic	5.15%	23.62%	15.43%	10.79%	100%
	International	18.01%	8.07%	15.77%	3.16%	
2008	Domestic	4.58%	25.47%	24.52%	8.10%	100%
	International	14.31%	4.38%	13.23%	5.40%	
2009	Domestic	4.80%	18.73%	19.95%	7.16%	100%
	International	14.59%	13.32%	16.68%	4.78%	
2010	Domestic	4.36%	21.48%	28.14%	5.91%	100%
	International	11.49%	14.23%	10.45%	3.94%	
2011	Domestic	4.34%	18.69%	20.80%	6.87%	100%
	International	12.34%	16.82%	15.56%	4.58%	

source: adapted from Department of Marine Park Malaysia

Research has been done on the islands of Tioman (Pahang state) and Redang (Terengganu state) marine parks (please refer to Figure 4- 34 and 4-35 for profile of the islands) to investigate the socio-economic impact upon its gazettement. Five standard of living indicators are used; (i) human assets; (ii) social assets; (iii) natural/ environment assets; (iv) physical assets; and (v) financial assets. Please refer to Table 4-24 below in reference to the indicators and its elements.

TABLE 4- 25: STANDARD OF LIVING INDICATORS

Indicators	Elements
Human Asset	Education, training, work experiences, knowledge, skills/expertise
Social Assets	Family relationship/rapport, community relationship
Natural/Environmental Assets	Land, water source, forest products, biodiversity
Physical Assets	Transportation, road infrastructure, technology
Financial Assets	Savings, credit and loans

Source: Ireland et al (2005)

Although in general the standard of living on both islands has improved, there are several issues that need serious attention in order to meet the Government aspirations to provide high value quality tourism products. There are a few differences between the two islands that influence its standard of living. For example, at Redang Island the local communities villages are quite remote and far from the main tourist attraction whereas at Tioman Island, its villages are located within a comfortable distance from the main tourist areas. Moreover, the locals themselves own most of the resorts and chalets on Tioman Island. This is not the case for Redang Island. Table 4-25 illustrates the summary of the research followed by a brief analysis of the findings based on the five (5) indicators used.

TABLE 4- 26: SUMMARY OF RESEARCH OBSERVATIONS ON THE STANDARD OF LIVING AND SUSTAINABLE LIVELIHOODS AT REDANG ISLAND MARINE PARK (RIMP) AND TIOMAN ISLAND MARINE PARK (TIMP)

Indicator	Performance/Achievements	
	TIMP	RIMP
Human	Improved education level, employment and health.	Better education level, employment and health
Natural/Environment	Improved land ownership and assets	Average land ownership with no apparent reduction and improvement in other stated assets
Social	Good community's rapport	Good community's rapport
Physical	Improved public facilities even though there is no fire station	Improved infrastructure, but need further improvement, i.e. Cyber cafes and fire station
Financial	Income quite stable, high savings as compared to the RIMP's locals and free from loans/borrowings.	Low income, average savings but free from loans/borrowings.
Uncertainties/ Threats	Free from stress/pressure in terms of socio-economic changes after marine park's gazettement and safe from natural disasters	Free from stress/pressure in terms of socio-economic changes after marine park's gazettement but threatened by natural disasters

source: Mohd Salleh, N.H, 2010

- **Human Assets**

The research reveals that the majority of the respondents from both Tioman and Redang islands has limited education qualification; i.e. at secondary school level with 51.9% and 56.7% respectively. Only a handful has diploma-level qualifications (Tioman, 5.7%; Redang, 1.7%). It is worthy to note that 9.2% of Redang Island respondents do not receive any form of formal education compared to 2.8% at Tioman Island.

In terms of employment rate, prior to the gazettement, most of the inhabitants on both islands were fishermen. Now, there are more work opportunities in the tourism industry as seen in Table 4-26 below. However, the proportion of local communities working in the tourism industry is higher in Tioman Island compared to Redang Island.

- **Social Assets**

Some of the more important elements of social assets are the relationship between individuals in the community and the rate of involvement in politics and/or associations. Not surprisingly, findings from the research found that members of the community are aware and compassionate towards individuals with financial / health / emotional problems. Despite being busy with daily work and shores, members of the islands community are fairly involved in associations and society's related activities.

- **Environmental Assets**

There were basically no changes in land ownership upon gazettement of the islands. Only 16.6% and 0.9% of the respondents sell their land, some due to limited land for individual ownership as most land are government-owned and current owners do not plan to sell their land. Thus, the research concludes that the locals' assets at both islands (in terms of land ownership) mostly are still maintained even after the gazettement despite the surge in tourism related infrastructure developments.

FIGURE 4- 34: MAP OF PULAU REDANG, TERENGGANU

Redang Island, locally known as Pulau Redang or just "Redang" is one of the largest islands off the east coast of Malaysia. The island is an important conservation site for sea turtles. Previously, the indiscriminate economic exploitation of turtle eggs had caused fewer turtles returning to nest on the island. This has led the Terengganu state government to set up the Koperasi Setiajaya Pulau Redang in 1989, a cooperative aiming to develop and manage socio-economic programmes that could improve the livelihood of Pulau Redang locals without endangering its natural resources. The Pulau Redang archipelago comprises Pulau Redang, Pulau Lima, Pulau Paku Besar, Pulau Paku Kecil, Pulau Kerengga Kecil, Pulau Kerengga Besar, Pulau Ekor Tebu, Pulau Ling and Pulau Pinang. Pulau Redang is the biggest of all the islands in the Marine Park, measuring about 7 km long and 6 km wide. Its highest peak is Bukit Besar at 359 metres above sea level. The boundary of the Pulau Redang Marine Park is established by a line linking all points 2 nautical miles (3.7 km) from the shores of Pulau Redang, Pulau Lima, Pulau Ekor Tebu and Pulau Pinang. The other nearby islands of Pulau Perhentian Besar, Pulau Perhentian Kecil, Pulau Lang Tengah, Pulau Kapas and Pulau Susu Dara are also gazetted and protected as Marine Parks. Today, only the bigger islands like Redang, Lang Tengah, Perhentian and Kapas have resort facilities for visitors. The management of Marine Parks primarily involves protection of the sensitive marine and terrestrial ecosystems by controlling the impact from human activities. These include waste & pollution management and conservation of coral reefs and terrestrial habitats.

source: http://en.wikipedia.org/wiki/Redang_Island

FIGURE 4- 35: MAP OF PULAU TIOMAN, PAHANG

Tioman Island (locally known as Gunung Daik Bercabang Tiga) is a small island located 32 km off the east coast of Peninsular Malaysia in the state of Pahang, and is some 39 km long and 12 km wide. It has eight main villages, the largest and most populous being Kampung Tekek in the north. The densely forested island is sparsely inhabited, and is surrounded by numerous coral reefs, making it a popular scuba diving spot. There are also a lot of resorts and chalets around the island which has duty free status. Its beaches were depicted in the 1958 movie, *South Pacific* as Bali Hai. In the 1970s, *TIME Magazine* selected Tioman as one of the world's most beautiful islands. Apart from its diverse marine life, the inland rainforest area, encompassing approximately 12,383 hectares, in Tioman is a strictly enforced nature reserve. There are several protected species of mammals on the island, including the Binturong, Long-tailed Macaque, Slow Loris, Black Giant Squirrel, Red Giant Flying Squirrel, Mouse deer, Brush-tailed Porcupine, and Common Palm Civet, from a total of 45 species of mammals and 138 species of birds, including the majestic Frigatebird. Moreover, Tioman has species that are endemic to its shores. The soft-shelled turtle and the Tioman walking catfish are both unique and can be seen on rainforest walks. The island is served by ferries from the Malaysian mainland, and a propeller plane service by Berjaya Air from the Changi Airport in Singapore and Sultan Abdul Aziz Shah Airport in Subang, Selangor.

source: http://en.wikipedia.org/wiki/Tioman_Island

TABLE 4- 27: LOCAL'S TYPE OF EMPLOYMENT (%)

Type of Employment	TIMP	RIMP
Housewife	2.8	3.3
Fisherman	6.6	34.2
Retailers/Traders	12.2	1.7
Tourist boat operator	11.3	9.2
Tourist guide	1.9	1.7
Public servant	7.5	3.3
Private sector	22.6	20.8
Divers/scuba diving operator	3.8	1.7
Pensioners	0.9	3.3
Unemployed	0.9	0.8
Others	11.3	20.0

source: Mohd Salleh, N.H, 2010

- **Physical Assets**

With reference to table below, majority of the respondents at Tioman Island agree that infrastructures such as water supply, electricity, roads, transportation, hospitals/clinics, schools, grocery stores/sundry shops, prayer room/*surau*[4], jetty, community halls and cyber cafe have improved after the gazettement with average rating in the range of 1-1.9. The said amenities have also improved at Redang Island post-gazettement with an average rating in the range of 1-1.2 except for the road and transportation infrastructure which did not register any changes (average in the range of 2.15-2.26). As for cyber cafes, their services are either deteriorating or approaching towards 'not applicable' (average 3.63). Such services are insufficient. Availability and services of the law enforcement such as availability of a police station and provision of its services has improved at Redang Island as compared to Tioman Island. Unfortunately, provision for fire station and its services are deteriorating at both islands.

On the whole, the overall average rating in Tioman Island is 1.21 (improving) compared to 2.09 in Redang Island indicating 'no changes'.

- **Financial Assets**

Research findings indicates that majority of the islanders earns household income of between RM751.00 to RM1,500.00 per month. These residents mainly lead a simple life and are only concerned on sustaining economic income on a monthly basis. On the other hand, it is unfortunate to discover that there is a small portion of the community who lives below the poverty line and may be considered as living in 'hardcore poverty' category.

In terms of loans / borrowings, many are not tied to any form of loans. Only a handful has difficulty to honour their monthly commitments with the lending institutions.

In another research done for four (4) marine parks in Peninsular Malaysia, the island communities expressed their willingness to adapt to the constraints (such as fishing activities) caused by the implementation of conservation activities that are typical for marine parks by acquiring alternative jobs within the tourism industry.

A sizable number of business activities are family-owned and approximately 84% of total respondents have a total asset of below RM10,0000.00. This may be due to the insufficient external financial and technical support from the government and financial institutions. A surprising 73% of total respondents have never applied for financial support from the government. This may be due to several reasons: (a) lack of opportunity to develop a relationship with financial institutions; (b) delay and long approval period; (c) lack of knowledge of the application process; (d) the need for risk-free collateral and inability to meet the terms and conditions of the loan; and (e) lack of understanding by the financial institutions over the loan amount applied (Kari, F., et al, 2011).

[4] Surau is a place of worship for Muslims

TABLE 4- 28: RESPONDENT'S PERCEPTION TOWARDS INFRASTRUCTURE POST-GAZETTEMENT

Infrastructure	Better (1)		No change (2)		Worsen (3)		Not Applicable(4)		Average	
	T	R	T	R	T	R	T	R	T	R
Water supply	88.7	90.8	10.4	5.8	0.9	2.5	-	0.8	1.12	1.13
Electricity	74.5	93.3	24.4	5.8	0.9	0.8	-	-	1.26	1.08
Roads	89.6	55.0	3.8	4.2	-	0.8	6.6	40.0	1.24	2.26
Public Telephone	50.0	40.3	1.9	8.4	43.4	12.6	4.7	38.7	2.03	2.50
Public toilets	30.2	44.1	37.7	5.9	8.5	0.8	23.6	49.2	2.25	2.55
Transportation	37.7	59.2	38.7	2.5	18.9	2.5	4.7	35.8	1.91	2.15
Hospital/clinic	87.7	93.3	-	2.5	1.9	0.8	10.4	2.5	1.35	1.12
School	73.6	96.7	-	-	-	2.5	26.4	0.8	1.80	1.06
Police station	30.2	94.1	38.7	2.5	-	3.4	31.1	-	2.32	1.09
Fire station	-	17.8	1.9	-	12.3	-	85.8	82.2	3.84	3.47
Grocery stores/sundry shops	94.3	90.0	0.9	6.7	-	1.7	4.7	1.7	1.15	1.15
Post Office	7.5	48.3	19.8	4.2	4.7	3.4	67.9	44.1	3.33	2.43
Sure	59.4	95.8	40.6	0.8	-	-	-	3.3	1.41	1.10
Jetty	81.1	95.8	17.0	2.5	0.9	1.7	0.9	-	1.22	1.06
Community Hall	65.1	88.3	22.6	5.0	-	0.8	12.3	5.8	1.59	1.24
Cyber cafe	60.4	11.7	25.5	0.8	-	0.8	14.2	86.7	1.68	3.63
Overall Amenities	81.1	61.3	17.9	3.4	-	-	0.9	35.3	1.21	2.09

1 The mean/average with the value of --
1 indicates that the infrastructure is improving. 2: assume no changes, 3: worsen/deteriorating, and 4: not applicable

TABLE 4- 29: MONTHLY GROSS INCOME FOR OVERALL WORKING HOUSEHOLD

Income	TIMP	RIMP
0 – 440	8.4	6.7
441 -750	14.2	32.6
751 – 1500	39.5	38.2
1501 – 2000	11.2	3.3
2001 – 5000	16.7	6.7
5001 – 10000	3.7	0.8
10001 – 15000	2.8	0.8
15000 and above	2.7	-
Confidential	-	10.8

source: Mohd Salleh, N.H, 2010

TABLE 4- 30: TYPE OF ALTERNATIVE EMPLOYMENT AND SIZE OF ASSETS IN ALTERNATIVE INCOME GENERATION (AIGS)

Alternate Employment	Percent	Size of Asset	Percentage
Chalets (tourism)	9	Less than RM 10,000	84.00
Chalets and boat renting (tourism)	2	RM 10,000 - RM 25, 000	13.40
Restaurant/food outlet	13	RM 25,000 - RM 50, 000	2.60
Food outlet, retailing, boat renting, equipment rent	2		
Retailing	15	Total asset owned	
Food outlet	15	Less than RM 10,000	57.80
Food outlet and boat renting	2	RM 10,001 - RM25,000	21.10
Boat and equipment renting (tourism)	39	RM 25,001 - RM50,000	15.80
Aquaculture	11	More RM 10,000	5.30

source: Kari, F., et al, 2011

Regrettably, tourism industry in marine parks has not been successful as it should be. It did not generate the desired multiplier effect amongst the local communities. Despite of a fairly matured tourism industry in the various marine parks, the dichotomous nature of the industry may have contributed to the low multiplier effect of the industry (Kari, F., et al, 2011). There is a need for a fundamental shift to achieve a more systematic and people-oriented approaches that supports the community's priorities and in accordance to their capabilities.

SABAH

Tunku Abdul Rahman Park (TARP), off Kota Kinabalu, Sabah was established in 1974 which comprised of a major portion of Pulau Gaya and the whole of Pulau Sapi with the aim to protect the marine life especially the coral reefs from human exploitations. In 1979, this park was expanded to include Pulau Manukan, Pulau Mamutik and Pulau Sulug expanding the area to 4,929 ha. In the East Coast of Sabah, Pulau Selingan, Bakungan Kecil and Gulisan which are small low-lying islands form the cluster of the Turtle Islands Park in the Malaysian waters. These islands are well-known for green and hawksbill turtles nesting sites - the eggs of which are placed in open-air hatcheries have been set up since 1966. Meanwhile, the fringing reefs around the Pulau Tiga Park are considered as amongst the most beautiful in Sabah. This islands is famed for its wild animals such as the megapodes (*Megapodius freycinet*), the harlequin tree frog (*Rhacophorus pardalis*), the monitor lizard (*Varanus salvator*) and the common skink, the yellow lipped sea krait (*Laticauda colubrina*) (Spait, M., 2001). Sipadan is located at the heart of the Indo-Pacific basin, the centre of one of the richest marine habitats in the world. It is the only oceanic island in Malaysia, rising 600 metres (2,000 ft) from the seabed. It is located in the Celebes Sea off the east coast of Sabah. It was formed by living corals growing on top of an extinct volcanic cone that took thousands of years to develop. More than 3,000 species of fish and hundreds of coral species have been classified in this ecosystem. Frequently seen in the waters around Sipadan are the green and hawksbill turtles (which mate and nest there), enormous schools of barracuda in tornado-like formations as well as large schools of big-eye trevally, and bumphead parrotfish. Pelagic species such as manta rays, eagle rays, scalloped hammerhead sharks and whale sharks also frequents the island. A turtle tomb lies underneath the column of the island, formed by an underwater limestone cave with a labyrinth of tunnels and chambers that contain many skeletal remains of turtles that become lost and drown before finding the surface. It was declared as a marine park in 2004.

Statistical data indicates a steady an increasing pattern in the number of visitors' arrival, both from domestic and international market. Table 4-31 and 4-32 indicates the number and percentage of visitors to three marine parks in Sabah over the period of 1998 through to 2009. Due to its close proximity to Kota Kinabalu, the Tunku Abdul Rahman Park (TARP) is the most frequented marine park in Sabah (more than 90% of total visitors to Sabah marine parks). However, the rate of visitation has declined by 1% to 2% per annum. This may be due to the deterioration of the natural resources mainly caused by anthropogenic effects from activities such as fish bombing and pollution. Excluding the TARP, Sipadan Island has been the major attraction for international visitors with 17% to 18% of total visitations by international visitors. Other marine park islands are experiencing a gradual but minimum decrease in both domestic and international visits.

TABLE 4- 31: NUMBER OF VISITORS TO SABAH PARKS

Station / Year	Tunku Abdul Rahman Park			Pulau Tiga Park			Turtle Islands Park			Pulau Sipadan Park			Total visitors		
	Malaysian	Non-Malaysian	sub-total	Malaysian	Non-Malaysian	sub-total	Malaysian	Non-Malaysian	sub-total	Malaysian	Non-Malaysian	sub-total	Malaysian	Non-Malaysian	Total
1998	62,106	74619	136,725	692	170	862	264	5462	5,726	-	-	-	63,062	80251	143,313
1999	57,576	114343	171,919	842	167	1,009	385	8347	8,732	-	-	-	58,803	122857	181,660
2000	54,896	150956	205,852	905	300	1,205	287	9844	10,131	-	-	-	56,088	161100	217,188
2001	57,215	141361	198,576	1,373	581	1,954	358	7892	8,250	-	-	-	58,946	149834	208,780
2002	44,445	102743	147,188	1,697	451	2,148	506	7944	8,450	-	-	-	46,648	111138	157,786
2003	43,872	86240	130,112	1,245	445	1,690	571	7466	8,037	-	-	-	45,688	94151	139,839
2004	43,842	128290	172,132	2,183	1914	4,097	636	12019	12,655	-	-	-	46,661	142223	188,884
2005	31,223	119226	150,449	2,028	2516	4,544	627	13764	14,391	-	-	-	33,878	135506	169,384
2006	51,027	134005	185,032	1,789	3475	5,264	677	13742	14,419	2,896	32748	35,644	56,389	183970	240,359
2007	81,831	152592	234,423	2,782	3531	6,313	673	13662	14,335	4,094	39288	43,382	89,380	209073	298,453
2008	115,017	157019	272,036	2,656	4001	6,657	511	13982	14,493	4,453	39172	43,625	122,637	214174	336,811
2009	134,111	163595	297,706	2,060	2392	4,452	433	12597	13,030	5,538	38015	43,553	142,142	216599	358,741

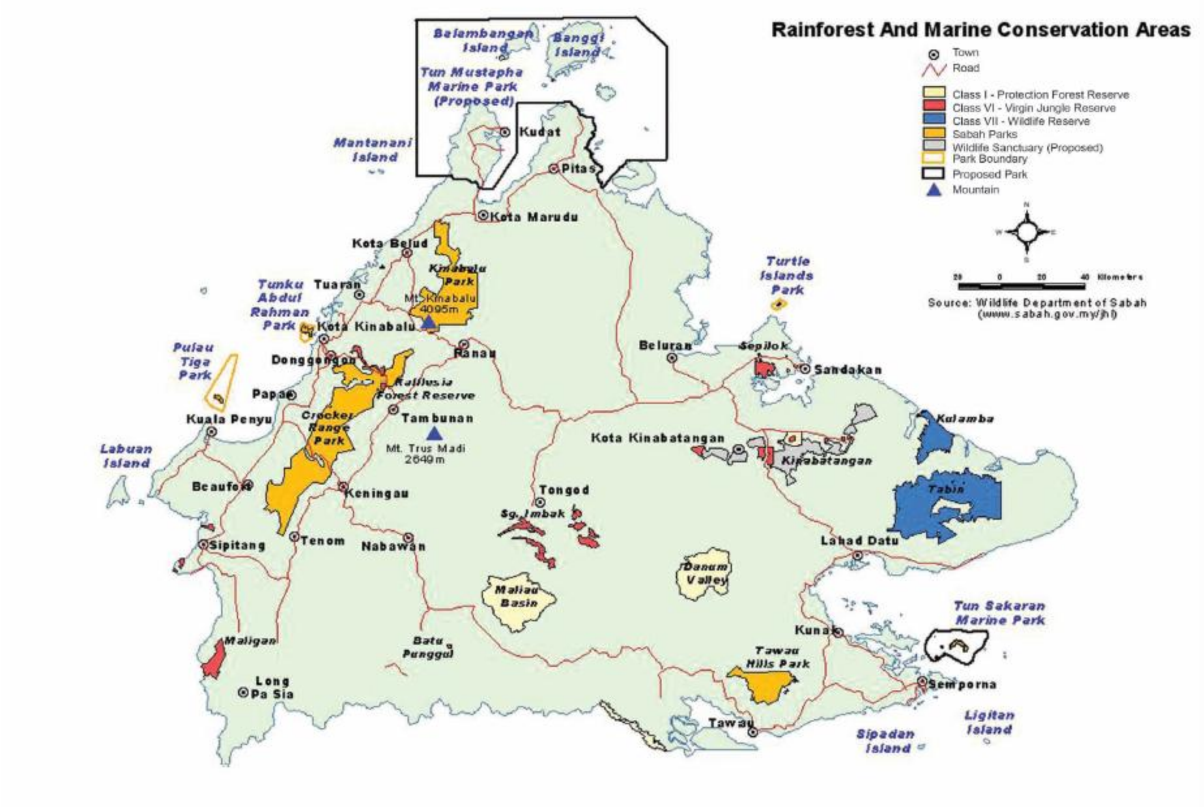
source: Sabah Parks

TABLE 4- 32: PERCENTAGE OF VISITORS TO SABAH PARKS

Station / Year	Tunku Abdul Rahman Park		Pulau Tiga Park		Turtle Islands Park		Pulau Sipadan Park		Total visitors	
	Malaysian	Non-Malaysian	Malaysian	Non-Malaysian	Malaysian	Non-Malaysian	Malaysian	Non-Malaysian	Malaysian	Non-Malaysian
1998	98.5%	93.0%	1.1%	0.2%	0.4%	6.8%	0.0%	0.0%	100.0%	100.0%
1999	97.9%	93.1%	1.4%	0.1%	0.7%	6.8%	0.0%	0.0%	100.0%	100.0%
2000	97.9%	93.7%	1.6%	0.2%	0.5%	6.1%	0.0%	0.0%	100.0%	100.0%
2001	97.1%	94.3%	2.3%	0.4%	0.6%	5.3%	0.0%	0.0%	100.0%	100.0%
2002	95.3%	92.4%	3.6%	0.4%	1.1%	7.1%	0.0%	0.0%	100.0%	100.0%
2003	96.0%	91.6%	2.7%	0.5%	1.2%	7.9%	0.0%	0.0%	100.0%	100.0%
2004	94.0%	90.2%	4.7%	1.3%	1.4%	8.5%	0.0%	0.0%	100.0%	100.0%
2005	92.2%	88.0%	6.0%	1.9%	1.9%	10.2%	0.0%	0.0%	100.0%	100.0%
2006	90.5%	72.8%	3.2%	1.9%	1.2%	7.5%	5.1%	17.8%	100.0%	100.0%
2007	91.6%	73.0%	3.1%	1.7%	0.8%	6.5%	4.6%	18.8%	100.0%	100.0%
2008	93.8%	73.3%	2.2%	1.9%	0.4%	6.5%	3.6%	18.3%	100.0%	100.0%
2009	94.4%	75.5%	1.4%	1.1%	0.3%	5.8%	3.9%	17.6%	100.0%	100.0%

source: Sabah Park

FIGURE 4- 36: RAINFOREST AND MARINE CONSERVATION AREAS



source: (SDC Blueprint, 2008-2025)

Unfortunately, due to economic and human needs and wants, the quality of the marine resources at the islands has deteriorated. A general survey carried out by the Marine Research Unit of Sabah Parks in 1998 showed that more than 50% of the coral reefs in Tunku Abdul Rahman Park (TARP) are in Index 2 of Reef Health Index, and only about 16% of the coral reefs located at the monitoring stations are in the Index 3 and 4 (Table 4-33) (Spait, M., 2001). For the Turtle Islands Parks, the "manta tow" survey carried out in 1998 showed that the average live coral cover for three islands was about 27%, while the rest was either dead coral or sand and rubble (Spait, M., 2001).This findings corresponds with the rate of decline of visitors as indicated in Table 4-31 & 4-32 above.

TABLE 4- 33: REEF HEALTH INDEX

Index	Description Percent Cover	Percent cover
1	Average of live corals are very low or none. Comprises dead corals, rubble or sand. Diversity of marine species in these areas is very low.	0 – 10 %
2	Sand, dead corals or debris of broken coral combined with algae. Live coral cover is patchy. Diversity of marine species is average in these areas.	11 – 30 %
3	Coral reefs covered some in parts with sand, dead corals or debris of broken corals. The diversity of marine species in these areas is average.	31 – 50 %
4	The growth of the corals is high with the diversity of marine species in the area also high.	51 – 75 %
5	The coral reefs are healthy and cover most of the substrate with a diversity of marine species in these areas.	75 – 100 %

sources: Survey 1998, Marine Research Unit of Sabah Parks

Data on total receipts / value from the visitations to the marine parks are not publicly available. However, one could assume that the structure of the various fees imposed on visitors based on the type activities recognizes the economic value of the natural resources at the islands. There are various fees based on type of activities such as conservation fees, scuba diving, use of conference room, camp sites, use of camera, and accommodations provided by the state government.

DOMESTIC ISSUES AND CHALLENGES

Southeast Asia's coasts have 30% of the world's coral reefs, 25% of its mangroves and 10% of its fish produce (P.P Wong, 1991). Sandy beaches, coral islands and reefs are the most widely demanded resources for resort development.

Given the widespread socio-economic benefits of tourism, State governments have strongly pushed the industry on the back of funding and technical support by the Federal Government. New resorts have sprung up, while additional developments in old ones have intensified. While this development has brought benefits to many rural areas, it has also had its share of problems.

The issues and challenges in coastal tourism industry can be discussed in two distinct aspects; maintaining the integrity of the resources for sustainable use and the conflicting uses of resources. Debate has been on-going on the issue of whether or not tourism development is the appropriate development for a particular coastal area over other type of coastal industry.

Unsustainable use of resources

Haphazard development of small-scale resort developments, dotting islands and many rural areas have caused many problems especially in terms of solid waste management, sewage disposal and drinking water resources. This is because these areas lacked the necessary support infrastructure to begin with. In addition to the above, other impacts have included aesthetic pollution to the area (e.g. Pasir Panjang area in Pulau Redang Marine Park), conflicting uses of the immediate coastal waters, and danger to users, especially when power boating is pitted against swimmers and non-power boat as well as other powerboat users.

The proliferation of unplanned/uncoordinated development has also led to the deterioration and eventually the destruction of the very source of economic wealth for the industry; i.e. natural resources such as coral reefs, mangrove areas or natural habitat.

The unregulated development of recreational/tourism activities can also represent a diminution in coastal resources that are source of livelihood to low-income groups. Increased tourism-related traffic in ecosystems that are supportive of marine fisheries (such as coral reefs and mangrove belts) tends to have negative impact on catch sustainability in terms of both species and volume (ICZM, 2004). Environment and fishing habitats are adversely affected by indiscriminate removal of young fish, rocks and coral formations to be sold as souvenirs to transient tourism traffic.

Irresponsible behaviour of users

Beachfront based tourism can also lead to serious solid waste problems, in particular litter. Local communities often cite tourism as a source of local beach litter, perhaps because it is highly visible. Litter includes materials that have been deposited directly into the sea (from boats or shore based facilities such as fishing platforms and seafood restaurants) and that have been left on beaches (by beach visitors). The actual extent of litter generated by tourism in Malaysia is difficult to assess, without systematic beach litter monitoring and characterisation studies. Litter has environmental impacts, can decrease amenity of recreational areas and can pose safety risks to beach users and people on boats. Discarded plastics can clog boat propeller, water intake pipes or drainage outlets. Plastic consumed by turtles that mistake them for sponges are a major source of mortality among these endangered animals. The decaying contents of discarded food containers can generate unpleasant odours and contaminate beach areas with bacteria.

Dense accumulations of litter can generate anaerobic gases that are toxic to aquatic life. The rush to enhance tourism infrastructure has also lead to overdevelopment and excess capacity.

TABLE 4- 34: EFFLUENT AND SOLID WASTE MANAGEMENT REPORT CARD

Issue	Effluent	Solid waste
Current Growth of Effluent/ Solid Waste Pollution	Increasing	Increasing
Future Growth Scenario for Effluent/ Solid Waste Pollution	Increasing	Increasing
Data of on Effluent/ Solid Waste Pollution • Point • Non-Point	 Available Not-Available	Landfill data only
System of Licensing for Point Sources	In place	None
Management and Planning	Limited	For landfills only

Source: ICZM, 2004

Conflicts in Resource-use

The same resources that serve the coastal tourism industry are also being utilised in other activities such as fishing, mining and agriculture-related industries. These conflicts are not uncommon. Similar conflicts in other Southeast Asia country such as in the Upper South Region of Thailand (Ban Don Bay and Phangnga Bay) occurs between tourism and capture fishery industries.

The challenges in the Upper South Region of Thailand resonate across Malaysia in its own coastal tourism industry. As in Table 4-35 indicates, the challenges are cross-cutting in nature from the government agencies to the business communities and local communities.

Although, the situation in Malaysia is not as severe as Thailand, these were the same issues faced by the industry perhaps 20 years ago. However, one main challenge that remains is the acknowledgement of how important implementation of the various policies, local planning plans and laws are in order for a harmonisation of these various resource uses.

TABLE 4- 35: MAJOR AND SUB-ISSUES ASSOCIATED WITH COASTAL TOURISM IN THE UPPER SOUTH REGION, THAILAND

Resource Degradation

- coral reef: boat anchoring, coral and shell collection
- beaches: shoreline construction, improper waste disposal
- nearshore water: domestic wastes from tourist facilities, sediments from construction sites
- forests: clearing for infrastructure development

Socioeconomic and cultural concerns

- Inequitable distribution of tourism benefits: some tourist facilities are not owned by locals
- Increasing cost of living
- Erosion of cultural values

Legal, Institutional and Administrative concerns

- No control over tourism development
- Lack of planning at the local level
- Lack of cooperation amongst government bodies
- Poor enforcement of laws

Education and public awareness

- Little public appreciation of resources supporting tourism
- Poor management of tourist operators
- Poor participation in tourism due to lack of skills, knowledge and capital

source: P.P. Wong, 1991

TABLE 4- 36: INTER-SECTORAL CONFLICTS IN THE UPPER SOUTH REGION, THAILAND

KEY ECONOMIC SECTORS	Mangroves	Coral Reefs	Islands	Beaches	Soft bottoms	Coastal lowlands
Industry						
Plantation / agriculture						
Urban Development						
Aquaculture						
Capture fisheries						
Tourism						
Wildlife						
Mineral resources						
Forestry						

source: P.P. Wong, 1991

Government Initiatives

Economic Transformation Program (ETP)

The New Economic Transformation Program (ETP) refers tourism to both leisure and business tourism and includes the following subsectors: accommodation, shopping, tourism products (i.e. eco-tourism, cruise tourism and other related activities such as spa and wellness) and food and beverage as well as inbound and domestic transportation (ETP, 2010). Two key tourism subsectors – education tourism and medical tourism – are not included in this NKEA, as they are addressed in other NKEA Labs[5].

The total Gross National Income (GNI) impact as a result of setting-up the Global Biodiversity Hub (GBH) is estimated at RM1.5billion with 2,900 job opportunities created

According to research done in preparation for the Economic Transformation Program Report, Malaysia's growth in tourism is predominantly reliant on growth of arrivals rather than yield. As shown in Figure 4-37, 75 percent of Malaysia's growth has been due to the increase of tourist arrivals compared to only 25 percent growth from yield. In comparison, Singapore and Thailand have grown in a more balanced manner. In Singapore, whereby 65 percent of Singapore's growth was driven by tourist arrivals while 35 percent of growth was attributed to yield. Thailand had the reverse situation, where 42 percent of growth was due to tourist arrivals and 58 percent was due to yields, indicating that it is attracting higher spending tourists. Out of the 24 million tourist arrivals into Malaysia in 2009, 78 percent came from short-haul markets especially from neighbouring countries, 15 percent from medium-haul markets and 7 percent from long-haul markets (2009).

In comparison, 43 percent of arrivals in Singapore were from the medium-haul markets, while 36 percent of arrivals in Thailand were from the long-haul markets[6].

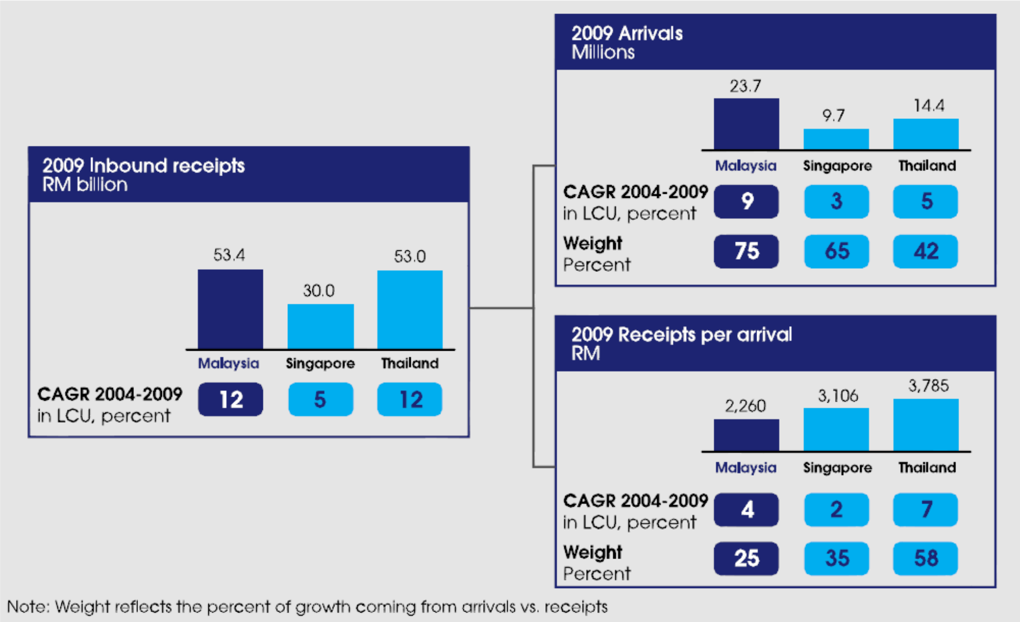
ETP has proposed 12 EPP (Entry Point Projects) under the Tourism NKEA. One of the EPP is to establish Malaysia as a Global Biodiversity Hub.

The Global Biodiversity Hub (GBH) is an accreditation body overseen by a Board of Management, drawn from key stakeholder groups, to establish the desired standards of excellence in the management and presentation of key ecotourism sites. The key functions of the Board will be to accredit and monitor each site to ensure the sustainability of ecotourism development and activities and assist with the promotion and marketing of accredited sites (ETP, 2010). The objective of the GBH is to attract international attention to Malaysia's rich biodiversity and promote responsible tourism and foster sustainable management of Malaysia's natural areas. On the ground, the GBH comprised of a network of natural areas that showcase the biodiversity of Malaysia's rainforests, freshwater habitats and marine environments and their associated flora and fauna. Sites will be managed by their individual management bodies. A GBH site that submits itself for accreditation and is designated as a GBH site must maintain the expected level of excellence or risk losing accreditation.

[5] Medical or health tourism refers to any activity related to the provision of healthcare services such as cosmetic surgery or other forms of
medical procedures and is covered under the Healthcare NKEA. This also includes areas such as assisted living that require the provision
of licensed doctors and nurses. Other areas such as wellness and spa fall under the scope of the Tourism NKEA. Education tourism refers to activities related to targeting and attracting foreign students to study in Malaysia and falls under the Education NKEA. However, the visiting friends and relatives segment of this group falls in the scope of the Tourism NKEA.

[6] Short-haul: Indonesia, Philippines, Vietnam; Medium-haul: China, India, Saudi Arabia, UAE, Japan, South Korea, Australia; Long-haul: UK, France, Germany, Netherlands, Russia

FIGURE 4- 37: MALAYSIA'S GROWTH IN IN-BOUND RECEIPTS DRIVEN BY GROWTH IN ARRIVAL, NOT YIELD



source: Immigration Department of Malaysia, Boston Consulting Group

Total funding required for the GBH is estimated at RM896 million over ten years (2010-2020) which will be used to construct a new Rainforest Discovery Centre and upgrade and improve sites identified to be part of the GBH. The bulk of this funding – RM640 million – will come from the private sector, while the remaining RM256 million will be provided by the Government. Total GNI impact of this EPP is RM1.5 billion and 2,900 jobs will be created.

Another segment of the tourism industry is the 'family-fun' category. Two highly potential projects have been identified to cater to families; i.e. integrated resorts and cruise tourism.

To differentiate and leverage on internal strengths, Malaysia plan to develop an Eco-nature Integrated Resort in Sabah. As illustrated in Figure 4-38, it will be a showcase of green development, with energy-efficient buildings, implementation of renewable energy products, recycling and use of electric transportation, as well as displaying Sabah's rich biodiversity, through a mangrove education centre.

The Ministry of Tourism shall oversee the implementation of this EPP. The total investment is expected to be approximately RM6.7 billion which will also include upgrading of existing utilities and infrastructure and undertaking flood mitigation measures within the proposed site. The bulk of this funding – RM6.1 billion – are to be provided by the private sector, while the remainder will be provided by the Government. Overall, the GNI impact is expected to be RM707 million with 7,700 jobs created by 2020.

The total Gross National Income (GNI) impact of the development of an Eco-nature Integrated Resort in Sabah is estimated to be RM707million with 7,700 jobs by 2020

FIGURE 4- 38: SELECTED ECO-NATURE INTEGRATED RESORT FEATURES

source: ETP, 2010

Based on the twelve proposed Entry Point Projects (EPPs) for tourism industry, a total of GNI impact by 2020 is expected to be RM66.7billion with 497,000 additional new job opportunities created.

TABLE 4- 37: SUMMARY OF TOURISM NKEA

Summary of Tourism NKEA	
• **Incremental GNI impact in 2020**	RM66.7 billion
• **Additional jobs in 2020**	497,000
• **Critical targets and milestones within 6 to 12 months** • Tariffs for first batch of duty-free items exempted • Pedestrian walkways in KLCC-Bukit Bintang Shopping area developed • First premium outlet operational • Interim Board of the Global Biodiversity Hub Board set up • National Passenger Sea Ports and Cruise Tourism Implementation Blueprint completed • Straits Riviera Council set up • Designation of a new Kuala Lumpur entertainment zone underway • Spa and Wellness National Council set up • Bidding for target set of business tourism events begun • Network expansion plans to priority cities developed by local carriers	

Sabah Initiatives

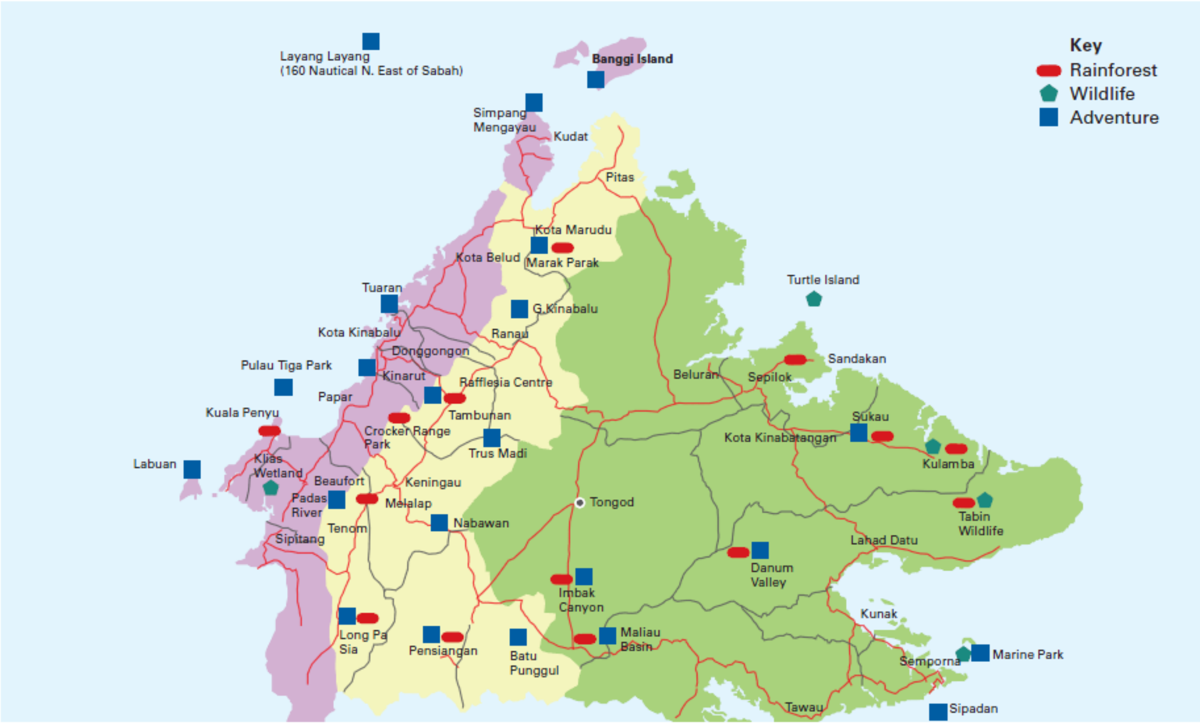
Background

The focus of Sabah's tourism strategy is to attract quality, high-yield and long-stay visitors.

Sabah is already positioning itself as a premier eco-adventure destination.

Its adventure attractions cater to enthusiasts interested in activities such as mountain climbing, white-water rafting and diving, while nature inspired holiday-makers seek out wildlife sighting and nature walks.

FIGURE 4- 39: ECO-ADVENTURE DESTINATIONS IN SABAH

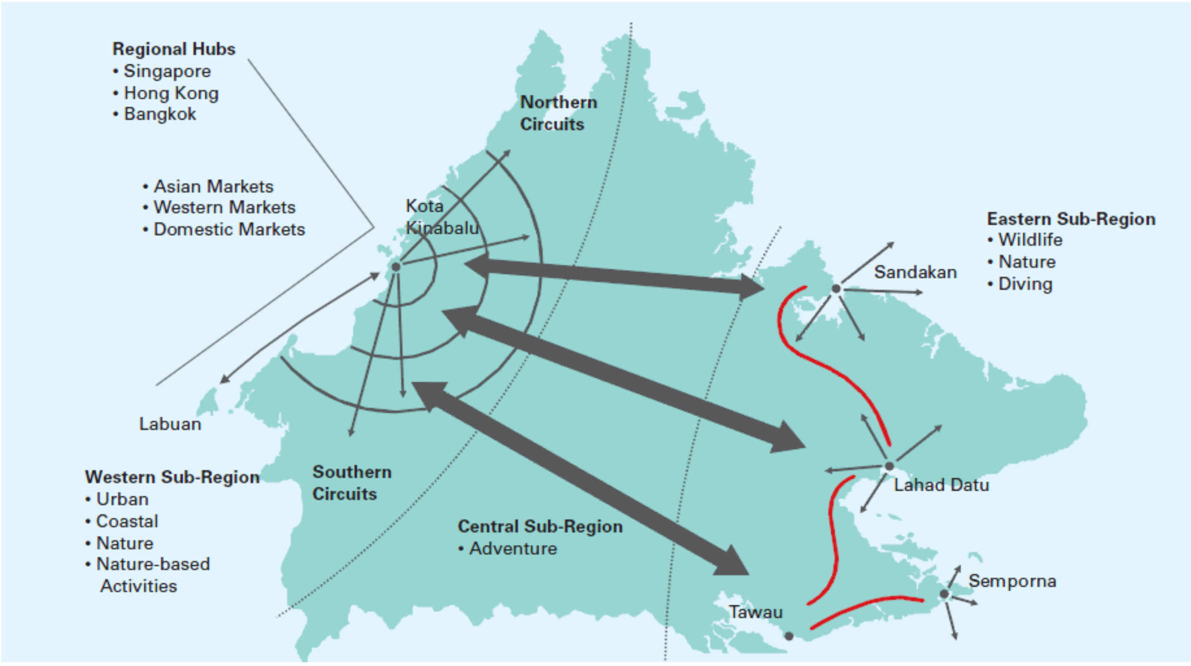


Source: Sabah Tourism, IDS

The tourism strategy fulfils the goal of spreading the benefits of tourism to the people of Sabah. As such, a three-zone concept is being adopted to ensure balanced development. Kota Kinabalu will remain as the state's primary gateway and central hub to both Eastern and Western Sub-Regions. Existing air linkages provide spokes from Kota Kinabalu to Sandakan, Lahad Datu and Tawau, all of which function as secondary hubs to the scattered Eastern tourism sites, which are home to most of Sabah's natural and marine treasures. The Western Sub-Region will be further enhanced with coastal developments along its Northern and Southern Circuits to accommodate integrated beach resorts, marina, and cruise terminal, among others. This will facilitate the growth of tourism and take pressure off key Western attractions such as Mount Kinabalu. The Central Sub-Region will be devoted to adventure tourism, which includes activities such as white-water rafting and jungle-trekking. Please refer to Figure 4-40 for illustration of the three-zone concept.

With proper branding and effective marketing strategies, the state of Sabah hope to generate RM24billion in tourism receipts by 2020 or to double receipts every five (5) years (SDC Blueprint, 2008-2025).

FIGURE 4- 40: SABAH TOURISM DEVELOPMENT CONCEPT



Source: Sabah Tourism Masterplan, IDS

Strategies

The World Tourism Organisation predicts that the trendiest destinations in the future will be from *"the tops of the highest mountains, the depths of the deepest oceans and the ends of the earth*". Therefore, conservation and conscientious tourism are important to ensure sustainability. With the increasing environmental sensitivities and greater awareness among discerning travellers, eco-tourism has become the fastest growing segment in the tourism industry. It is estimated to be increasing 20% annually compared with 7% for tourism overall.

The Ecotourism Society defines eco-tourism as 'responsible travel to natural areas which conserves the environment and sustains the well-being of local people'. The industry is estimated to grow at 20% annually in comparison to the tourism industry in general at 7%

To cater to the rising demand, existing natural attractions need to be enhanced and new nature sites can be developed in line with the eco-tourism concept. The Ecotourism Society defines the eco-tourism concept as "*responsible travel to natural areas which conserves the environment and sustains the well-being of local people*". Environmental impact, carrying capacity, visitor experience and incorporation of local communities into the tourism development as well as natural area management process will be key considerations for the development of all eco-tourism sites.

In view of the above, the Sabah plans to attract renowned signature resorts, such as the Four Seasons, Ritz-Carlton, Shangri-La and Bvlgari, to anchor new tourism products such as spa and wellness tourism in Kundasang and marine tourism on the islands. Signature resorts conduct their own market research and are attuned to customers' needs. They also have its group of loyal customers which bodes well in the promotion of Sabah to well-travelled visitors.

Minerals, oil and gas

Malaysia's source of minerals are barite, bauxite, clay, coal, copper, ilmenite, iron ore, monazite, natural gas, petroleum, silica, silver, struverite, tin and zircon. During the 20th century, mineral production contributes to a significant portion of the national economy, however, after many years of exploitation, minerals such as the barite, bauxite, copper, ilmenite, iron ore and tin were either depleted or production moves at a much slower rate (Tse, P.K., 2011). The mining and quarrying sector accounted for 13.0% of the GDP (2009) compared to 17. % in 2008.

Government Policies and Programs

The mineral activities are governed by the Mineral Development Act 1994 and the State Mineral Enactment. The Mineral Development Act 1994 defines the power of the Federal Government to regulate and conduct inspections of mineral explorations, mining and related activities. The State Mineral Enactment provides power to the States to issue mineral prospecting and exploration licenses and mining leases. Besides from paying corporate tax to the Federal Government, mine and quarry operators are required to pay value-based royalties to the State where their operations is located. Royalty rates depend on the mineral commodity and on the assessment of each of the individual States.

In 2009, the Malaysian Government has undergone a second review of the National Mineral Policy with the intention to increase the mineral sector's role in the socio-economic development of the country. The revised policy sought to ensure sustainable development and the optimal use of mineral resources. Under the new policy the development of the country's mineral resources is to be accomplished in an environmentally sound, responsible and sustainable manner (Tse, P.K., 2011). Amongst others, the Government plans for a mineral industry training fund to upgrade workers skills and knowledge.

Production

Malaysia produces bauxite, coal, feldspar, gold, ilmenite, iron ore, mica, natural gas, petroleum, tin, and zircon. It has been one of the major tin producing countries in the world; owing to depleted ore resources and lower ore grades, however, tin concentrate production had decreased in recent years (Tse, P.K., 2011). The country mainly depends on imported tin concentrates and crude tin from Australia and Indonesia to meet its demand for feedstock for the smelter and refinery. In 2009, production of commodities such as mined gold, iron ore, pig iron, tin metal, and zirconium has increased by more than 10% whereas production of bauxite, feldspar, ilmenite, mica, silica sand, crude steel, rare earths, rutile, and struverite decreased by more than 10% (Please refer to Table 4-38).

Malaysian Mineral Industry Structure

Malaysia' mineral industry consists of a small mining sector of coal and ferrous and nonferrous metals. Metallic and non-metallic processing facilities are operated by private companies. Oil and gas exploration, production, and processing activities are owned and operated by Petroliam Nasional Berhad (PETRONAS). Please see Table 4-39 for private companies holding in the mineral industry.

TABLE 4- 38: MALAYSIA: PRODUCTION OF MINERAL COMMODITIES[1]
(metric tons unless otherwise specified)

Commodity[2]		2005	2006	2007	2008	2009
METALS						
Aluminum, bauxite, gross weight		4,735	91,806	156,785	295,176 [r]	263,432
Gold, mine output, Au content[3]	kilograms	4,250	3,497	2,913	2,489 [r]	2,794
Iron and steel:						
Iron ore, gross weight		949,605	667,082	802,030	981,932 [r]	1,470,186
Pig iron, direct-reduced iron and hot-briquetted iron	thousand metric tons	1,349	1,277	1,872	1,957	2,388
Steel, crude	do.	5,296	5,834	6,895	6,423	5,787
Lead metal, secondary[e]		71,000	73,000	73,000	73,000	72,000
Niobium (columbium)-tantalum metals, struverite, gross weight		552	93	52	216 [r]	176
Rare-earth metals, monazite, gross weight		320	894	682	233 [r]	25
Silver, mine output, Ag content[3]	kilograms	401	410	295	349 [r]	367
Tin:						
Mine output, Sn content		2,857	2,398	2,263	2,605 [r]	2,412
Metal, smelter		36,924	22,850	25,471	31,691 [r]	36,407
Titanium:						
Ilmenite concentrate, gross weight		38,196	45,649	59,310	36,779 [r]	15,983
Rutile		5,509	16,921	1,450	1,834	1,502
Dioxide[e]		56,000	56,000	56,000	56,000	56,000
Zirconium, zircon concentrate, gross weight		4,954	1,690	7,393	984 [r]	1,145
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand metric tons	16,658 [r]	19,457 [r]	21,909 [r]	19,629 [r]	19,457
Clays and earth materials	do.	28,757	25,081	28,102	25,065 [r]	25,000 [e]
Feldspar		117,180	142,358	358,775	457,377 [r]	356,620
Kaolin		494,511	341,223	587,508	506,462 [r]	463,736
Mica		4,542	5,152	6,118	5,593 [r]	4,323
Nitrogen, N content of ammonia		920,000	950,000	950,000	950,000	950,000
Sand and gravel	thousand metric tons	17,072	25,225	22,370	24,472 [r]	23,000 [e]
Silica sand, peninsular Malaysia and Sarawak		531,891	512,277	719,221	1,466,904 [r]	161,115
Stone:						
Aggregate	thousand metric tons	62,761	79,912	79,118	75,883 [r]	75,000 [e]
Dolomite		38,500	37,702	49,320	57,900 [r]	49,000 [e]
Limestone	thousand metric tons	30,868	33,471	33,688 [r]	35,228 [r]	34,000 [e]
MINERAL FUELS AND RELATED MATERIALS						
Coal		789,356	901,801	1,074,936	1,166,525 [r]	1,050,000 [e]
Gas, natural:						
Gross	million cubic meters	70,471	70,191	71,170	68,000	65,000
Net[4]	do.	59,904 [r]	59,668 [r]	60,804 [r]	61,004 [r]	58,560
Liquefied natural gas	thousand metric tons	21,948	21,948	22,900 [r]	22,870 [r]	22,180
Petroleum:						
Crude and condensate	thousand 42-gallon barrels	267,720	243,455	249,295	251,811 [r]	240,843
Refinery products[e, 5]	do.	218,000	208,000	220,000	210,000	200,000

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. do. Ditto.

[1]Table includes data available through October 5, 2010.

[2]In addition to the commodities listed, a variety of crude construction materials, which include clays and stone, fertilizers, and salt, is produced but not reported, and information is inadequate to make reliable estimates of output.

[3]Includes byproduct from tin mines in peninsular Malaysia and gold mines in peninsular Malaysia and the State of Sarawak.

[4]Includes production from peninsular Malaysia and the States of Sabah and Sarawak.

[5]Gross less volume of reinjected and flared.

Sources: Ministry of Primary Industry, Minerals and Geoscience Department (Kuala Lumpur), Malaysian Minerals Yearbook 2009; U.S. Geological Survey Minerals Questionnaire, 2009; and Southeast Asia Iron and Steel Institute, Steel Statistical Yearbook, 2009.

TABLE 4- 39: MALAYSIA - STRUCTURE OF THE MINERAL INDUSTRY IN 2009
(metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite		Johore Mining and Stevedoring Co. Sdn. Bhd.	Teluk Rumania and Sg. Rengit, Johor	400.
Cement[1]		Cement Industries of Malaysia Bhd. (United Engineers Malaysia Bhd., 53.97%, and others, 46.03%)	Kangar, Perlis and Bahau, Negeri Sembilan	3,400 cement; 2,800 clinker.
Do.		CMS Cement Sdn Bhd (subsidiary of Cahya Mata Sarawak Bhd)	Bintulu and Kuching, Sarawak	1,750 cement; 600 clinker.
Do.		Holcim (Malaysia) Sdn Bhd (Holcim Ltd.)	Pasir Gudang, Johor	1,200 cement.
Do.		Lafarge Malayan Cement Bhd. (subsidiary of Lafarge S.A.)	Rawang, Selangor; Kanthan, Perak, Langkawi, Kedah; and Pasir Gudang, Johor	12,950 cement; 8,200 clinker.
Do.		YTL Cement Berhad (subsidiary of YTL Group)	Bukit Sagu, Pahang; Padang Rengas, Perak; and Pasir Gudang and Wesport, Johor	5,700 cement; 4,200 clinker.
Do.		Perak-Hanjoong Simen Sdn. Bhd. (Gopeng Bhd., 45%, and Korea Heavy Industries and Construction Co. and others, 55%)	Padang Rengas, Perak	3,400 cement; 3,000 clinker.
Do.		Tasek Corp. Bhd (publicly owned company)	Ipoh, Perak	2,300 cement; 2,300 clinker.
Gas:				
Natural	million cubic meters per day	ExxonMobil Exploration and Production Malaysia, Inc.	Offshore Terengganu	45.
Do.	do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	3.
Do.	do.	Sarawak Shell Bhd.	Offshore Sarawak	80.
Liquefied		Malaysia LNG Sdn. Bhd. (Petroliam Nasional Berhad, 65%; Shell Gas N.V., 15%; Mitsubishi Corp., 15%; Sarawak State government, 5%)	Tanjung Kidurong, Bintulu, Sarawak	8,100.
Do.		Malaysia LNG Dua Sdn. Bhd. (Petroliam Nasional Berhad, 60%; Shell Gas N.V., 15%; Mitsubishi Corp., 15%; Sarawak State government, 10%)	do.	7,800.
Do.		Malaysia LNG Tiga Sdn. Bhd. (Petroliam Nasional Berhad, 60%; Shell Gas N.V., 15%; Nippon Oil LNG (Netherlands) BV, 10%; Sarawak State government, 10%; Diamond Gas Netherlands BV, 5%)	do.	6,800.
Gold, refined	kilograms	Specific Resources Malaysia Sdn. Bhd. (joint venture of Pahang State Development Corp. and Avocet Mining Plc)	Penjom, Pahang	4,000.
Iron and steel:				
Direct-reduced iron		Lion DRI Sdn Bhd (Lion Group)	Banting, Selangor	1,540.
Do.		Perwaja Steel Sdn. Bhd. (Kinsteel Bhd, 51%, and Maju Holdings Sdn. Bhd., 49%)	Kemaman, Terengganu	1,800.
Hot-briquetted iron		Amsteel Mills Sdn Bhd (Lion Group)	Labuan Island, offshore Sabah	880.
Crude steel		do.	Banting, Selangor	1,250.
Do.		do.	Klang, Selangor	750.
Do.		Ann Joo Steel Bhd (Ann Joo Group)	Prai, Penang	900.
Do.		Antara Steel Sdn. Bhd. (Lion Grop)	Pasir Gudang, Johr	600.
Do.		Kinsteel Sdn Bhd	Kuantan, Pahang	500.
Do.		Megasteel Sdn Bhd (Lion Group)	Banting, Selangor	700.
Do.		Malaysia Steel Works Bhd	Bukit Raja, Selangor	450.
Do.		Perwaja Steel Sdn. Bhd. (Kinsteel Bhd, 51%, and Maju Holdings Sdn. Bhd., 49%)	Kermaman, Terengganu	1,500.
Do.		Southern Steel Bhd. [Camerlin (a member of Hong Leong Group Malaysia), 40.75%; Natsteel Ltd., 27.03; others, 32.22%]	Prai, Penang	1,300.

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Nitrogen, ammonia		Asean Bintulu Fertilizer Sdn. Bhd. (Petroliam Nasional Berhad, 63.5%; P.T. Pupuk Sriwidjaja Indonesia, 13%; Thai Ministry of Finance, 13%; Philippines National Development Co., 9.5%; Singapore Temasek Holdings Pte. Ltd., 1%)	Bintulu, Sarawak	395.
Do.		Petronas Fertilizer Kedah Sdn. Bhd. (wholly owned subsidiary of Petroliam Nasional Berhad)	Gurun, Kedah	378.
Do.		Petronas Ammonia Sdn. Bhd. (wholly owned subsidiary of Petroliam Nasional Berhad)	Kerth, Terengganu	370.
Petroleum, crude	thousand 42-gallon barrels per day	ExxonMobil Exploration and Production Malaysia, Inc.	Offshore Terengganu	390.
Do.	do.	Sabah Shell Petroleum Co. Ltd.	Offshore Sabah	100.
Do.	do.	Sarawak Shell Bhd.	Offshore Sarawak	184.
Do.	do.	do.	do.	184.
Do.	do.	Petronas Carigali Sdn. Bhd.	Offshore Terengganu	22.
Do.	do.	Murphy Sarawak Oil Co. Ltd.	Offshore Sarawak	15.
Tin:				
Concentrate		Delima Industries Sdn. Bhd.	Dengkil, Selangor	1.1.
Do.		Maiju Sama Sdn. Bhd.	Puchong, Selangor	1.6.
Do.		New Lahat Mines Sdn. Bhd.	Lahat, Perak	0.3.
Do.		Omsam Telecommunication Sdn. Bhd.	Bakap and Batu Gajah, Perak	0.5.
Do.		Rahman Hydraulic Tin Bhd.	Klian Intan, Perak	1.2.
Do.		S.E.K. (M) Sdn. Bhd.	Kampar, Perak	0.4.
Do.		Tasek Abadi Sdn Bhd.	Senudong and Kampar, Perak	0.5.
Refined		Malaysia Smelting Corp. Bhd. (The Straits Trading Co. Ltd., 37.44%; Malaysia Mining Corp., 37.44%; others, 25.12%)	Butterworth, Penang	35.
Titanium dioxide		Huntsman Trioxide Sdn. Bhd. (a subsidiary of Huntsman Tioxide)	Kemaman, Terengganu	56.

Do., do. Ditto.
[1] All companies operated integrated plants.

Commodity Review

Aluminium

Malaysia does not have aluminium refineries or smelters. Most of its bauxite outputs are exported to China, while it imports unwrought aluminium to meet domestic demands (Tse, P.K., 2011).

Gold

Peninsular Malaysia consists of three main geological domains striking parallel to the peninsula. These domains include the Western Tin Belt, Central Gold Belt and Eastern Tin Belt (Yeab, E.B., 1993). Please refer to Figure 4-41 for illustration of these geological domains. The Central Gold Belt hosts the majority of Peninsular Malaysia's gold occurrences. This is the belt of primary, but not exclusive, interest. The Central Gold Belt is a deeply eroded fold and thrust belt formed during the late Triassic collision of Indochina (Cathaysia) with the western Sibumasu Terrane (Gondwana) (Metcalfe, 1988, 2000, 2002).

There are ten (10) gold mines in Malaysia and most are e located in the states of Kelantan, Pahang and Terengganu.

Approximately 98% of mined gold are from Pahang, mainly from the Penjom Gold Mine of Specific Resources Malaysia Sdn Bhd which is wholly owned subsidiary of Avocet Mining Plc based in the United Kingdom. Since 1996, the company has mined approximately 31.2metric tons (t) (1million troy ounces) of gold, and the company estimated that the area retain another 37.4t (1.2 million troy ounces) of gold resources (Tse, P.K., 2011).

FIGURE 4- 41: MINERAL BELT OF PENINSULAR MALAYSIA (MAP FROM MONUMENT MINING SDN BHD)

Iron and Steel

Malaysian iron ore productions are from small scale mines located in the states of Johor, Pahang, Perak and Terengganu. Low-grade iron ores are consumed by the pipe-coating industry that supplies to the oil and gas sector and to cement plants. High-grade iron ore are exported to China. However, domestic production capacity is running at 60% capacity due to weak demand from the construction sector (Tse, P.K., 2011). The Malaysian Iron and Steel Federation (MISF) estimated that the country's steel consumption has reduced from 8.4Mt in 2008 to 7.1Mt in 2009.

Tin

Mining of tin has been active for more than 100 years and over the recent years production has been on a declining trend due to a drop in available resources. Malaysia's tin production has reduced to 2,400t (2009) compared to 6,000t in 2000. Solder production is the main tin consumer followed by tinplate and pewter. Tin consumption also is on a declining trend from 5,000t in 2000 to 3,000t in 2009. The decline is mainly from the solder and pewter industry (Tse, P.K., 2011). However, Malaysia's tin reserve is still ranked as the world's third largest (malaysianminerals.com.

Coal

Malaysia's coal resources are mainly in the states of Perak, Perlis, Sabah, Sarawak and Selangor. Sarawak produces coal from the areas of Bintulu, Merit-Pila, Silantek and Tutoh. The country has approximately 1.9billion metric tons (Gt) in available resources. About 1.5Gt of coal is located in Sarawak and more than 300Mt in Sabah (Tse, P.K., 2011). Most of the coal in the interior areas has yet to be exploited. In Sabah, most of the coal resources are located in the Maliau Basin Conservation area, which is designated as a protected area. Currently, mining and exploration for coal are only confined to Sarawak. The main consumers of coal are the power-generation plants (70%) followed by cement, iron and steel production sectors. Unfortunately, demand for coal exceeded supply and the country are forced to import coal from Australia, Indonesia, South Africa and Vietnam (Minerals and Geoscience Department, 2009).

NATURAL GAS AND PETROLEUM

Petroleum exploration in Malaysia kick-off at the beginning of the 20th century in Sarawak, where oil was first discovered in 1909 and produced in 1910. Prior to 1975, petroleum concessions were granted by state governments, where oil companies have exclusive rights to explore and produce resources (Razmahwata, M.R. 2005). The companies then paid royalties and taxes to the government. This arrangement ceased on April 1, 1975 upon the introduction of the Petroleum Development Act, when Petroliam Nasional Berhad (PETRONAS) became the custodian of petroleum resources with rights to explore and produce resources. The national oil company retains ownership and management control in exploration, development and production of oil resources. Expenditure and profits are managed under instruments called Production Sharing Contracts (PSCs). The Production Sharing Contractor assumes all risks and sources all funds for all petroleum operations. The Contractor receives an entitlement through production. Each PSC may have different terms and conditions.

For example, different time periods are allowed for exploration of acreage, developing and installing infrastructure to produce any hydrocarbons discovered, and the actual production period.

Facts

Oil Production	Ranking: 27th (over 209 countries) 693,700 bbl/day (est.2009) 84% crude oil
Oil Exports	Ranking: 30th (over 210 countries) 511,900 bbl/day (est.2007)
Oil Reserves	Ranking: 27th (over 205 countries) 4 bill bbl (est. 1 Jan 2010)
Nat. Gas Production	Ranking: 17th (over 208 countries) 57.3bill cu m (est. 2008)
Nat. Gas Exports	Ranking: 8th (over 207 countries) 31.03bill cu m (est. 2008)
Nat. Gas Reserves	Ranking: 16th (over 204 countries) 2.35 trillion cu m (est. 1 Jan 2010)

Source: CIA Factbook

According to the *Oil & Gas Journal (OGJ)*, Malaysia has proven oil reserves of 4 billion barrels (Figure 4-42). and 83 trillion cubic feet (Tcf) of natural gas reserves as of January 2010 (Figure 4-43). Most of the oil reserves are located in the Malay basin and are of high quality and its natural gas production comes from eastern Malaysia, offshore Sarawak k and Sabah (SBSR2025, 2010).

FIGURE 4- 42: TOP 5 ASIA-PACIFIC PROVEN OIL RESERVE HOLDERS, JANUARY 2009

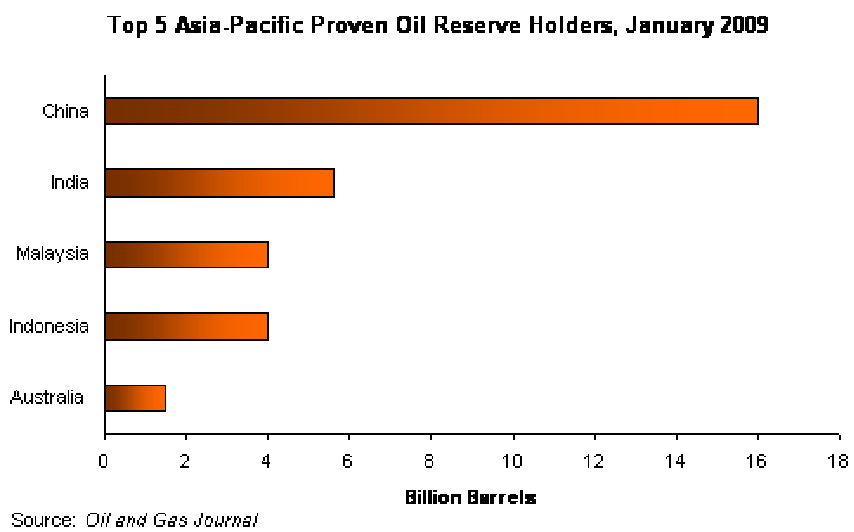
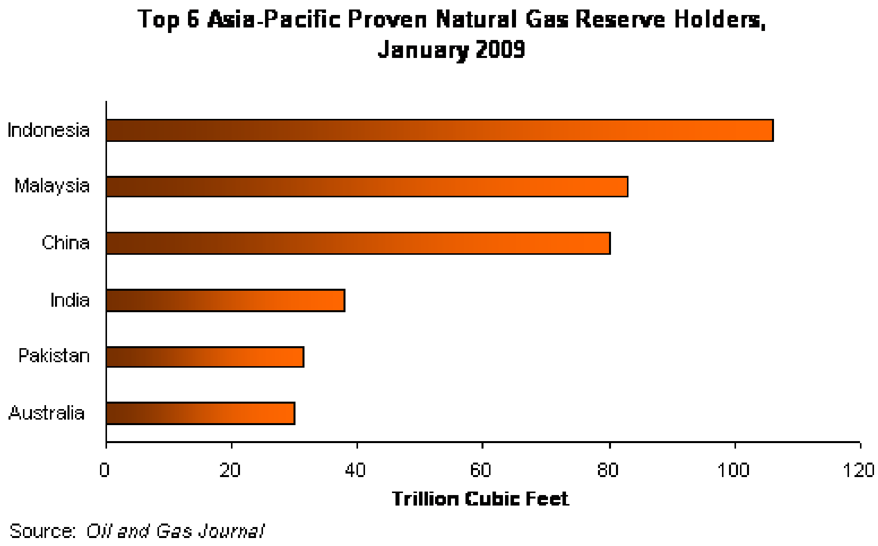


Figure 4- 43: Top 6 Asia-Pacific Proven Natural Gas Reserves Holders, January 2009



Malaysia remains as a net exporter of natural gas and crude oil. Malaysia was the second largest exporter of LNG in the world after Qatar in 2007, exporting over 1Tcf of LNG, which accounted for 13% of total world LNG exports. Japan, South Korea, and Taiwan were the three (3) primary purchasers.

LNG is primarily transported by Malaysia International Shipping Corporation (MISC), which owns and operates the single largest LNG tanker fleet in the world by volume of LNG carried

Source: Energy Information Administration

Labour Force

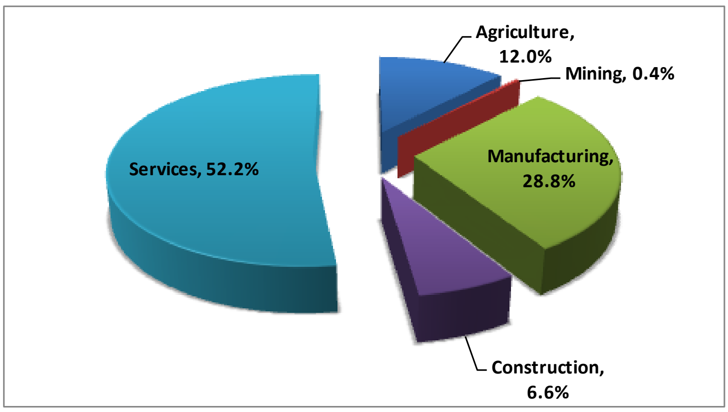
The mining sector has consistently ranked the lowest in terms of rate of employment (0.4%, 2008) compared to other sectors such as agriculture, construction, manufacturing and services (Please refer to Figure 4-40).

TABLE 4- 40: NUMBER OF EMPLOYMENT IN MINING INDUSTRY (2001-2011)

Year	No. of employment
2001	27,000
2002	28,000
2003	30,000
2004	35,000
2005	36,000
2006	42,000
2007	39,000
2008	46,000
2009	46,000
2010	46,000
2011	46,000

source: Department of Statistics Malaysia

TABLE 4- 41: PERCENTAGE OF EMPLOYMENT IN RELATION TO INDUSTRIES, 2008



source: Department of Statistics Malaysia

However, the number of employment in the mining industry has been steadily increasing to 46,000 (2008) compared to 27,000 in 2001. Figures for 2010 are preliminary figures and 2011 is the estimated number of employment (please refer to Table 4-43).

TABLE 4- 42: LABOUR FORCE, EMPLOYMENT BY SECTOR (MSIC 1972) AND UNEMPLOYMENT, 2001 - 2007 IN ('000)

	Guna Tenaga Mengikut Sektor/*Employment by Sector*											
Tahun *Year*	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**Jumlah** *Total*	**Kadar Pengangguran** *Unemployment Rate(%)*	**Kadar Penyertaan Tenaga Buruh** *Labour Force Participation Rate (%)*
2001	1,416	27	2,184	830	57	468	2,043	574	1,758	9,357	3.5	64.9
2002	1,425	28	2,069	905	51	497	2,113	638	1,819	9,543	3.5	64.4
2003	1,408	30	2,131	943	58	482	2,236	628	1,955	9,870	3.6	65.2
2004	1,453	35	2,023	891	58	533	2,305	695	1,988	9,980	3.5	64.4
2005	1,470	36	1,989	904	57	545	2,292	706	2,045	10,045	3.5	63.3
2006	1,504	42	2,083	909	75	540	2,372	751	2,000	10,275	3.3	63.1
2007	1,558	39	1,977	923	61	538	2,473	840	2,129	10,538	3.2	63.2

Nota/*Note*:
S1: Pertanian, Pemburuan, Perhutanan & Perikanan/*Agriculture, Hunting, Forestry & Fishing*
S2: Perlombongan & Kuari/*Mining & Quarrying*
S3: Pembuatan/*Manufacturing*
S4: Pembinaan/*Construction*
S5: Elektrik, Gas dan Air/*Electricity, Gas & Water*
S6: Pengangkutan, Penyimpanan dan Komunikasi/*Transport, Storage & Communications*
S7: Perdagangan Jual Borong dan Jual Runcit, Pembaikan Kenderaan Bermotor, Motosikal, Barangan Persendirian & Isi Rumah dan Hotel & Restoran
Wholesale & Retail Trade, Repair of Motor Vehicles, Motorcycles, Personal & Household Goods and Hotels & Restaurants
S8: Pengantaraan Kewangan, Aktiviti hartanah, Penyewaan dan Perniagaan/*Financial Intermediation, Real Estate, Renting and Business Activities*
S9: Perkhidmatan-perkhidmatan lain/*Other Services*

Sumber : Jabatan Perangkaan Malaysia
Source: Department of Statistics Malaysia

TABLE 4- 43: LABOUR FORCE AND EMPLOYMENT DATA (2008 TO 2011)

	Unit	2008	2009	2010(p)	2011(e)
2.4 Labour Force					
Labour force	'000	11,968	12,083	12,361	12,646
Labour Force Participation Rates:					
Total(1)	%	62.7	63.3	64.3	64.8
Male(2)	%	79.0	79.5	79.8	80.0
Female	%	45.7	46.2	48.0	49.0
Unemployment	% of labour force	3.3	3.7	3.4	3.3
2.5 Employment					
Total	'000	11,577	11,632	11,937	12,227
Agriculture	% of total	12.0	12.0	11.6	11.4
Mining	% of total	0.4	0.4	0.4	0.4
Manufacturing	% of total	28.8	27.6	28.3	28.9
Construction	% of total	6.6	6.6	6.5	6.3
Services	% of total	52.2	53.5	53.3	53.1

Notes: (p) Preliminary (e) Estimate
(1) Total number of people economically active as a percentage of total number in the working age population of 15 to 64 years
(2) Total number of people economically active as a percentage of total number of males or females in the working age population
Sources: Economic Planning Unit, Ministry of Finance & Department of Statistics

Oil & Gas: Environmental Issues

Oil and gas upstream activities (exploration, development and production of crude oil or natural gas) and downstream activities (tankers, pipelines, retailers and consumers) are the two important activities in the petroleum industry. These two activities pose different set of environmental issues. At the upstream level, majority of the productions process are undertaken on the continental shelf and in deepwater where marine pollution is the main concern. At the downstream level, the environmental issues include emission of gas, pollution from transportation, storage and utilisation of petroleum and gas (Norfadhilah, M.A., 2006).

One of the most devastating oil spill event occurred on 19th September 1992 when a Liberian – registered tanker Nagasaki Spirit collided with container Ocean Blessing in the Malacca Straits spilling some 12,000 tonnes of crude oil into the sea[7]. Consequently, in 1994 the Merchant Shipping (Oil Pollution) Act 1994 was passed, effectively ratifies the International Convention on Civil Liability for Oil Pollution Damage 1969 (CLC) and the International Convention on the establishment of an International Fund for Compensation for Oil Pollution Damage 1971 and 1976 Protocol (Fund Convention), a convention supplementary to the CLC, which provides for compensation for damages not compensated by CLC. The CLC provides for the liability of a ship owner for all pollution damage caused in the territory or in the territorial waters of another contracting state by oil which has escaped or has been discharged from his ship (Norfadhilah, M.A., 2006). Further environmental related legislations are discussed in Chapter III of this Report.

TRANSPORTATION AND SHIPPING

BACKGROUND

As a maritime nation, Malaysia's trade has been predominantly dependent on seaborne trade. As of 2009, the United Nations Conference on Trade and Development (UNCTAD) ranked Malaysia 21st in a list of 35 most important maritime countries and territories in terms of deadweight tonnage (DWT) of its merchant vessels (including national and foreign flagged) contributing 1.05 percent or 11.56 million DWT to the global merchant fleet capacity[8]. Since then, Malaysia started to experience positive economic growth and this has direct impacts on all maritime-related business performance (see Table 4-44). In 2010, sea freight in Malaysia accounted for 95% of the total cargo volume and sea cargo volume was expected to increase by 12.5%, equivalent to 493.7million tonnes the following year. Two of the major contributing ports in terms of sea cargo volume handled for 2010 were Port Klang (37.8%) in Selangor and Port of Tanjung Pelepas (22%) in Johor (MLD, 2010).

TABLE 4- 44: MALAYSIA'S EXTERNAL TRADE, 2008 - 2010

	2008			2009			2010f		
External Trade	RM (mill)	% growth	% share	RM (mill)	% growth	% share	RM (mill)	% growth	% share
Total exports (f.o.b.)	**633,494**	**9.6**		**530,626**	**-20.0**		**558,981**	**5.3**	
USD (mill)	*190,026*			*148,017*			*155,927*		
Manufactured goods	495,337	3.7	74.7	406,971	-17.8	76.7	425,445	4.5	76.1
Palm oil (crude and processed)	47,051	44.1	7.1	32,912	-30.1	6.2	34,863	5.9	6.2
Crude petroleum	43,040	31	6.5	25,857	-39.9	4.9	29,711	14.9	5.3
Liquefied natural gas	40,732	55.7	6.1	38,400	-5.7	7.2	42,697	11.2	7.6
Total imports (c.i.f)	**521,611**	**3.3**		**424,507**	**-18.6**		**452,775**	**6.7**	
USD (mill)	*156,466*			*118,415*			*126,301*		
Intermediate goods	379,136	5.7	72.7	297,155	-21.6	70.0	316,942	6.7	70.0
Capital goods	69,913	0.03	13.4	59,431	-15	14.0	63,388	6.7	14.0
Consumption goods	32,304	11.8	6.2	30,013	-7.1	7.1	31,694	5.6	7.0
Balance of trade	**141,883**			**106,119**			**106,206**		

source: Treasury Malaysia, Ministry of Finance

[7] United Kingdom. www.wwf.org.uk/filelibrary/pd/tankerincidents.pdf. 24th May 2006.
[8] Khalid, N., The curious case of the Malaysian shipbuilding industry -, Baird Maritime, May 2010, source: http://www.bairdmaritime.com/index.php?option=com_content&view=article&id=6584%3Athe-curious-case-of-the-malaysian-shipbuilding-industry&catid=98%3Afull-speed-ahead&Itemid=122&limitstart=1

Shipping Fleet

The Malaysian shipping fleet size, which stood at just 200,000 GRT in 1968, now composed of a diversified fleet of nearly 3,210 ships totalling 6.55 million GRT. As a major producer and exporter of oil and gas resources, the transportation of LNG is primarily undertaken by the Malaysia International Shipping Corporation (MISC), which owns and operates the single largest LNG tanker fleet in the world by volume of LNG carried (29 LNG tankers) Other tankers include 83 petroleum tankers and 27 chemical tankers. This sector of shipping account for one-third of the Malaysian GRT.

A smaller percentage of 35% consists of general cargo and bulk carriers (UNESCAP, 2000).

Container ships accounts for only 10 per cent of the Malaysian GRT. The establishment of the Malaysia International Shipping Corporation (MISC) by the government in 1968 marked the entry of Malaysian shipping industry into international shipping. In 1982, MISC pioneered the introduction of containerised shipping in Malaysian domestic trade with two purpose-built 292-TEU containership. Since then, other Malaysian shipping lines have injected second-hand containership into the Malaysian coastal trade. Today, MISC remains the owner and operator of the largest fleet of Malaysian registered containerships with 29 vessels ranging from 495 TEUs to more than 5,000 TEUs. Beside MISC, there are also number of shipping companies involve in international trade, such as Halim Mazmin Berhad, Nepline, Global Carriers, PDZ, and Malaysian Merchant Marine Berhad (UNESCAP, 2000).

Shipbuilding and Ship Repair

Generally, there is insufficient data and information to enable a comprehensive analysis / review of the Malaysian shipbuilding and ship repair industry.

The promotion for ship repair activities such as maintenance, overhauling and refurbishment of vessels were highlighted in the Second Industrial Master Plan (IMP2) (1995-2005). The industry achieved an average annual growth of 10.1% in total exports in comparison to 3.6% in total imports of marine transport products. During this period, RM750.2million was generated in domestic and foreign investments (SBSR, 2010). Provision for financial assistance to ship owners to acquire vessels and for shipyards to upgrade its infrastructures totalling RM2.3billion was allocated from the Malaysia Shipping Finance Fund and New Shipping Fund (SBSR, 2010). In 2005, the ship repair industry has generated 25,000 job opportunities.

Subsequently, the Third Industrial Master Plan 2006-2020 (IMP3) was introduced and shipbuilding industry was identified as a strategic industry.

The IMP3 has outlined several strategic thrust for the Malaysian shipbuilding and ship repair industry:

- Enhancing domestic capabilities in the building of smaller vessels, ship repairing and maintenance activities;
- Intensifying the upgrading of skills and engineering capabilities;
- Strengthening the infrastructure and supporting facilities;
- Strengthening the institutional supports; and
- Expanding activities in the fabrication of offshore structures.

As at 2010, Malaysia has seventy (70) shipyards with six (6) major sites capable to meet orders for larger vessels (up to 30,000DWT). Most of the other shipyards primarily operate on a smaller scale of which seven (7) shipyards under the purview of the central government and two (2) under state-ownership[9]. Meanwhile, there are 26 shipyards capable for the provision of ship repair services.

These shipyards to some extent offer the following services:

- Construction of ocean-going vessels, tug boats, patrol vessels, supply vessels, fishing

[9] Association of Marine Industries of Malaysia (AMIM)

vessels, landing crafts, passenger ferries and boats, small tankers and leisure crafts;
- Construction of offshore structures for the oil and gas industries;
  Ship repairing, maintenance, upgrading, overhauling and refurbishing of vessels;
- Conversions of ships;
- Heavy engineering; and
- Fabrication of offshore structures, steel structures and cranes.

There are six (6) reputable shipyards in Malaysia in terms of capacity in newbuildings of merchant ships. They are; Malaysian Marine Heavy Engineering (MMHE), Boustead, Sabah Shipyard, Ramunia, Sasacom and Muhibbah[10].

Nevertheless, one of the main issues in Malaysia is that local orders for larger and more sophisticated vessels are still placed with foreign shipyards which have the capacity and experience utilising up-to-date technology[11]. For example, Daewoo Shipbuilding and Marine Engineering, the world's second largest shipbuilder had won a 530 billion won ($436.6 million) order to build four very large crude carriers (VLCCs) to Malaysia's American Eagle Tankers (AET). The delivery date is set for October 2013. AET is a unit of Malaysian petrochemicals shipper MISC. According to MISC, AET shall utilise internally generated funds to pay for the 320,000 dwt vessels that were part of AET's plans to expand its fleet of VLCCs[12].

Port Development

Ports in Malaysia can be classified as Federal Ports and State Ports (see Figure 4-44). These ports are under the purview of the Marine Department. The federal ports, which are under the jurisdiction of the Ministry of Transport, are further divided into major and minor ports. There are at present eight major federal ports i.e. Port Klang, Penang Port, Bintulu Port, Johor Port, Pelabuhan Tanjung Pelepas, Kuantan Port, Labuan Port and Kemaman Port. Out of eight federal ports, 6 of them except Kemaman port have been privatised. These ports are regulated by its respective port authorities. An estimated 80 minor ports or jetties are under the control of Marine Department. The ports in Sabah and Sarawak are also administered by port authorities, which report directly to the respective State Ministry concern.

International trade has contributed to the rapid growth of activities at Malaysian ports. Referring to Table 4-44, as at 2010, the top three (3) ports in terms of number of ship calls are Port Klang, Bintulu Port and Penang Port. This is followed closely by Port of Tanjung Pelepas.

Cabotage Policy

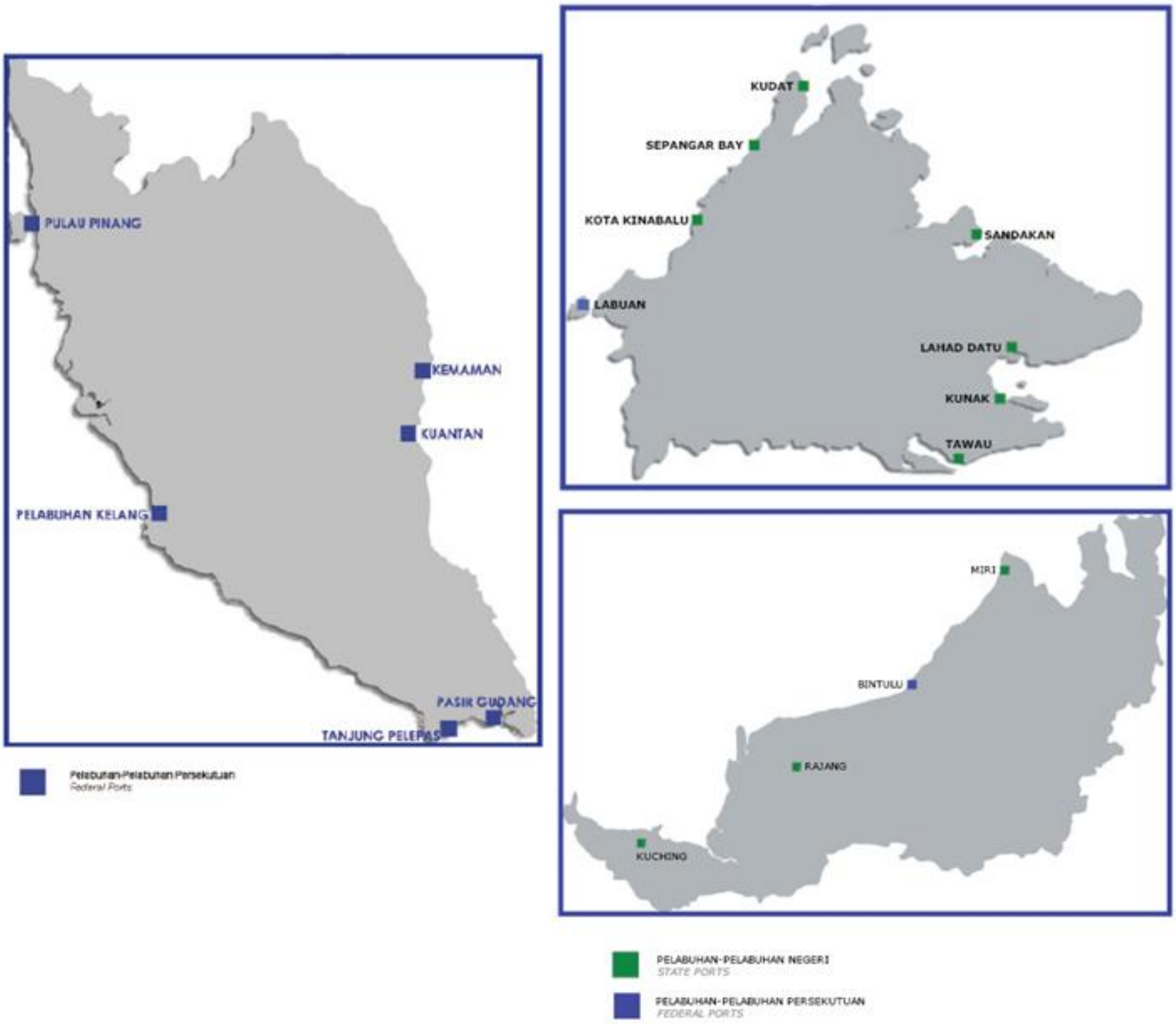
The Malaysian merchant fleet is still very small by global standards and currently carries less the 20 per cent of Malaysian cargo. This indicates that international shipping is already a very liberal sector for Malaysia. As an initiative to encourage local participation in the maritime industry, the Malaysian Government has implemented a policy which reserves the transportation of goods in the domestic trades to ships flying the Malaysian Flag. Initially, this policy was intended to grow and support local shipping companies in the coastal transportation market. This policy that reserves the domestic trade to its own flagged vessels is known as the Cabotage Policy and was implemented on 1 January 1980 through the Merchant Shipping Act 1952 (MSO 1952) (with amendments) (SBSR2025, 2010). With the amendments to the Merchant Shipping Act 1952, the Government provides for the appointment of a Domestic Shipping Licensing Board (DSLB) to regulate and control the licensing of ships engaged in domestic shipping between any ports in Malaysia. The purpose is to encourage local participation in coastal domestic transportation market through local registration of ships and local incorporation of companies.

[10] ECER : Shipbuilding Industry, Dec 2008, source: http://matradewilayahtimur.blogspot.com/2008/12/ecer-shipbuilding-industry.html

[11] [11] Khalid, N., The curious case of the Malaysian shipbuilding industry -, Baird Maritime, May 2010, source: http://www.bairdmaritime.com/index.php?option=com_content&view=article&id=6584%3Athe-curious-case-of-the-malaysian-shipbuilding-industry&catid=98%3Afull-speed-ahead&Itemid=122&limitstart=1

[12] Reuters, S.Korea Daewoo Shipbuilding wins $437 mln Malaysia jobJuly 20, 2010, source: http://in.reuters.com/article/idINSGE66J0EK20100720

FIGURE 4- 44: MALAYSIAN PORTS



source: Ministry of Transport, Malaysia

Despite the implementation of the Cabotage Policy and the New Economic Model policy, the local shipping companies were unable to meet the industry's transportation needs, and hence, the Ministry of Transport (MOT) have issued more than 650 Domestic Shipping License to Foreign Owners licenses per year between 1993 - 2006 (SBSR, 2010). Up to 2008, MOT have issued up to 1245 Domestic Shipping License issued by registration to Foreign Owners, against 415 issued to local owners (SBSR, 2010). Based on Figure 4-45 and Table 4-46, foreign registered vessels have constantly contributed to a higher percentage of transportation of goods, especially oil & gas related transportation needs. For example, exploration work equipment transportation needs are met by 382 (91.4%) foreign registered vessels compared to 36 (8.6%) locally registered vessels (SBSR2025, 2010). The same pattern is repeated in the transportation of petroleum / diesel and palm oil.

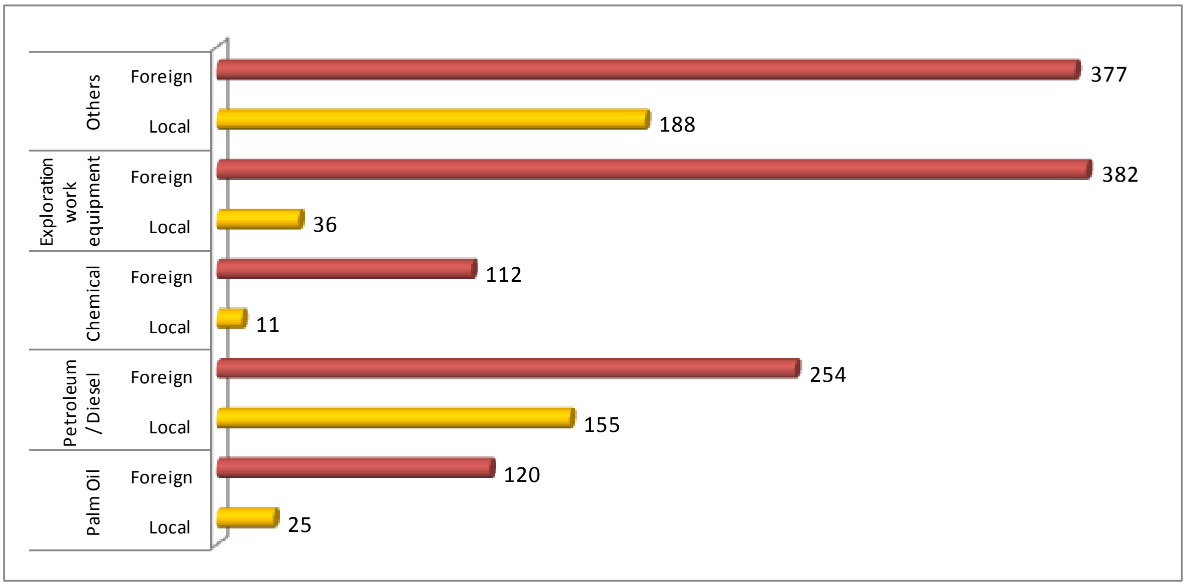
TABLE 4- 45: TOTAL NUMBER OF SHIPS CALLING BY PORTS, MALAYSIA, FOURTH QUARTER, 2010

PELABUHAN Ports		SUKU PERTAMA First Quarter	SUKU KEDUA Second Quarter	SUKU KETIGA Third Quarter	SUKU KEEMPAT Fourth Quarter
KELANG	BIL No	4,134	4,499	4,701	4,606
	GRT (' 000)	83,266	91,809	89,556	98,691
PULAU PINANG	BIL No	1,463	1,585	1,501	1,587
	GRT (' 000)	13,193	15,089	15,483	17,213
JOHOR	BIL No	1,230	1,287	1,230	1,135
	GRT (' 000)	9,606	9,297	10,201	9,074
KUANTAN	BIL No	567	616	621	601
	GRT (' 000)	4,738	4,898	4,639	4,999
BINTULU	BIL No	1,792	2,020	1,967	1,822
	GRT (' 000)	15,870	14,687	15,109	15,897
TANJUNG BRUAS	BIL No	28	35	20	21
	GRT (' 000)	104	139	66	74
KUCHING	BIL No	487	541	553	530
	GRT (' 000)	2,363	2,458	2,444	2,451
MIRI	BIL No	373	431	401	440
	GRT (' 000)	1,593	2,169	1,912	2,046
RAJANG	BIL No	460	468	463	430
	GRT (' 000)	1,725	1,723	1,849	1,693
SABAH	BIL No	2,909	3,257	3,472	3,487
	GRT (' 000)	7,090	8,634	8,480	9,133
PORT DICKSON	BIL No	183	252	241	216
	GRT (' 000)	2,205	3,024	2,830	3,144
KEMAMAN	BIL No	136	163	123	131
	GRT (' 000)	1,219	1,105	924	993
TELUK EWA	BIL No	144	115	167	169
	GRT (' 000)	689	466	740	757
TANJUNG PELEPAS	BIL No	958	999	1,061	1,144
	GRT (' 000)	7,664	7,992	8,488	9,152
JUMLAH Total	BIL No	**14,864**	**16,268**	**16,521**	**16,319**
	GRT (' 000)	**151,325**	**163,490**	**162,721**	**175,316**

SUMBER : SEMUA PELABUHAN DAN JABATAN LAUT
Source : All Ports and Marine Department
GRT : Gross Register Tonnage

source: Ministry of Transport, Malaysia

FIGURE 4- 45: NUMBER OF MALAYSIAN SHIPPING LICENSES ISSUED BY REGISTRATION, 2008



In addition, the current situation is in such state that there is inadequate Malaysian-registered vessels, hence, have compelled shippers to transport goods using foreign-flagged vessels. It is important to note that other developed countries such as the United States, Japan as well as several countries in Europe and Africa also have adopted cabotage policy in one form or another.

The Malaysian Cabotage Policy is less stringent compared to what has been adopted by the United States, where the Jones Act demands ships trading in its domestic waters must not only be flagged, owned and manned by US nationals but must also be built in a US shipyard[13]. If the Cabotage Policy were to remain and be practical and profitable for the nation, current issues needs to be wisely addressed and solutions to capture sustainable wealth domestically have to take into account the point of views of all stakeholders concerned (SBSR, 2010).

TABLE 4- 46: NUMBER OF MALAYSIAN SHIPPING LICENSES ISSUED BY REGISTRATION (2001-2008)

Types of cargo	Registration	2001	2002	2003	2004	2005	2006	2007	2008
Palm Oil	Local	34	29	136	12	54	29	6	25
	Foreign	86	73	223	47	97	127	92	120
Petroleum / Diesel	Local	79	88	83	92	124	137	117	155
	Foreign	149	93	71	125	203	247	252	254
Chemical	Local	8	30	-	1	10	9	31	11
	Foreign	19	98	3	54	116	108	129	112
Exploration work equipment	Local	80	75	-	12	35	34	22	36
	Foreign	244	550	847	110	273	200	137	382
Others	Local	37	12	83	103	95	107	160	188
	Foreign	25	52	-	547	503	497	581	377

source: DSLB, Ministry of Transport Malaysia

Issues and Challenges: Shipbuilding and Ship Repair Industry

In 2001, the 1st National Marine Industries Forum was jointly organised by the Association of Marine Industries of Malaysia (AMIM), the Malaysian Industry-Government Group for High Technology (MIGHT), Maritime Institute of Malaysia (MIMA), and joint-branch of RINA IMarEST Malaysia. The two-day forum was attended by various stakeholders to discuss, amongst others the challenges in shipbuilding and ship repair, the support industry, and marine leisure industry and recommendations to address the challenges. Table 4-47 illustrated the issues and challenges facing the shipbuilding and ship repair industries.

[13] MASA against removal of cabotage rule, The Star, 28th April 2008,
source: http://thestar.com.my/maritime/story.asp?file=/2008/4/28/maritime/21057628&sec=maritime

TABLE 4- 47: DESCRIPTION OF ISSUES AND CHALLENGES IN THE SHIPBUILDING INDUSTRY

Category	Issues & Challenges
Government & Financial Support	1. Insufficient political will and industry protection (e.g. aerospace and automobile industry).
	2. Limited players in shipbuilding and other related industries.
	3. Insufficient spare parts due to holding tax.
	4. Delay in production and increase in cost due to the COA requirement on selected materials (steel plates & pipes).
	5. Minimum support from the Government in terms of provision of government tenders in the refurbishment of old naval vessels and new fleets in order to ensure survival of shipbuilders and ship repairers.
Legal & Institutional arrangements	1. No single entity / management body to govern and coordinate the maritime industry. This creates inefficiency, increased cost (not competitive globally) and potential duplication work.
	2. Insufficient comprehensive studies / data (statistics, economic data, etc) available to assess industry's performance.
	3. Lack of a Plan of Action for industry development. Industries are left on their own devices without clear guidance encouraging industry players working in isolation instead of taking advantage of other local companies to complement each other.
Human Capital	1. Shortage of skilled human resources (e.g. in management of very large projects) at shipyards. Similar situation in sub-contracting work, therefore completion period takes longer time compared to foreign shipyards.
	2. Migration of skilled human resources.
	3. Insufficient infrastructure and facilities to encourage participation in the industry due to minimum support from the government.
	4. Government restriction on foreign expertise.
	5. Insufficient training schemes.
R&D and Technology	1. Insufficient specialised equipments due to high cost of acquisition in addition to minimum government incentives to purchase these items.
	2. Large investment / capital required to embark in R&D
	3. The industry is still labour intensive to minimise cost (to capitalise on the tax incentives) when other foreign shipyards have moved towards automation.
	4. Absence of design capability. Most local shipyards rely on designs procured from foreign design / naval architecture firms for its reliability.
	5. Sub-contracting jobs were mostly given to foreign companies; e.g. to China
Locality	1. Shipyards and other supporting businesses' location are spread out over a large geographical area, thus increasing logistical cost and end product.
	2. Restricted land area zoned for shipyards.
Opportunities Lost	1. Minimum capacity for construction of larger vessels and sophisticated vessels

Category	Issues & Challenges
	2. Limited capability in terms of vessel designs thus shipyards often purchase designs from foreign companies
	3. Low level of automation thus rely on labour-intensive work and thus promote lower-income earner (less skilled)
	4. Minimum R&D and technology efforts from shipyards and the nationally
	5. High level of monetary outflow to foreign shipyards for new orders from local companies
Marketing / Branding	1. Shipyards marketing activities are undertaken on an individual basis thus results in limited coverage due to cost of marketing / promotion, thus increases the end product cost.
	2. Inefficient connectivity between shipyards and supporting industries.
	3. Minimum collaboration between the Government and private corporations.
	4. Acknowledge that most ship owners prefer to purchase newbuildings from foreign shipyards with reasons being on-time delivery and competitive pricing.

source: SBSR, 2010

Traditional Knowledge Management

The "Juruselam": Expert Divers of Malaysia

The late Jacques Yves Cousteau first popular book of scuba-diving was given the title "*The Silent World*", as it happens, was somewhat untrue. The ocean is far from silent. They are very noisy. Sound is the one form of energy which travels uninterrupted, for great distances, through salt water. Because of this, many marine animals, and also many fish and even crustaceans - live their lives in a world dominated not by visual imagery - but in a visually dense world controlled by acoustical surroundings. Through observation and adaptation, most remote and autonomous vehicles and underwater gliders owe its designs to underwater creatures. Similarly, underwater sounds may be used as indicators of the health of marine ecosystems. Though it is still an unproven science, underwater acoustics may provide at least some of the measurements needed in order to approach the management of the marine environment with confidence and armed with fact rather than superstition.

Interestingly, a small community in Terengganu have mastered the art of identifying species of fish through the sounds each species makes.

For centuries, native fishermen in Malaysia rely on the curious skills of the *Juruselam* or "Expert Diver" who, by listening to the underwater sounds made by the fishes, is able to identify what species are to be found, the size of the shoals, and able to advise the skipper where the nets should be cast (Coates, 2009). These *juruselam* does not need any breathing apparatus to dive a few metres below the surface to listen for fish. More intriguing is the fact that each *juruselam* specialises in identifying a particular species of fish (Coates, 2009).

As one might expect, the practices of the *juruselam* are bound by rituals. Prior to going out to sea the *juruselam* touches the water with one foot and recites Koranic verses. There is also a belief in the sea-spirits (the *hantu laut*) which must be placated (Coates, 2009).

Unfortunately, the few remaining *juruselam* who still practice their trade are now elderly and could not pass down their knowledge to the younger generation due to indifference and unwilling to spend the time necessary working underwater.

There is no known or published report on this unique cultural heritage except that there was an interest to produce a documentary about the *juruselam.*

BOATBUILDERS OF PULAU DUYONG, TERENGGANU

Pulau Duyong in the State of Terengganu is made up of two islands, Duyong Besar and Duyong Kecil. Duyong Besar is about 62.0 hectares, and Duyong Kecil is 3.9 hectares. It has a population of about 2,000 people. Pulau Duyong is located at the river mouth among several other islands in the Terengganu River. Until the completion of the Sultan Mahmud Bridge in the 1980s, it was only accessible by boat from Kuala Terengganu. Not very long ago Pulau Duyong was much alive with many of Terengganu's traditional culture and values. Traditional fisheries, batik making, weaving and keropok making are scarce on the island. However, the unique craft of Malay boat building tradition seems to have survived. The island has, in fact, been a traditional boatbuilding centre for centuries - an industry born out of the needs of merchants plying their trade in the South China Sea (TCIS, 2006).

...the true identity of the cultural heritage of traditional boat builders is an intangible one, which is the skills and tradition of building boats are shaped only by eye and memory rather than plans

The Pulau Duyong boat builders developed a reputation for sturdy, seaworthy vessels and the base became a popular stopover for the traders in the olden days. Even today, amongst wooden sailing boats enthusiasts around the world, wooden boats of Duyong are famous for being among the sturdiest, prettiest and of best quality (TCIS, 2006). It is therefore more than appropriate to recognize that the Malay boat building tradition of Pulau Duyong is a precious maritime heritage not just for Terengganu, but for the nation as well.

However, at present much work is needed to revive these diminishing heritages especially in keeping the authenticity of the art.

Many of the local traditional fishing boats built here include the *Perahu Sekoci, Perahu Setak, Perahu Jalur, Kolek, Kolek Kuel* and *Payang*. Bigger boats for transport like the *Anak Bedar* and the *Perahu Besar* which looked like *Kapal Layar* and *Bedar Besar* also found their origins here (TCIS, 2006). At present times, Pulau Duyong is internationally known for the making of ocean-going traditional sailing crafts: many in the 'pinisi' style which is of solid timber, 50 to 80 foot, twin-masted schooner with an upright stem (TCIS, 2006).

Albeit the exceptional craftsmanship, the true identity of the heritage is the intangible one that is the skills and tradition of building boats shaped only by eye and memory rather than plans (TCIS, 2006). The amazing shell first construction technique typical of ancient boat building method is another distinctive characteristic of Duyong. Furthermore, the use of traditional fasteners like trunnels to pin and fix the heavy, thick cengal planks to one another and the process of plank steaming to make them sufficiently pliable are also priceless tricks of the trade that bears the mark of Duyong's boat building authenticity (TCIS, 2006). Inevitably, the lure of city lights and development has dimmed Pulau Duyong's traditional boatbuilding industry.

According to the boat builders, the young generations are not interested in staying on the island and learning the trade instead they prefer more modern careers. In the mid 80s there were around 40 traditional boat builders on the island.

As of 2006, there are only four left (TCIS, 2006). There is a pledge from the Yayasan Usahawan Negeri Terengganu (state-based entrepreneur foundation) to support the traditional boatyard but in what capacity remains to be seen. The Majlis Amanah Rakyat (MARA) - government entrepreneur-based agency has also initiated apprenticeship program with the local boat builder Haji Abdullah bin Muda and presently several young apprentice from MARA are being trained.

From the perspective of academia and purist heritage conservation, Duyong boat building plays a much bigger role in the search for the gist of Malay nation boatbuilding tradition. Delicate research has been done to make the connections between the Duyong tradition and those from nearby nation such as Indonesia and Thailand or even to the rest of the world. New discoveries that implicate the socio-culture environment of past maritime society are revealed (TCIS, 2006). There are other aspects of physical heritage in Pulau Duyong some of which have historical values whilst others are based upon anecdotal recollections of the locals.

PICTURE 1: TRADITIONAL BOAT-MAKER, PULAU DUYONG, TERENGGANU

Gender Issues

Since the Independence in 1957, Malaysian women and girls have enjoyed equal opportunities with men and boys in access to social services. Starting from the Fifth Malaysian Plan (1986-1990), the crucial role of women in development has been increasingly reflected in national development plans. Gender sensitive policies and programs that accompanied sustained economic growth have helped to promote gender equality and women empowerment (MDG, 2005).

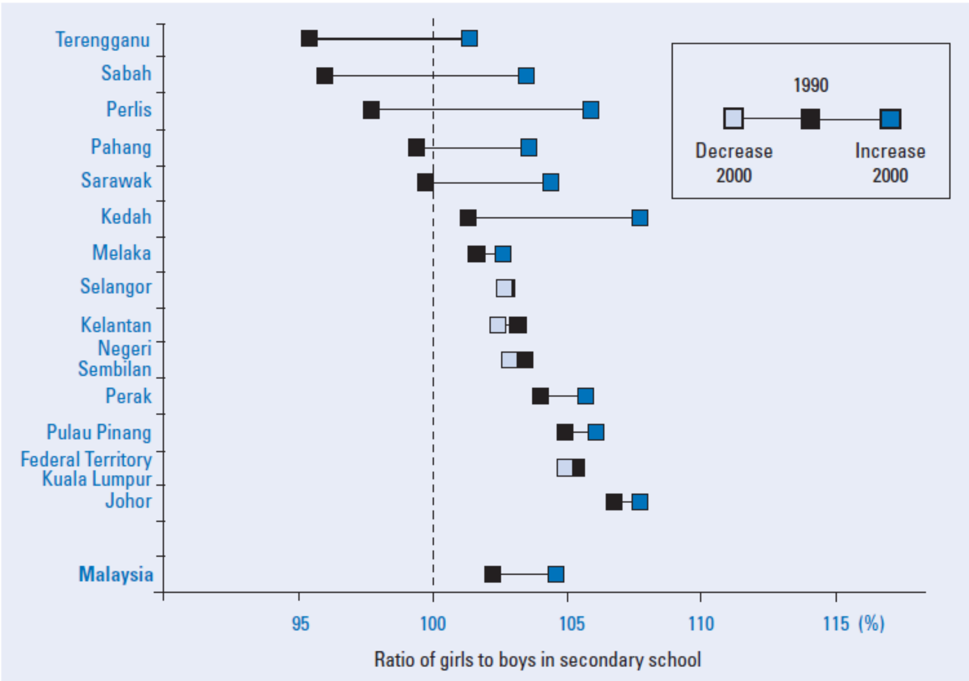
Four key indicators are used to monitor progress of the Millennium Development Goals (MDG) to promote gender equality and empower women. These are (i) ratio of girls to boys in primary, secondary and tertiary education; (ii) ratio of literate women to men, 15–24 years old; (iii) share of women in wage employment in the non-agricultural sector; and (iv) proportion of seats held by women in national parliament.

Gender equality in education

Since the beginning of the 1990s, enrolment rates of girls have been equal to, or have exceeded, those of boys at all levels of education. At the tertiary level, there has been an increasing trend in enrolment rates of girls, reflecting in part the much greater number of girls than boys seeking tertiary qualifications. This in turn is attributable to girls performing better than boys in public examinations. Gender gaps prevail in terms of the selection of courses.

Girls tend to dominate in the arts, economics, and business courses but are in a minority in technical and science-based courses such as engineering. During the decade 1990–2000, the ratio of girls to boys in secondary schools increased in almost all states in Malaysia. By 2000, even the four less developed states of Terengganu, Sabah, Perlis, and Pahang had reversed the situation where secondary enrolment of boys was greater than that for girls in 1990 (Figure 4-46).

FIGURE 4- 46: RATIO OF GIRLS TO BOYS IN SECONDARY SCHOOL MALAYSIA (1990 AND 2000)



Sources of data: Computed from Malaysia, Department of Statistics, 1990b and 2000f.

...further progress could be made in encouraging girls in Malaysia to enrol in subjects where they are under-represented such as in technical and science-based courses such as engineering

Given investments made to achieve universal primary schooling, further progress could be made in encouraging girls in Malaysia to enrol in subjects where they are under-represented. An important outcome of the spread of educational opportunities for girls has been a closing of the gender gap in literacy levels among youths aged 15–24 (MDG, 2005). This achievement has also been made possible with mandatory schooling of up to 11 years for all children. By 2000, only in Sabah and Sarawak, where marked improvements had taken place during the 1990s, were literacy rates of young women lagging behind those of young men.

GENDER EQUALITY IN EMPLOYMENT

The female labour force participation rate at ages 15–64 has remained at around 47 per cent throughout much of the period between 1975 and 2002 (Table 4-48). By contrast, the labour force participation rate of males, although falling slightly, has been consistently above 80 per cent over the corresponding period. The tendency for a sizeable proportion of women to stop work after they have their first birth, and not return once their childbearing is complete, has been a continuing feature of Malaysia's labour market, and this pattern holds for each of the ethnic communities. For example, age-specific participation rates generally decline sharply after ages 20–24 (Department of Statistics, 2000). This is in contrast to the situation of many industrialized countries where women either do not leave the labour force during childbearing or re-enter once their childbearing has been completed.

TABLE 4- 48: LABOUR FORCE PARTICIPATION, MALAYSIA (1975-2002)

Category	1975*	1980	1990	2000	2002
Labour force distribution, ages 15–64 (%)					
Males	65	66	67	65	64
Females	35	34	33	35	36
Both sexes ('000s)	3,823	5,064	7,042	9,616	9,886
Labour force participation rates, ages 15–64 (%)					
Males	86.0	85.9	85.3	83.1	81.5
Females	47.3	44.1	47.8	47.2	46.7
Both sexes ('000s)	66.7	64.9	66.5	65.4	64.4

Sources of data: Malaysia, Department of Statistics, *Labour Force Survey Report*, various years.
* Data for 1975 are for Peninsular Malaysia.

In tandem with sectoral changes of the economy, the composition of employed females by occupation has also changed markedly. By 2000, just 15 per cent of employed women had agricultural occupations, compared with 43 per cent in 1980. By contrast, the proportions in clerical and service occupations were 35 per cent in 2000, compared with 22 per cent in 1980. Among employed females, significantly higher proportions are currently in clerical and service occupations, as compared with employed males (Table 4-49). If the professional, managerial, and clerical occupations are combined, as the three groups of occupation that tend to employ the better educated workers, the proportion of females in these occupational categories rose sharply between 1980 and 2000, whereas the proportion of males did not.

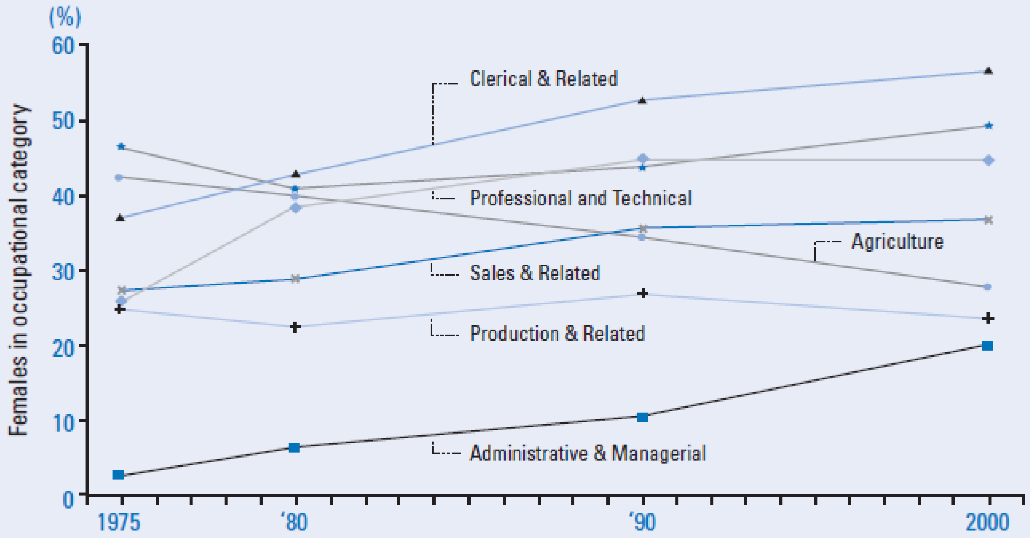
TABLE 4- 49: DISTRIBUTION OF EMPLOYED FEMALES AND MALES OF TOTAL FEMALE AND MALE LABOUR FORCE BY OCCUPATIONAL CATEGORY (%) (1980 AND 2000)

Occupational Category	1980		2000	
	Females	Males	Females	Males
Professional, Technical & Related Workers	7.7	6.2	13.5	8.9
Administrative & Managerial Workers	0.4	2.6	2.2	4.7
Clerical & Related Workers	10.7	7.2	17.5	7.1
Sales & Related Workers	8.4	10.4	12.1	11.1
Service Workers	11.1	8.1	17.4	9.5
Agriculture Workers	42.5	32.4	14.8	20.4
Production & Related Workers	19.2	33.2	22.6	38.4
All categories	100	100	100	100

Sources of data: Computed from Malaysia, Department of Statistics, *Labour Force Survey Report*, various years.

Over time, although women are least represented in administrative and managerial occupations, this group of female workers is on an increasing trend (Figure 4-47). Similar trends can be seen in almost all occupational categories with the exception of the agriculture and production and related occupational categories. A vast majority of women workers in the professional and technical occupational category are in the teaching profession. The next largest group of women workers in this category are the assistant engineers and nurses. By contrast, significantly fewer women are employed as surveyors, engineers, and scientists. There is thus considerable scope for women to be more widely represented in the higher paid professional occupations (MDG, 2005).

FIGURE 4- 47: SHARE OF FEMALES IN EMPLOYED POPULATION BY OCCUPATIONAL CATEGORY (1975-2000)



Sources of data: Computed from Malaysia, Department of Statistics, *Labour Force Survey Report*, various years.
Note: 1975, Peninsular Malaysia only.

Gender Equality in Political Life

Since Independence, the number of female candidates elected to political decision-making bodies in Malaysia has increased, but at a moderate rate. In 1990, only 5 per cent of parliamentarians were women (Table 4-50). This proportion doubled to 10 per cent in 1999 but remained at that level in the 2004 general election. While the proportion of women elected to state assemblies almost doubled between 1990 and 2004, their representation remains low at just 6 per cent. By contrast, in the Senate where members are appointed to represent various groups in the society, the proportion of female senators has increased sharply from 18 per cent in 1990 to 33 per cent in 2004.

TABLE 4- 50: REPRESENTATION OF WOMEN AND MEN IN POLITICAL LIFE (1990-2004)

	1990	1995	1999	2004
Elected Members of Parliament				
Females	9	13	20	22
Males	162	166	173	197
TOTAL	**171**	**179**	**193**	**219**
Female (%)	5.3	7.3	10.4	10.1
Appointed Members of House of Senate				
Females	10	11	14	19
Males	45	57	48	38
TOTAL	**55**	**68**	**62**	**57**
Female (%)	18.2	16.2	22.6	33.0
Elected Members of State Legislative Assembly				
Females	15	24	28	36
Males	428	474	443	531
TOTAL	**443**	**498**	**504**	**567**
Female (%)	3.4	4.8	5.6	6.3

Sources of data: Malaysian Election Commission, various years.

Future Challenges

A number of constraints continue to inhibit women's active participation in mainstream economic activities. These include women's overlapping responsibilities at home and at work, the choice of courses at schools, and inadequate access to credit and market information. Some ongoing policies and programs are being implemented to address these constraints, such as improving education and training for women, removing discriminatory legislation, and enhancing the legal status of women (MDG, 2005).

Women's dual roles

Many women are educated and hold permanent jobs, and their monetary contribution ensures a better standard of living for their families. Yet they are expected to be primarily responsible for the reproduction and care of their children. The overlapping responsibilities of family and career restrict women's mobility and participation in the labour market.

The working environment in Malaysia generally is not sensitive enough to women's needs and priorities. To enable women to participate more fully in national development, existing policies should take these factors into consideration to enable women to combine work, childcare, and household duties. These include safe, high-quality childcare facilities, along with flexible time arrangements at work. While the government has provided tax incentives for employers to provide day-care centres for young children of employees, few employers have complied. As at 2005, Malaysia has 7.4 million women aged between 15 and 64, only 47 per cent are in the labour force (MDG, 2005). To tap into the female labour force market, the government is promoting "working from home" concept as an alternative work option for women (MDG, 2005).

This move is likely to increase the proportion of women participating in the labour force.

PROFESSIONAL SKILLS AND ACCESS TO CREDIT

The majority of the female workforce lacks managerial and professional skills and this tends to restrict women's progress to higher professional positions. Greater education and vocational training opportunities for women are in place to encourage their participation in areas that potentially lead to higher-paying jobs in all sectors. Additionally, women are not given fair opportunity to access credit services and market information to sustain their businesses (MDG, 2005).

PROTECTION AGAINST VIOLENCE

Gender-based abuses and violence cases, both physical and psychological, are still prevalent amongst the female category.

LEADERSHIP ROLE FOR WOMEN

As women gain access to better education, it is expected that women will participate more fully at all levels of decision making. In order to increase women's rate of participation, it is necessary to provide more opportunities for women to take up leadership various positions in political, economic, and social fields.

DISAGGREGATION OF DATA BY SEX

Basic issues such as disaggregation of statistical data and information by sex should be taken into consideration by relevant government agencies and organisations. This is to facilitate the process of formulation and monitoring of various development plans and policies affecting women.

PAYMENTS FOR ECOSYSTEM SERVICES

BACKGROUND

Ecosystems as a whole provides society with a wide array of valuable and useful range of services – from reliable flows of clean water to productive soil and carbon sequestration. Often, these services are taken for granted and thus undervalued or in certain situation have no financial / economic value at all.

TABLE 4- 51: TYPES OF ECOSYSTEM SERVICES

	Forests	Oceans	Cultivated / Agricultural Lands
Environmental Goods	• Food • Fresh water • Fuel • Fiber	• Food	• Food • Fuel • Fiber
Regulating Services	• Climate regulation • Flood regulation • Disease regulation • Water purification	• Climate regulation • Disease regulation	• Climate regulation • Water purification
Supporting Services	• Nutrient cycling • Soil formation	• Nutrient cycling • Primary production	• Nutrient cycling • Soil formation
Cultural Services	• Aesthetic • Spiritual • Educational • Recreational	• Aesthetic • Spiritual • Educational • Recreational	• Aesthetic • Educational

Source: Millennium Ecosystem Assessment 2005 (http://www.millenniumassessment.org)

As day-to-day decisions often focus on immediate financial returns, many ecosystem structures and functions are being fundamentally undercut (Daily, Gretchen, C., 1997). The most comprehensive assessment of ecosystem services to date is the Millennium Ecosystem Assessment, which found that over 60% of the environmental services studies are being degraded faster than they can recover (Millennium Ecosystem Assessment, 2005).

In response to growing concerns, markets are emerging for ecosystem services in countries around the world. Formal markets, some voluntary and other mandated by law now exist for greenhouse gases (carbon); water and even biodiversity (please refer to Table 4-51). In some cases, business deals and Payment for Ecosystem Services (PES) are also being forged as investments in the restoration and maintenance of particular ecological systems and the services that they provide. Please refer to Table 4-52 for more types of markets and PES.

The key characteristics of these PES deals is that the focus is to maintain and ensure the sustainable supply of specified ecosystem 'services' – e.g. clean water, biodiversity habitat, or carbon sequestration capabilities in exchange for something of economic value (PES, 2008). The defining factor of what represent a PES transaction is that the payment causes the benefit to occur where it would not have otherwise. In other words, the service is 'additional' to 'business as usual', or at the very least, the service can be quantified and tied to the payment (PES, 2008).

A definition of PES that has been generally accepted includes the following:

1. a ***voluntary*** transaction in which
2. a ***well-defined*** environmental service (ES), or a form of land use likely to secure that service
3. is bought by at least one ES ***buyer***
4. from a minimum of one ES ***provider***
5. if and only if the provider continues to supply that service ***(conditionality)***

TABLE 4- 52: TYPES OF PAYMENTS FOR BIODIVERSITY PROTECTION

Purchase of High-Value Habitat

- Private land acquisition (purchases by private buyers or NGOs explicitly for biodiversity conservation)
- Public land acquisition (purchases by government agency explicitly for biodiversity conservation)

Payment for Access to Species or Habitat

- Bioprospecting rights (rights to collect, test, and use genetic material from designated areas)
- Research permits (rights to collect specimens and take measurements in designated areas)
- Hunting, fishing or gathering permits for wild species
- Ecotourism use (rights to enter the area, observe wildlife, camp, or hike)

Payment for Biodiversity-Conserving Management Practices

- Conservation easements (owner is paid to use and manage defined piece of land only for conservation purposes; restrictions are usually in perpetuity and transferable upon sale of the land)
- Conservation land lease (owner is paid to use and manage a defined piece of land for conservation purposes, for a defined period of time)
- Conservation concession (public forest agency is paid to maintain a defined area under conservation uses only; comparable to a forest logging concession)
- Community concession in public protected areas (individuals or communities are allocated use rights to a defined area of forest or grassland in return for a commitment to protect the area from practices that harm biodiversity)
- Management contracts for habitat or species conservation on private farms, forests, or grazing lands (contract that details biodiversity management activities, and payments linked to the achievement of specified objectives)

Tradable Rights under Cap & Trade Regulations

- Tradable wetland mitigation credits (credits from wetland conservation or restoration that can be used to offset obligations of developers to maintain a minimum area of natural wetlands in a defined region)
- Tradable development rights (rights allocated to develop only a limited total area of natural habitat within a defined region)
- Tradable biodiversity credits (credits representing areas of biodiversity protection or enhancement, which can be purchased by developers to ensure they meet a minimum standard of biodiversity protection)

Support Biodiversity-Conserving Businesses

- Business shares in enterprises that manage for biodiversity conservation
- Biodiversity-friendly products (eco-labeling)

Source: Excerpted from: Scherr, Sara, Andy White, and Arvind Khare with contributions from Mira Inbar and Augusta Molar. 2004. "For Services Rendered: The Current Status and Future Potential of Markets for the Ecosystem Services Provided by Tropical Forests." Yokohama, Japan: International Tropical Timber Organization (pp. 30-31).

Table 4-53 describes the types of payments available for biodiversity protection. Some of these include purchases of high-value habitat; access to species or habitat – these includes bio-prospecting rights, research permits, activities-related permits and ecotourism use; support biodiversity-conserving businesses; etc.

TABLE 4- 53: TYPES OF MARKETS AND PAYMENTS FOR ECOSYSTEM SERVICES

Public payment schemes for private land owners to maintain or enhance ecosystem services	These types of PES agreements are country-specific, where governments have established focused programs (as in Mexico and Costa Rica). While specifics vary by program focus and country, they commonly involve direct payments from a government agency, or another public institution, to landowners and/or managers.
Formal markets with open trading between buyers and sellers, either: **(1) under a regulatory cap or floor** on the level of ecosystem services to be provided, **or** **(2) voluntarily**	**Regulatory ecosystem service markets** are established through legislation that creates demand for a particular ecosystem service by setting a 'cap' on the damage to, or investment focused on, an ecosystem service. The users of the service, or at least the people who are responsible for diminishing that service, respond either by complying directly or by trading with others who are able to meet the regulation at lower cost. Buyers are defined by the legislation, but are usually private-sector companies or other institutions. Sellers may also be companies or other entities that the legislation allows to be sellers and who are going beyond regulatory requirements. **Voluntary markets** also exist, as in the case of most carbon emission trading in the United States. For example, companies or organizations seeking to reduce their carbon footprints are motivated to engage in the voluntary market to enhance their brands, to anticipate emerging regulation, in response to stakeholder and/or shareholder pressure, or other motivations. Voluntary exchanges are also a category of private payments (see below).
Self-organized private deals in which individual beneficiaries of ecosystem services contract directly with providers of those services	**Voluntary markets**, as outlined above, are a category of private payments for ecosystem services. Other **private PES deals** also exist in contexts where there are no formal regulatory markets (or none are anticipated in the near term) and where there is little (if any) government involvement. In these instances, buyers of ecosystem services may be private companies or conservationists who pay landowners to change management practices in order to improve the quality of the services on which the buyer wishes to maintain or is dependant. The motivations for engaging in these transactions can be as diverse as the buyers, as is explored further in the step-by-step section that follows on finding buyers.

source: PES, 2008

PES and Poverty Alleviation

PES are not designed solely as a poverty reduction tool, rather, it offers economic incentives to encourage more efficient and sustainable use of ecosystem services. However, there are opportunities in the design of the PES that enable low-income people to earn money by undertaking ecosystem restoration and conservation activities. The relationship between PES and poverty reduction are explored briefly in Box 1. Just like any other business investments, there are potential risks to PES, especially for 'sellers' of ecosystem services (ES).

Careful consideration should be taken on the following (PES, 2008):

- Inadequate understanding of what is being bought and sold, and long-term implications for local livelihoods and resource rights;
- Loss of rights to harvest products, or environmental services;
- Other opportunity costs;
- Loss of employment;
- Unfair outcomes;
- Increased competition for land, or loss of rights to land;
- Loss of critically important ecosystem services;
- Confusion over resource and ecosystem service rights;
- Loss of control and flexibility over local development options and directions;
- Performance risk and need for insurance; and
- Incompatibility of PES with cultural values.

PES can be used as a tool to contribute to the formalisation of resource tenure and clarify property rights. Since PES recognises the role of environmental stewardships, PES agreements could potentially strengthen rural peoples' position in other resource-based negotiations (PES, 2008). Importantly, the deal should be done in consideration of the benefits to the community, group of sellers, and / or individual sellers of ecosystem services during the design phase of a PES deal.

LIMITING FACTORS

A range of limiting conditions currently deters a more widespread application of PES in rural communities. These are (PES, 2008):

- **Limited access to information** about payments for ecosystem services, the economic land use, and downstream resource users or prospective PES buyers;
- **Lack of financing for PES assessment**, start-up, and transaction costs;
- **Limited bargaining power** to influence, shape or enforce rules and contracts; to resolve disputes; or to process grievances, particularly with private sector actors;
- **Limited asset base to absorb risks**, **invest time and resources in management** or to weather periods of lower returns or higher labour requirements;
- **Limited organisation or outreach to aggregate supply of services** needed to attract a range of buyers;
- **Lack of efficient intermediary institutions** to reduce transaction costs along the value chain to buyers; and
- **Local priorities for meeting ecosystem service needs.**

BOX 1: POTENTIAL BENEFITS OF PES FOR THE RURAL POOR

Potential Benefits of PES for the Rural Poor

In the short-term:

- **Increased cash income** for consumption or investment purposes (such as increased caloric intake for children, expanded access to education and health care, new products for sale, improved enterprise productivity, etc.)
- **Expanded experience with external business activities** through PES-related economic transactions and interactions with PES-relevant intermediaries
- **Increased knowledge of sustainable resource use practices** through training and technical assistance associated with PES deal implementation

In the long-term:

- **Improved resilience of local ecosystems** and flow of ecosystem services
- Potential for **higher productivity land** due to ecosystem service investments

source: PES, 2008

IDEAL CONDITIONS FOR PES

In light of the limitations, PES deals are most likely to flourish when and where (PES, 2008):

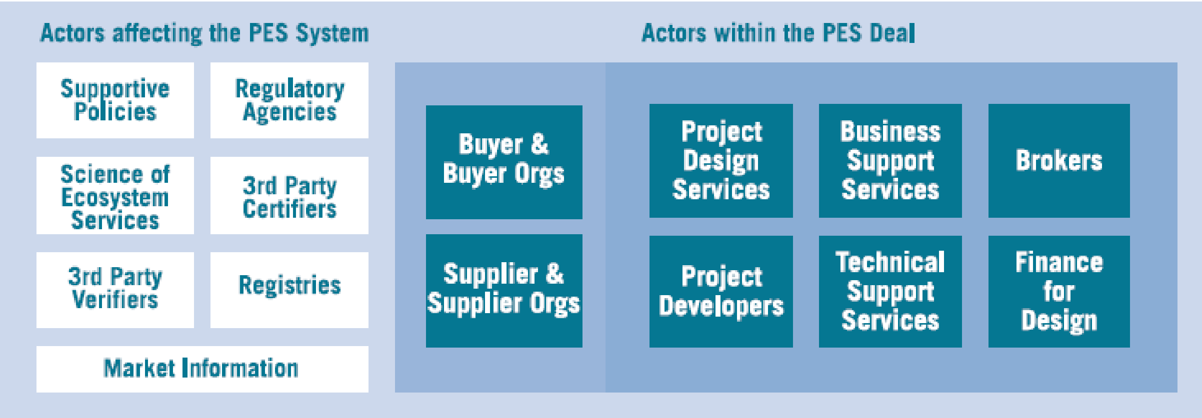
- **Demand for ecosystem services is clear and financially valuable to one or more players.** PES is most likely to occur when there is at least one beneficiary of ecosystem services with both an incentive to invest in the maintenance of this service and available funds for doing so.
- **Supply is threatened.** If resources are clearly diminishing to the point of scarcity because of a declining ecosystem service, then a PES deal holds potential.
- **Specific resource management actions have the potential to address supply constraints.** For PES to be a viable option, it is essential to identify what resource management practices could be changed and what ecosystem services results will ensure improvement of 'supply' issues.
- **Effective brokers or intermediaries exist** who can assist with documenting ecosystem service conditions, identifying specific resource management alternatives, aggregating multiple landowners/resource users (if needed), engaging and negotiating with prospective buyers, and any other activities related to implementation (including monitoring, certification, verification, etc.).

- **Contract laws not only exist but are enforced, and resource tenure is clear**. The supplier must have control over the area where the PES agreement is to be implemented, and the buyer must have assurance, and recourse to ensure, that contract provisions of the deal are secure.
- **Clear criteria for evaluating equitable outcomes across partners are established.** In the case where partnerships are formed to supply the ecosystem service, clear criteria of fairness need to be designed and agreed by all parties to the transaction.

However, if PES is to develop on an ecologically and economically significant scale, a comprehensive set of private, public, and non-profit institutions — as illustrated in Figure 4-48 must be established to meet and adapt to market needs.

Without a dedicated effort, PES will bypass the poor (PES, 2008). Opportunities must be developed, nurtured and monitored for the benefit of the people who need them most.

FIGURE 4- 48: INSTITUTIONAL ACTORS IN EXPANSION OF PES DEALS



Adapted from: Bracer, C., S. Scherr, A. Molnar, M. Sekher, B. O. Ochieng, and G. Sriskanthan. 2007. "Organization and Governance for Fostering Pro-Poor Compensation for Ecosystem Services." CES Scoping Study Issue Paper No. 4, ICRAF Working Paper No. 39. Nairobi, Kenya: World Agroforestry Center.

DEVELOPMENT OF PAYMENTS FOR ECOSYSTEM SERVICES (PES) DEALS IN MALAYSIA

The development of PES deals follows four (4) core steps – from identification of ecosystem service markets; assessment of institutional and technical capacity; structuring agreements and the actual implementation of PES agreements. This is reflected in Figure 4-49.

Malaysia is currently at Step 1 in terms of developing its own PES. The Economic Planning Unit (EPU) under the Prime Minister's Office together with United Nations Development Programme (Malaysia) (UNDP) is currently spearheading this effort. The research outfit responsible for this project is Universiti Putra Malaysia (UPM).

FIGURE 4- 49: FOUR CORE STEPS IN THE DEVELOPMENT OF PES (PES, 2008)

Step 1: Identifying Ecosystem Service Prospects & Potential Buyers
- ✓ Defining, measuring, and assessing the ecosystem services in a particular area
- ✓ Determining marketable value
- ✓ Identifying potential buyers who benefit from the service
- ✓ Considering whether to sell as individuals or as a group

Step 2: Assessing Institutional & Technical Capacity
- ✓ Assessing legal, policy, and land ownership context
- ✓ Examining existing rules for PES markets and deals
- ✓ Surveying available PES support services and organizations

Step 3: Structuring Agreements
- ✓ Designing management and business plans to provide the ecosystem service that is the focus of the PES deal
- ✓ Reducing transaction costs
- ✓ Reviewing options for payment types
- ✓ Establishing the equity and fairness criteria for evaluating payment options
- ✓ Selecting a contract type

Step 4: Implementing PES Agreements
- ✓ Finalizing the PES management plan
- ✓ Verifying PES service delivery and benefits
- ✓ Monitoring and evaluating the deal

The objective of the 'project' are; (i) to review and document past and current studies on economic valuation of ecosystem services; and (ii) to provide baseline information on PES in Malaysia to strengthen understanding and knowledge amongst decision-makers for better conservation efforts of the country's ecological assets.

A national consultation Workshop on PES organised by EPU will take place on April 9, 2012 with speaker participations from Universiti Malaya, Forestry Research Institute Malaysia, Marine Park Department and Sabah Parks to share their past experiences and thoughts on PES.

STEP 1: IDENTIFY ECOSYSTEM SERVICE PROSPECTS & POTENTIAL BUYERS

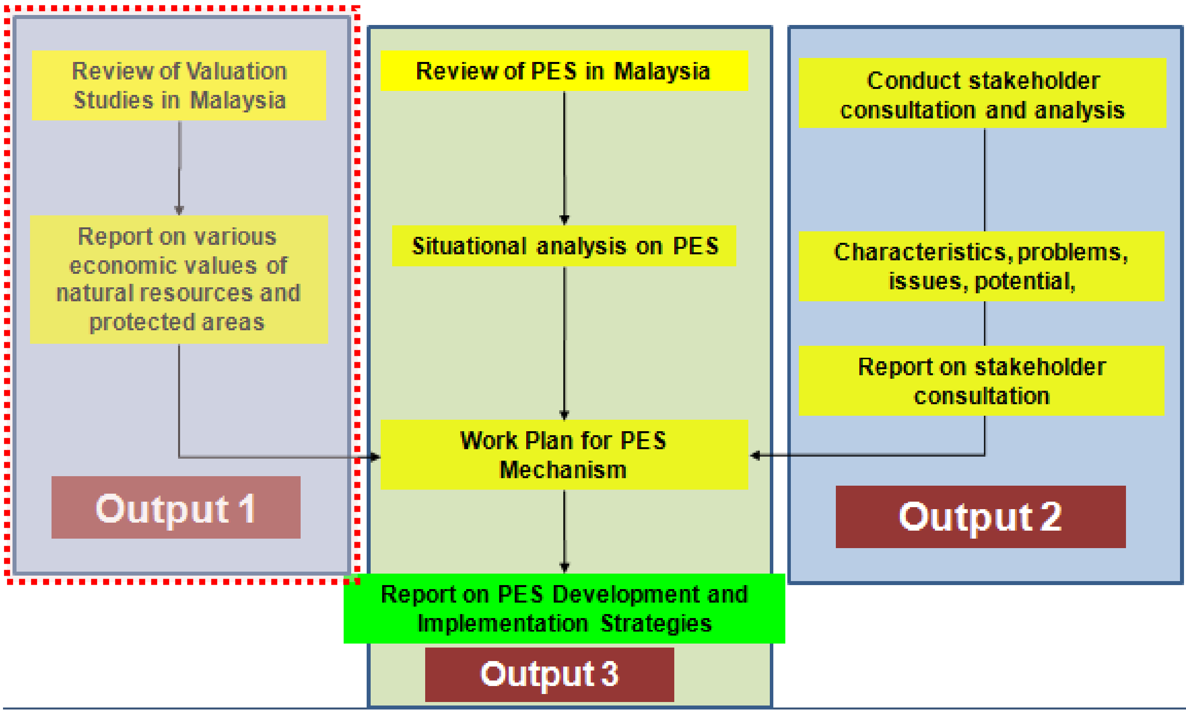
The PES concept is fairly new to Malaysia and thus requires expert assistance locally and internationally. The UNDP in particular has been supportive of this initiative through its relationship with the EPU.

There are four (4) basic checklists in order to complete Step 1 (PES, 2008):

- ✓ Define, measure, and assess the ecosystem service being provided in a particular area;
- ✓ Determine marketable value;
- ✓ Identify potential buyers who benefit from the service; and
- ✓ Consider whether to sell as individuals or as a group.

In comparison to the basic checklist above and to the outputs that have been identified by the Malaysian PES project, one could safely assume that Malaysia is on the right track towards developing its own PES system. Figure 4-50 below illustrates the process that this project shall entails.

FIGURE 4- 50: SCOPE AND METHOLOGY FOR MALAYSIAN SCOPING EXERCISE IN THE DEVELOPMENT OF PES IN MALAYSIA



Source: Core Group Meeting, March 15, 2012, Environment and Natural Resource Economic Section, Economic Planning Unit (EPU), Prime Minister Department, Malaysia

There are three (3) outputs from this Project. There are:

Output 1: Economic Valuation of Ecosystems Services Report

- Status and progress towards sustainable management of various ecosystems;
- Economic valuation and discussion of types of economic values as well as methods used to determine the economic value of ecosystem services;
- Status of economic values of various ecosystems services including market and non-market goods and services; and
- Recommendation for necessary actions to be taken to capture economic values of ecosystem services for income generation and efficient harvesting methods to sustain long-term benefits to the society.

Output 2: Stakeholder Consultation Report

- Summary of various stakeholders consultations in relation to the implementation of PES;
- Identification and discussion of issues, potential problems and interest with regards to PES;
- Potentials and deficiencies of implementing PES; e.g. resource endowment, knowledge on PES, experience with PES, capacity building;
- Implications in implementation of PES mechanism; e.g. support and resistance from stakeholders; and
- Recommendations for necessary national actions to be taken to implement PES in Malaysia.

Output 3: PES Development and Implementation Strategy Report

- Development goal and outcomes of PES mechanism;
- Prospects of ecosystem service and potential buyers;
- Legal, policy, and land ownership context of PES;
- Existing rules for PES markets and deals;
- Available PES support services and organizations;
- Institutional and technical capacity for the implementation of PES; and
- Work plan for the development of national strategy for PES in Malaysia

On the surface, the three outputs recommended for PES mechanism in Malaysia reflects the four (4) core steps in the development of PES deals (as in Figure 4-49) – Output 1 reflects the outcome from Step 1; Output 2 mirrors to some extent the outcome of Step 2; and Outcome 3 has several similar items in Step 3 and 4.

There were two forest-related projects in Sabah undertaken during the 1990s. These projects provides carbon sequestration services, however, it is not termed as PES projects per se. A brief of the two projects are as follows:

- ### Case Study 1: Infapro (Pilot-Launched in 1992)

  Environmental Service: Carbon Sequestration

  Demand: Sep (the Dutch Electricity Generating Board) to offsets carbon emissions from Dutch coal-fired power stations.

  Supply: Offsets through enrichment planting by part of the Innoprise Corporation, a semi-governmental body in 14,000 ha of damaged forests in Northern Borneo.

  Mechanism: NGO (Face Foundation) intermediary-based transaction

- ### Case Study 2: Reduced Impact Logging in Sabah

  Environmental Services: Carbon Sequestration

  Demand: New England Power Company, a US in 1992

  Supply: Carbon offsets are generated through the placement of selective logging with reduced impact logging by Innoprise Corporation, a semi-government organisation in 1440ha of land between 1992-1995

  Mechanism: Project based bilateral transaction

More projects / programs that have been done or currently underway will be inventoried so as to provide a better outlook of what has been done and what needs to be done in order to develop a comprehensive PES deals.

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Chapter V: Threats and Vulnerabilities

This chapter describes issues that have been and still are serious issues in the marine and coastal environment. However, these issues are wider in scope and involve transboundary issues that have not been discussed in earlier chapters such as fisheries degradation & food security; threatened species; marine pollution and degradation of mangrove forests. Other more pressing emerging issues include the current state of environmental issues in mariculture activities, harmful algal blooms, climate change impacts, ocean acidification are the few issues that are also discussed in this chapter.

Left: Turtle Hhtchery on Turtle Island, Sabah., source: http://blog.travelpod.com/travel-photo/jason_m_smith/1/1254045043/the-hatchery-on-turtle-island.jpg/tpod.html; Right: Mangrove Replanting Program organised by Intel Malaysia at Kampung Bagan Belat, Teluk Air Tawar, Penang, Peninsular Malaysia, source: http://myintelblog.typepad.com/intel_blog_2/2010/12/20/index.html

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List of Acronym

AKP	Adaptation Knowledge Platform
AOGCMs	Atmosphere-Ocean General Circulation Models
BWM	Ballast Water Management Convention -
CCC	Coral Cay Conservation
CITES	Convention on International Trade in Endangered Species
CMS	Convention of Migratory Species
COREMAP	Coral Reef Rehabilitation and Management Program
DOFM	Department of Fisheries Malaysia
DOF Sabah	Sabah Department of Fisheries
EBMF	Ecosystem-based management of fisheries
EEZ	Exclusive Economic Zone
GEF	Global Environment Facility
HAB	Harmful algal bloom
INCO-DEV	International Cooperation with developing countries
INWQS	Interim Water Quality Standards
ISMP	Integrated Shoreline Management Plan
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated
JTPP	Technical Committee on Planning and Implementation
JTRD	Technical Committee on Research and Development
MMD	Malaysian Meteorological Department
MOA	Ministry of Agriculture and Agro-based Industries
NC2	Malaysia's Second National Communication
NCVI	National Coastal Vulnerability Index
NPOA	National Plan of Action
NRE	Ministry of Natural Resources and Environmental
PRECIS	Providing Regional Climates for Impacts Studies
PSP	paralytic shellfish poisoning
PVC	Polyvinyl chloride
RCM	Reef Check

RegHCMPM	Regional Hydro-Climate Model for Peninsular Malaysia
SCORE	Sarawak Corridor of Renewable Energy
SDC	Sabah Development Corridor (SDC)
SDP	Sarawak Dolphin Project
SEAFDEC	Southeast Asian Fisheries Development Center
SITC	Standard International Trade Classification
SSME	Sulu-Sulawesi Marine Ecoregion Initiative
TED	Turtle Excluding Devices
TIHPA	Turtle Islands Heritage Protected Areas
TSS	Total suspended solid
UNFCC	United Nations Framework Convention on Climate Change
UNIMAS	Universiti Malaysia Sarawak
WWF	World Wildlife Fund

Current Issues for Marine Resource Management

Fisheries Degradation and Food Security

Current scenario

The Malaysian fisheries industry employs more than 129,000 fishermen and fish farmers (Department of Fisheries, 2010) and consumes more protein from fish than almost any other Southeast Asian country (please refer to Figure 5-1).

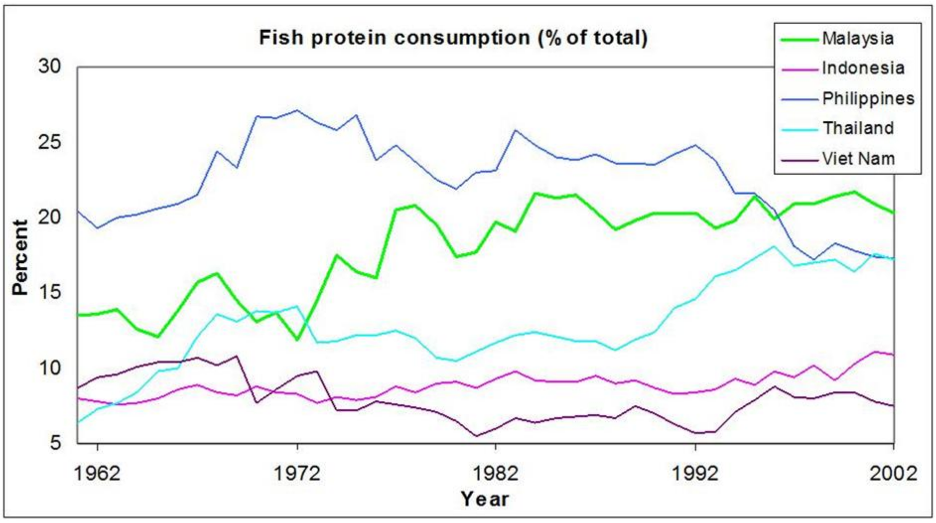
Evidence gathered by the Department of Fisheries research data shows that demersal fish biomass, densities, and catch rates have dropped by up to, and beyond, 90% since 1971 (Figure 5-2) (EBMF, 2011). In 2003, a general consensus was reached at the National Conference on Management of Coastal Fisheries in Malaysia where it acknowledged that, "*the abundance of coastal fisheries resources has declined substantially and that the coastal fishing sector suffers from excess fishing capacity*".

In response to the current dire situation, close cooperation between the Malaysian government and non-governmental organisation has been forged in an effort to ensure sustainability of this precious protein source. One of the means to achieve this is the introduction of applying ecosystem-based management of fisheries (EBMF) methodologies in managing fish stocks and its surrounding habitats.

EBMF aims to achieve 'sustainability' in exploiting natural resources. Two main themes run through the concept (i) the effect of the environment on the resource, and (ii) the effect of resource exploitation on the environment.

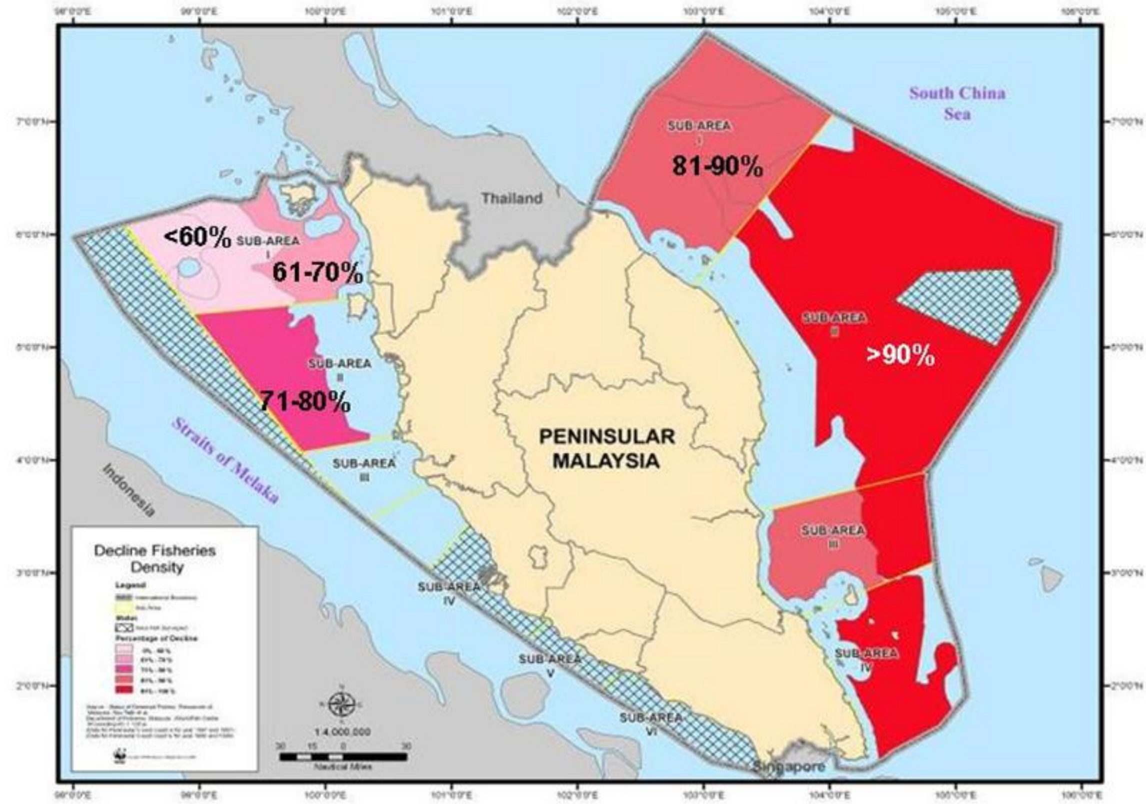
Malaysia acknowledged, to some extent, EBMF approaches in projects such as the Sulu-Sulawesi Marine Ecoregion Initiative (SSME), but without proper institutional and legal provisions, these attempts will remain ineffective in addressing the decline in fisheries and the marine environment. These steps need to be systematically expanded to address the current fisheries crisis. The Ministry of Agriculture and Agro-based Industries (MOA) and its technical arm, the Department of Fisheries Malaysia (DOFM) are in a strategic position to implement EBMF together with partners in the government, civil society and the fishing industry through the formation of a Steering Committee or National Council.

FIGURE 5- 1: FISH PROTEIN CONSUMPTION (% OF TOTAL) FOR SOUTHEAST ASIAN COUNTRIES



source: EBMF, 2011

FIGURE 5- 2: STATE OF MALAYSIA'S FISHERIES



source: adapted from EBMF, 2011 (Department of Fisheries)

PICTURE 1: TRAWLER CATCH BEING SORTED INTO BASKETS IN KUDAT BAY, SABAH
source: WWF Coral Triangle Photo Expedition

Issues and Threats

Fisheries Management

While current fish landings are still significant enough to engender a degree of comfort among resource managers, the current scenario does not point to a healthy fisheries resource base for Malaysia. The issue is that as with many tropical fisheries where there are multi-fishery industries is that overall volume figures often mask collapses for sub-fisheries that are often too small to make statistical impact (SOMER, 2010).

The shifts in species profiles that have been picked up through long-term studies in both west and east coast of Peninsular Malaysia are an indication to the fact that there have been serious decline in specific populations.

The health of the fisheries resources cannot be divorced from that of the overall marine environment in which the activity is undertaken

In addition, marine fishery resources (particularly for coastal fisheries) of the west coast of Peninsular Malaysia are currently exploited beyond their maximum sustainable levels. While catch levels continue to be sustained broadly in volume terms, there have been major shifts in the species profile (SOMER, 2010).

In the case of the east coast of Peninsular Malaysia, the coastal marine fish resources are also exploited beyond maximum levels. Indications of overfishing includes the difficulty to catch specific fish species, decline in average catch volume, more time spent out in the sea, and the decrease in fish composition.

Though deep sea fisheries appeared at one time to offer some scope for further development, recent studies point to a significant decline possibly due to IUU[1] fishing (SOMER, 2010). There is still some scope for development in the offshore fishery in Sabah and Sarawak, though the extent of IUU fishing undertaken in those waters also makes the situation somewhat uncertain.

While a comprehensive fisheries management regimen is in place, it is still inadequate to address many issues of resource health. For instance, current management regimes have tended to focus on controlling fishing effort through licensing and access limitations to sustain present stock levels (SOMER, 2010). The complexity of the marine environment, however, precludes such a one dimensional management approach.

Fisheries resource management cannot be seen in isolation of issues such as habitat degradation and pollution. In this respect, the present style of management is still strongly lacking in fundamentals. For instance, habitat conservation has been limited to establishment of marine parks and protection of coral reefs. While the parks have to a large extent managed to limit the kind of degradation seen elsewhere in the region (McManus, 1988), the institutional arrangements in jurisdiction between the federal government and the state governments means that while the latter is in charge of the marine parks, land matters (and land based development on the islands) largely remains under the jurisdiction of the state governments.

The degradation of the environmental health of the marine environment, and the fisheries resources that depend on it, have strong socio-political implications. Fish is a staple protein in the local dietary intake and is a major feature of national cuisine. In addition, increasing affluence accompanying economic growth has led to an escalation in fish consumption. The Ministry of Agriculture and Agro-based Industry (MOA) forecasted in 1999, that total consumption of fish was expected to reach 56 kg/capital in 2010. Though some of this increase has been met by aquaculture, traditional consumer preferences dictate that marine fisheries have to cope with much of this increased demand.

[1] IUU - Illegal, Unreported and Unregulated

A list of important fisheries area in Peninsular Malaysia with its respective localised issues is presented in Table 5-1. The general summary of the issues resonates over all the states in coastal fisheries for Peninsular Malaysia. It includes the encroachment of vessels into restricted zones (e.g. zone C vessels into zone B), increasing use of foreign employees, increase in by-catch, dredging activities in estuaries, destructive fishing methods, land-based pollution and coastal mega developments that have environmental effects on the coastal habitats and ecosystems.

In addition, changes in the availability of fish supplies can have far reaching effects. For example, retail fish prices rose dramatically during the 1990s. The retail price of Grade 1, 2 and 3 fish, for instance, rose 46.4%, 59.4% and 61.4% over the 1991-2000 time period, while shrimp prices climbed 46.9% over the same time frame (DOFM, 1992;2002). For the years of 1998-2007, the retail price of Grade 2 fish, Grade 3 fish and shrimp increased by 15.2%, 34.1% and 3.9% while the retail price of Grade 1 fish declined about 10% (DOFM, 2009).

Existing regimes can only work in an environment where stakeholders are willing make short-term sacrifices to ensure long-term sustainability. However, in the case of Malaysian coastal fisheries, fishers are increasingly unwilling to accommodate short-term constraints because a continuing deterioration of the coastal marine environment (over which they have no control) will impact on future fisheries stocks (SOMER, 2010).

Knowledge of fishery stock status largely relies upon fish landing statistics complemented by periodic inquiries on fishing rate of effort. There is no minimum target on how many fish landing reports lodged by fishers are to be checked as accurate by Department of Fisheries (DOFM) officials, or any profiling effort done to measure trash fish composition or shifts in species size in landings. This is only a general understanding of the rate of effort changes that have been needed to sustain current landings volume. There is also poor control of IUU fishing especially in the offshore fishery of Kelantan and Sarawak where the re-flagging of foreign vessels, whilst leaving the fishing operations in foreign hands, is common (SOMER, 2010). For socio-economic reasons, many unlicensed small fishers operating outboard engines <40 h.p. are tolerated. In short, therefore, DOFM managers have limited stock survey data or accurate and reliable data on fish landings or rate of effort. In such circumstances, their resource-management task becomes problematic indeed.

In short, there is greater economic imperative for fishers to harvest the fish now than wait for some future time when conditions will most likely become untenable for the fish to survive anyway. In this view, any downslide in catch is expected to be compensated by the higher marker prices that such shortages would eventually engender. Balancing this purely economic imperative would be the pressure to ensure security of supply for increased demand brought about by population increases and increasing affluence, and the need for conservation of natural biodiversity (SOMER, 2010).

Domestic demand needs are likely to take an increasingly critical profile in coming years. Malaysia has long had to import fish (particularly from Thailand and Indonesia) to supplement local supply. However, the export value of fish and fisheries products outweighed imports, accruing a net benefit value to country. For instance, in 1991, the country imported 246,257 tonnes of fish and fishery products valued at RM480 million. However, it exported 175,216 tonnes amounting to RM739.70 million. By 1997, however, the balance had totally shifted, with an importation of 297,776 tonnes valued at RM979.2 million as compared with imports of 107,622 tonnes (RM939.6 million). In the last decade, the important cost of seafood has continued to rise and this trend is set to continue (SOMER, 2010).

Although, there are some efforts to move towards the implementation of the Ecosystem-based Management of Fisheries (EBMF), such as the Sulu Sulawesi Marine Ecoregion (SSME) program, the Department of Fisheries for Peninsular Malaysia has limited financial allocation within the 10th Malaysia Plan to implement conservation and rehabilitation programs of marine resources within its jurisdictional areas. Thus, co-operations and assistance from research institutions and non-governmental organisations are much needed.

Furthermore, good science and economic research are needed for efficient and realistic decisions to be made.

Water Quality Degradation

The dangers of coral reef ecosystem destruction posed by water quality degradation associated with unsustainable land development on the island adjacent to the marine park is very much still a concern. In addition, other habitats, notably mangroves and seagrasses, are also major determinants of marine environmental health, especially in coastal and near shore areas.

A deterioration of marine water quality, particularly from land based sources, is another major factor mediating ecosystem health. Effluent from land-based industries and domestic discharges, coastal land reclamation, illegal dumping of sludge from vessels and accidental oil spills have contributed to the pollution and degradation of the water quality of the coastal aquatic environment (SOMER, 2010). Further discussion on marine water quality issues are in subsequent sections.

Mangrove Forest and Seagrass Beds

Jurisdictional Management

Mangroves and seagrass beds serve as important nursery areas for commercially important species of fish and prawns, and have been shown to support inshore fish production (MacNae, 1974). However, mangroves are classified as a forestry resource in Malaysia and come under the direct jurisdiction of the State governments. Seagrass beds within 3 nautical miles of the low water line are similar within State jurisdiction.

Another reason for the apparent bias towards reef based parks is their economic appeal as tourist destinations. On the other hand, mangrove and seagrass based parks are unlikely to attract the same kind of visitor flow making it less appealing to government planners, who often need to justify setting aside reserves in economic terms. In short, monetary worth of the resource being conserved has precedent over its biodiversity values (SOMER, 2010). As a consequence of these legal and administrative issues, there are no mangroves or seagrass reserves that have been so declared exclusively for marine environmental or fisheries purposes.

TABLE 5- 1: IMPORTANT FISHERIES AREAS IN PENINSULAR MALAYSIA & ISSUES

No.	Area	Importance	Ecosystem features	Issues / Problems
1	**Perlis**			November - April, brooding mackerel spawns (reproduction), strong wave. Zone C vessels enter Zone B to harvest the aggregating fish. Increased utilization of foreign workforce increased the exploitation of fisheries resources. Mega project developments. Dredging of estuaries.
2	**Kedah**			November - April, brooding mackerel spawns (reproduction), strong wave. Zone C vessels enter Zone B to harvest the aggregating fish. Increased utilization of foreign workforce increased the exploitation of fisheries resources. Mega project developments. Dredging of estuaries. Fishermen utilizes "pukat buaya" led to bycatch of seabirds in Zone A and Zone B
	Kuala Sanglang	Cockles	Mangrove, mudflat	
	Pulau Langkawi	Fish cage, cockle, reef	Sandy, mudflat	
	Kuala Kedah	Shellfish, shrimp, mackerel	Sandy	
	Pulau Payar	Marine park, fish nursery area	Coral reef	
	Yan	Spanish mackerel's habitat	Sandy	
	Tg. Dawai, Pulau Bunting, P.Bidan, P. Songsong, P. Telor	Fisheries Zone A Fish refuge after spawning Cockle, shellfish	Mangrove Sandy Artificial reef	
	Kuala Muda	Fishing area, cage	Sandy beach	
3	**Pulau Pinang**			November - April, brooding mackerel spawns (reproduction), strong wave. Zone C vessels enter Zone B to harvest the aggregating fish. Increased utilization of foreign workforce increased the exploitation of fisheries resources. Mega project developments. Dredging of estuaries.
	Butterworth	Not polluted	Mangrove	
	Juru - Sg. Udang	Cage, cockle, shrimp	Mangrove, mudflat	Cage culture. Convection of deoxygenated sediment causes fish mortality. Invasion between fisheries zones and states. Discharged from inland aquaculture ponds pollute fishing ground at sea. Landfill at Pulau Burung (for the entire state of Penang). Leachate from landfill

No.	Area	Importance	Ecosystem features	Issues / Problems
				pollutes fishing ground at sea. Industrial zone in Juru along Sg. Juru and Sg. Jejawi. Polluted river system pollutes fishing ground at sea. Invasion of fishermen from neighbouring states. Utilisation of banned fishing gears. (small trawl net, pukat sosong)
	Bukit Tambun	Octopus breeding ground. From existing 14 sites decline to 3 sites at present.		
	Balik Pulau	Fishing area		
	Pulau Betong	Green turtle	Sandy	
	Pulau Jerejak	Fish cage, tourism	Mangrove, mudflat	
	Pulau Kendi	Artificial reef		
	Batu Maung	Fish cage		Construction of the second bridge affects the reproduction of fish (shellfish, squid, and shrimp) due to vibration from pilings and sedimentation.
	Pulau Aman	Fish cage, tourism		
4	**Perak**			<u>In Lekir and Manjung:</u> Deforestation/ clearing of mangrove area for shrimp aquaculture destroying natural habitat for fish reproduction. Chemicals used in shrimp aquaculture pollute seawater. <u>In Sg.Dinding:</u> Dredging causes sedimentation and algae bloom causes major loss to cage farmers. <u>In Lumut:</u> Discharge of spent oil and grease from The Royal Navy base and Lumut port pollutes seawater.
	Kerian	Cockle		
	Tg. Piandang	Fish cage	Mangrove, mudflat	
	Kuala Kurau	Industrial	Peat	Invasion between fisheries zones and states
	Port Weld	Fishing area		
	Kuala Sepetang	Aquaculture, fish cage, cockle, shrimp	Mangrove	Over-exploitation of fisheries resources and destruction to mangrove ecosystem.
	Kuala Terung	Cockle, fish cage, fishing area	Mudflat	
	Sg. Kerang	Cockle, shrimp pond	Mangrove, mudflat	
	Bagan Panchor	Fish cage, cockle, shrimp pond, fishing area	Mangrove	Over-exploitation of fisheries resources and destruction to mangrove ecosystem.
	Pantai Remis	Fishing area, fish cage, shrimp pond	Sandy	
	Segari	Turtle sanctuary, shrimp pond, fishing area	Mangrove, sandy	
	Pulau Pangkor	Artificial reef, fishing area, fish cage	Island	
	Pulau Sembilan	Marine park, fish breeding ground, shrimp pond, fishing area	Island	

No.	Area	Importance	Ecosystem features	Issues / Problems
	Pulau Jarak	Fishing area	Island, sandy	Invasion of foreign fishermen at Malaysia-Indonesia borders threaten the safety of local fishermen. Exploitation of fisheries resources by foreign fishermen.
	Bagan Dato'	Fishing area	Mangrove	
	Hutan Melintang	Fishing area	Mangrove	Invasion of foreign fishermen at Malaysia-Indonesia borders threaten the safety of local fishermen. Exploitation of fisheries resources by foreign fishermen.
5	**Selangor**			
	Kg. Pulau Ketam	Cockle	Mangrove, mudflat	
	Sg. Chuah, Sepang	Shrimp, fourfinger threadfin	Mangrove, mudflat	
	Sg. Kati, Selangor	Cockle seedlings	Mudflat	
	Sekinchan - Bgn Nakhoda Omar	Pomfret, mackerel, shrimp		
	Air Hitam - Morib	Spanish mackerel, wolf-herring, snapper		
6	**Negeri Sembilan**			
	Kuala Sg. Bharu	Reef	Mangrove	
	Bukit Pelanduk	Reef	Mangrove	
	Tanjung Tuan, Port Dickson	Fish breeding ground, turtle	Coral reef	
	Blue Lagoon, Port Dickson	Spanish mackerel, pomfret, wolf-herring, snapper		
	Negeri Sembilan (Tg. Agas - Batu 10)	Shrimp, fourfinger threadfin	Mudflat	
7	**Melaka**			
	Melaka (Sebatu, Melimau)	Cockle, mussel		
	Kuala Sg. Baru - Pulau Panjang, Pulau Upeh	Dolphin, turtle, coral reef		
	Kuala Sg. Baru - Pengkalan Balak	Turtle		
8	**Johor**			Foreign fishermen target Grade A species: threadfin breams, red snapper, john's snapper. The intensity depended on their ability and expertise. Constantly happening at the transnational borders.
	Muar (Parit Jawa)	Cockle		
	Muar - Kuala Linggi	Spanish mackerel, wolf-herring, banana prawn		
	Selat Tebrau	Mussel, shrimp, dugong		
	Pontian - Batu Pahat	Shellfish		
9	**Kelantan**			Foreign fishermen target Grade A species: threadfin breams, red snapper, john's snapper. The intensity depended on their ability and expertise. Constantly happening at the transnational borders.
10	**Terengganu**			Foreign fishermen target Grade A species: threadfin breams, red snapper, john's snapper. The intensity depended on their ability and expertise.

No.	Area	Importance	Ecosystem features	Issues / Problems
				Constantly happening at the transnational borders.
	Setiu	Anchovy		
	Pulau Tenggol	Anchovy		
	Rompin - Mersing	Dolphin		
	Pulau Kapas - Rantau Abang	Squid breeding ground		
	Pulau Kaps, Rantau Abang, Pulau Tenggol, Pulau Pemanggil	Squid		
11	**Pahang**			Foreign fishermen target Grade A species: threadfin breams, red snapper, john's snapper. The intensity depended on their ability and expertise. Constantly happening at the transnational borders.
	Kuala Sedelih, Desaru	Shrimp (Acetes spp.)		

source: EBMF, 2011

THREATENED SPECIES

MARINE TURTLES

Marine turtles and their products have been used as a basis of food and for a host of other uses for thousands of years. Today, turtles are also used for non-consumptive uses such as in tourism, education and research activities, employment and other benefits. Turtles also support commercial fish and invertebrates (found in seagrass beds, open oceans, and coral reefs, among others (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009).

Marine turtle populations in Southeast Asia have been seriously depleted through long-term harvest of eggs and adults; and as by-catch in trawl fisheries. More recently, direct poaching is the number one threat in the survival of marine turtles.

The IUCN Red List Global Status have categorized Hawksbill and Leatherbacks as '*critically endangered*'; Green Turtles and Loggerheads as '*endangered*' and Olive Ridley as '*vulnerable*'[2].

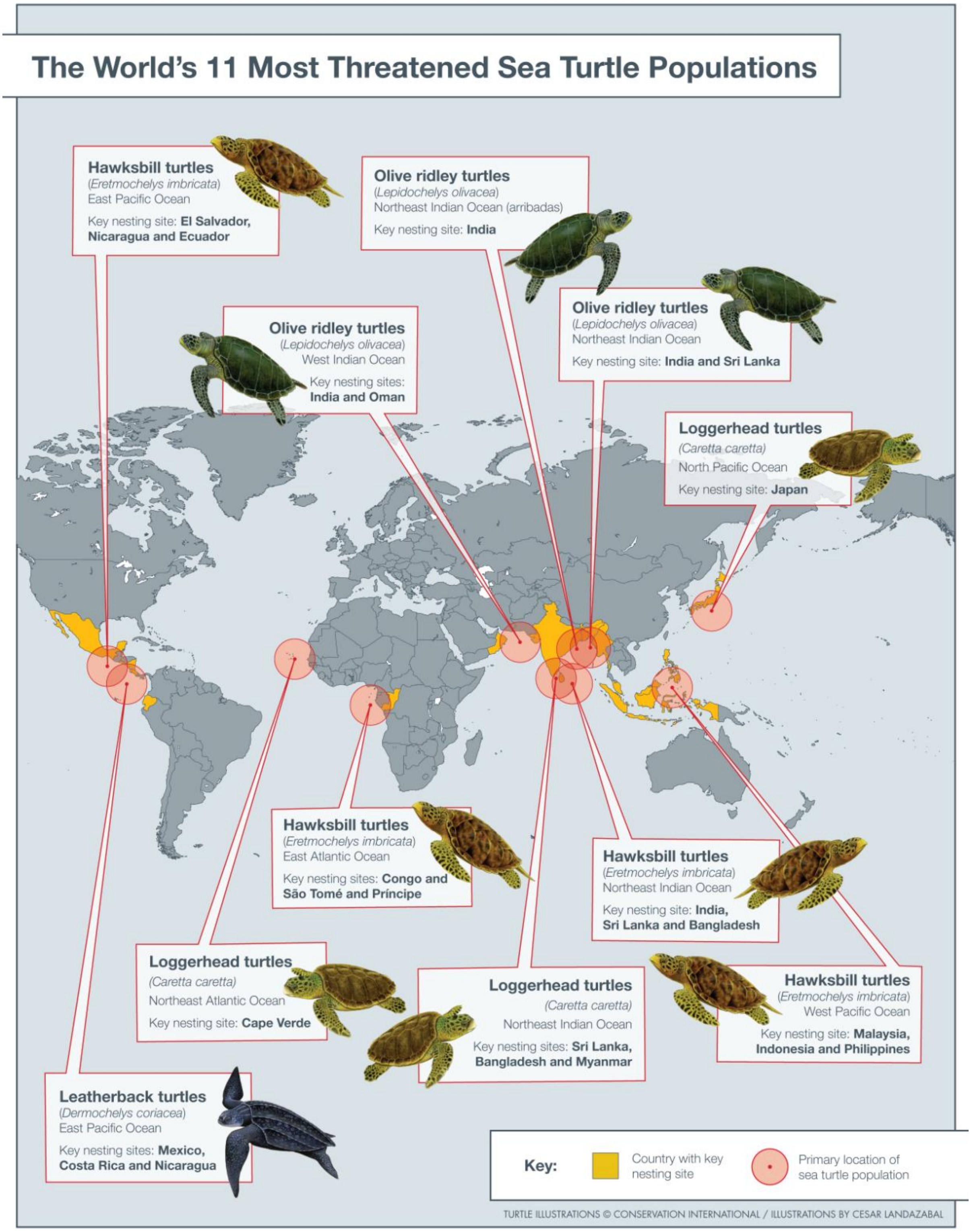
Although, there have been substantial increase in scientific knowledge on marine turtles; e.g. their environmental needs, reproductive cycles, habitat requirements - these are not incorporated into conservation projects in Southeast Asia.

Thus, it is imperative that conservation activities are to be based on current and good science. This knowledge can also be applied in mitigation efforts on issues such as over-harvesting and commerce. One of the recent understandings about marine turtles is that marine turtles only mature thirty years into its life-cycle and not five or six years as previously thought.

These new understanding presents unique management challenges to managers and decision-makers as 'simple *fishery-style closures or seasons are ineffective for turtles due to its long maturity period'* (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009).

[2] Critically Endangered (CR) - Extremely high risk of extinction in the wild; Endangered (EN) - High risk of extinction in the wild; Vulnerable (VU) - High risk of endangerment in the wild.

FIGURE 5- 3: THE WORLD'S 11 MOST THREATENED SEA TURTLE POPULATIONS



source: http://www.conservation.org/SiteCollectionImages/Maps/CI_SeaTurtleSept_Threatened_Turtle_Map.jpg

Major Threats and Issues

Fisheries by-catch

Marine turtles constitute a large portion of by-catch in trawl fisheries especially in this region. Trawling fleets in Southeast Asia have been on the rise over the last three decades. Accidental drowning of marine turtles in fishing nets pulled by shrimp trawl vessels is another critical pressure in the fight for marine turtle's survival.

Rate of capture in Terengganu was high in the past where over 700 turtles were estimated to drown in trawl nets every year (Chan et al., 1988), in comparison to a more recent estimates of 50 turtle drowning per year (Chan, E.H and Liew, H.C., 2001). Fishing mortality is corroborated by strandings of turtles where a total 188 carcasses attributed to incidental capture in fishing gears have been recovered from the beaches of Terengganu between 1990-95 (Ramli and Hiew, 1999). Fishing mortality does not only incur in inshore territorial waters, but in the high seas as well during the long-distance migrations between feeding and nesting grounds.

Direct Poaching

One of the more pressing and current pressure on marine turtles is the continued decline of endangered marine turtles particularly in the Southeast Asia due to direct poaching. The main markets for marine turtles are China and Vietnam. Having depleted stocks along the north and several archipelagos in the central South China Sea, poachers now venture as far as into the Sulu and Sulawesi seas – into foreign sovereign territory to satisfy the growing demand for marine turtles. Evidence suggests that majority of poachers are from Vietnam and Hainan (China) with majority of the catches is landed in Hainan, where the material is processed and moved northward into mainland China. Anecdotal reports suggest much of the Vietnamese catch is traded at sea with Hainan's vessels for other commodities.

Malaysia, Indonesia and Philippines apprehend at least two to three vessels each, every year, and confiscated thousands of stuffed turtles and other body parts.

Unfortunately, this trend continues to intensify due to high profit margins for these poachers (Pilcher, N. Et al, 2009).

Habitat Destruction & Marine Pollution

Similar to other developing nations, loss of nesting habitats can be expected in Malaysia where prime beaches are being developed for tourism, except for areas where turtle sanctuaries have been established (please refer to Table 5-) for a list of turtles sanctuaries established in Malaysia.

TABLE 5- 2: TURTLE SANCTUARIES THAT HAVE BEEN ESTABLISHED IN MALAYSIA

State	Name of sanctuary	Year established
Terengganu	Rantau Abang Turtle Sanctuary	1988
	Ma'Daerah Turtle Sanctuary	2003
	Nesting beaches on Redang Island	2005
	Nesting beaches on Perhentian Island	2005
Sabah	Turtle Islands Park	1984
Sarawak	Talang-Satang National Park	1999
Perak	Segari	n/a
Melaka	Padang Kemuning, Pengkalan Balak	n/a
	Pulau Upeh	n/a
Penang	Pantai Kerachut	n/a
Pahang	Cherating	n/a
	Teluk Sri Intan, Tioman Island	n/a
	Teluk Baruk & Pasik Mentawak, Kg Juara, Tioman Island	n/a

Source: Chan, E.H., 2006 & extracts from various sources

Marine pollution is also one of the major threats to turtles as it can degrade feeding grounds. Although there are evidence of pollution and marine debris in the South China Sea, no studies have been conducted locally to determine the interactions (Chan, E.H., 2006). Persistent debris is also of serious concern as numerous cases of accidental ingestion of plastic bags and entanglement in monofilament fishing line and discarded fishing nets have been documented (National Research Council, 1990).

Migratory Nature

Marine turtles are highly migratory and require suitable developmental habitats throughout their range and at each stage of their life-cycle. Satellite tracking studies have demonstrated that green turtles that nest in Redang Island (Terengganu) and Sarawak Turtle Islands migrate to near-shore feeding grounds in the territorial waters of countries bordering the South China Sea as well as Sulu Sulawesi Sea (Liew et al., 1995; Bali et al., 2002). Nesting turtles requires clean beaches and free from human encroachment; foraging turtles require healthy coral reefs, seagrass beds; and in the deep-sea hatchlings and juveniles requires unpolluted open oceans free from debris and fishery pressures.

PICTURE 2: CONFISCATED TURTLES IN SABAH

Being highly migratory and with no understanding of political boundaries, turtles are a shared coastal resource among coastal nations, within small confined seas and across vast open ocean. Therefore, one of the issues in marine turtle's management is the institutional and legal arrangements between coastal countries to jointly protect this precious resource. In addition to national laws, international conventions may help to assist in some transboundary issues such as the Convention of Migratory Species (CMS) with the signing of the Memorandum of Understanding on Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South-East Asia (IOSEA Marine Turtle MoU). Malaysia recently signed the MOU in September 2011.

Long-term Harvesting of marine turtle adults and eggs

One of the major threats to regional turtle populations is the near-complete depletion of localized populations in Southeast Asia. As a result of long-term harvesting of turtle adults and eggs, this has resulted in the collapse of valuable breeding populations. For example, in Terengganu, the eggs of Leatherback Turtle (*dermochelys coriacea*) have been systematically harvested for hundreds of years, and as result of that, the nesting population has crashed, from 5000 nests per year, down to an average of only 10 per year. Fortunately, leatherback turtle eggs are completely protected under national law, but given the extent of damage done and the long life-cycle of leatherback turtles, it is doubtful that the population will recover (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009). One of the reasons for the uncontrolled marine turtle eggs harvesting despite the ban of such activity is the lack of understanding amongst villagers of the turtles' nesting cycle. Although turtles continue to nest (every four years), and do so for several years, without new recruitment of young to the breeding population (due to overharvesting of turtle eggs), once the adults are removed by hunting or by natural causes, the population will disappear forever (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009).

Inadequate Institutional arrangements

One of the more common issues that have been cited over the years in marine turtle's conservation efforts is the inadequate coordinated efforts between various related agencies, and more pressing is the absence of a national policy or strategic plan on marine turtle conservation (Chan, E.H., 2006).

Status in Peninsular Malaysia

There are three species of marine turtles that can be found on the west coast of Peninsular Malaysia. These include the more widely distributed Green Turtle (*Chelonia mydas*), followed by the Hawksbill Turtle (*Eretmochelys imbricata*) and the Olive Ridley Turtle (*Lepidochelys olivacea*) which is on the verge of extinction (Chan, 2006).

Nesting data for Terengganu is available for all four species for the last 24 years. Trends in nesting sites are as follows (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009):

- Leatherback turtles have declined by 99.9% in the last 24 years and with current annual nesting density of about four nests per year, the population can be considered to be effectively extinct.
- Olive Ridley turtles have suffered a 100% decline. No nesting has been recorded since 2005.
- Green turtles have been on a steady decline with current annual nesting events of 2,300; 75% of total nesting sites 20 years ago.
- Hawksbill turtles nesting are low and have declined from 50 per year in the 1980s to 14 per year (70% decline).

In other states, green turtles are known to nest mostly in Perak (Pantai Remis) but it they can also found in Melaka, Penang and Kedah. The Hawksbill Turtle's main nesting area is in Melaka while the Olive Ridley's nesting area is fragmentary and isolated to Penang Island (SOMER, 2010).

Hawksbill nesting population in Melaka appears to have stabilised numbering approximately on average of 200 nests per year (Chan, 2006) (Table 5-3).

TABLE 5- 3: ANNUAL TURTLE LANDINGS COUNT IN WEST COAST OF PENINSULAR MALAYSIA, 1991 – 2006.

State	Turtle	Year																Total
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
Melaka	Green	0	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0	**20**
	Hawksbill	306	269	203	233	255	297	241	222	241	159	205	272	205	285	301	379	**4073**
Johor	Leatherback	0	0	0	0	0	7	3	0	0	0	0	0	0	0	0	0	**10**
	Green	0	5	15	0	0	0	100	6	0	1	6	3	4	16	25	61	**242**
	Olive Ridley	0	0	9	0	0	0	0	1	0	0	0	12	3	10	15	2	**52**
	Hawksbill	63	69	94	10	0	45	108	43	15	15	33	88	57	105	55	39	**839**
Perak	Green	67	102	211	197	197	144	128	132	220	105	208	123	147	101	80	74	**2236**
	Olive Ridley	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Kedah	Green	50	46	60	0	0	0	0	0	0	0	0	0	0	0	0	0	**156**
	Olive Ridley	0	5	22	0	0	0	0	0	0	0	0	0	0	0	0	0	**27**
Penang	Green	0	0	0	0	30	13	4	0	0	0	63	39	47	59	39	71	**365**
	Olive Ridley	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	**4**
Total		**6,594**	**2,666**	**4,366**	**2,945**	**3,851**	**2,731**	**3,757**	**3,019**	**2,856**	**1,969**	**3,557**	**3,370**	**2,075**	**2,986**	**1,725**	**3,417**	

Source: Adaptation from National Coastal Resources and Marine Environment Profile of Malaysia, 2009

In August 2010, a leatherback turtle, dubbed "*Puteri Rantau Abang*" or Rantau Abang Princess, made a surprise return to a Malaysian beach after 32 year of absence. The northern state of Terengganu, where the Rantau Abang beach is located, is Malaysia's sole nesting place for the endangered leatherback, which used to come in by the thousands to lay their eggs before overfishing, poaching and pollution decimated their numbers. The Puteri Rantau Abang, which was hatched in the area in 1978 and marked on its shell and left flipper, returned at a weight of 500 kilograms (1,100 pounds), measuring 1.5 metres (five feet) in length and 1.16 metres wide. It was released back into the sea, carrying a satellite transmitter which will help conservationists track turtle migration patterns.

Status in Sabah

Of the four marine turtle species found in Malaysian waters, the Leatherback turtle is the only species that does not nest on Sabah's islands and beaches.

The Green turtle is the most abundant species recorded in Sabah, while the Olive Ridley is infrequently found nesting on the beaches. Turtle nesting in Sabah occurs primarily in the archipelago of Selingan Island, Bakungan Kecil Island and Gulisan Island (the Turtle Islands Park), and in Sipadan Island. Although there have been recorded marine turtles (Green and Hawksbill turtle) at Layang-Layang Island, neither species has been known to have landed or nested there (SOMER, 2010).

The trend for green turtles in the Turtle Islands Park over a 22 year period (1984-2006) indicates to an increasing trend, with the trend levelling off over the last 10 years. By averaging annual nesting events for each five-year period, annual nesting events from the 1990s to 2000s have declined by 38%.

As for the Hawksbilll turtles in the Turtle Islands Park, a decline of 25% has been recorded from the 1989-1993 to 2004-2008 period (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009).
In an effort to reduce the by-catch of turtles in the trawl fisheries in Sabah, the Sabah Fisheries Department and the Marine Research Foundation have cooperated in introducing Turtle Excluding Devices (TEDs) to the Sandakan trawl fishery. The programme is sponsored by a GEF Small Grant Programme, and has potential to spread to other trawl-fishing ports in the region.

Another initiative of by the Government of Malaysia and Philippines is the establishment of the **Turtle Islands Heritage Protected Areas (TIHPA),** which are the first and only trans-frontier protected areas for marine turtles in the world. As TIHPA are managed by both countries, the conservation of the habitats and migratory pathways encompass large area independent jurisdictional boundaries. The extension of the TIHPA to the Berau Islands Conservation Area in Indonesia will strengthen key nesting aggregations in the region. As for now, TIHPA in Sabah only covers the area of Turtles Islands Park. However, there are plans to extend the initiative to Tun Sakaran Marine Park and Pulau Sipadan Park (Pilcher *et al*., 2008).

Status in Sarawak

There are four (4) species of marine turtles that nest along the sandy beaches and islands of Sarawak and are currently listed as Totally Protected Animals and Endangered species. They are the Leatherback Turtle (Derm*ochelys coriacea*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle *(Eretmochelys imbricata)* and Olive Ridley Turtle *(Lepidochelys olivacea)*. The main sea turtle nesting sites are located at Turtles Islands (consisting of Talang-Talang Besar, Talang-Talang Kecil and Satang Besar), Telok Melano, Sematan, Samunsam Wildlife Sanctuary, Tanjung Dato National Park and Similajau National Park (http://td.seafdec.org).

Green turtles in Sarawak Turtle Islands have registered 84% decline in the last 50 years, with annual nesting events declined from 13,062 nests in the 1950s to 2,152 in current years. However, the rate of decline the last 30 years has been less severe, at approximately 25% (Workshop on Regional Cooperation to Address Direct Capture of Sea Turtles, 2009).

Around 70 to 100 adult turtles were found stranded on Sarawak beaches every year prior to 1998 due to improper use of fishing gears.

Several initiatives have been taken to overcome this problem such as the Sarawak Reef Balls Project and Marine Turtle Adoption Programme. From 1998 to 2006, 2584 units of reef balls were deployed along the Sarawak coast i.e. around Talang-Satang National Parks, Lawas, Bintulu and Kuching. This resulted in a marked reduction in number of dead turtles to about 20 individuals per year. In addition, the number of nesting turtles at the Talang-Satang National Parks rose from 737 in 2004 to 1,104 in 2009. The number of turtles tagged at the park for monitoring purposes also increased from 639 in 2004 to 1,028 in 2009 (The Star, 22 October 2009).

Marine Mammals

Peninsular Malaysia

There are eighteen taxa of marine mammals identified from the coastal and marine waters of Peninsular Malaysia either as residents or as occasional transients (Table 5-4). These are comprised of one species of sirenian, that is the dugong, and 17 species of cetaceans belonging to the Families Balaenopteridae (baleen whales), Delphinidae (dolphins), Phocaenidae (porpoises), Kogiidae (dwarf and pygmy sperm whales) and Physeteridae (sperm whales) (SOMER, 2010).

The Indo-Pacific humpback dolphins are found off Langkawi Island, the east coast of Peninsular Malaysia, Matang and Kuala Sepetang in Perak. Irrawaddy dolphins are observed around the waters of Penang, southwestern Johor and east and west coast of Peninsular Malaysia. Finless porpoises have been sighted around Langkawi Island and Penang and along the east and west coasts of Peninsular Malaysia.

The Indo-Pacific bottlenose dolphins are known to occur along the east and west coast of Peninsular Malaysia, and as far as the offshore island of Tioman with known strandings from Butterworth, Penang, and in Bagan Lalang. The pelagic long-beaked common dolphins are known to occur around the offshore islands of the east coast of Peninsular Malaysia' (islands of Tioman, Aur and Pemanggil) (SOMER, 2010).

Bryde's whales are known to occur in waters around Peninsular Malaysia (South China Sea, Perak Island, Langkawi Island) (Berry *et al.,* 1973) and Sabah. The only record of the Omura's has been a stranding at Cherating, Pahang while false killer whales are sighted around Tioman Island and other east coast islands. Spinner dolphins and the pygmy killer whale (skeletal remains) are known from waters off Tioman Island. The dugong (*Dugong dugon*) appears to be concentrated in the Johor Marine Parks and Johor Straits (Johor River estuary, Sibu Island, Tinggi Island) (Ponnampalam, *et al.,* 2010) and the Langkawi Islands. However, it is not known whether dugongs regularly occur around Langkawi.

TABLE 5- 4: MARINE MAMMALS THAT ARE CONFIRMED TO OCCUR IN PENINSULAR MALAYSIA.

Common Name	Scientific Name	Mode
Family Dugongidae		
Dugong	*Dugong dugon*	Si, St
Family Balenopteridae		
Omura's whale	*Balaenopteridae omurai*	St
Bryde's whale	*Balaenopteridae edeni*	Si, St
Non-edeni Bryde's whale	*Balaenoptera* sp.	St
Family Ziphiidae		
Ginkgo-toothed whale	*Mesoplodon ginkgyodens*	St
Family Kogiidae		
Pygmy sperm whale	*Kogia breviceps*	St
Family Delphinidae		
Indo-Pacific humpback dolphin	*Sousa chinensis*	Si, St
Irrawaddy dolphin	*Orcaella brevirostris*	Si, St
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Si, St
Long-beaked common dolphin	*Delphinus capensis*	Si, St
Spinner dolphin	*Stenella longirostris*	Si
Pantropical spotted dolphin	*Stenella attenuata*	St
Striped dolphin	*Stenella coeruleoalba*	St
False killer whale	*Pseudorca crassidens*	Si, St
Pygmy killer whale	*Feresa attenuata*	St
Melon-headed whale	*Peponocephala electra*	St
Short-finned pilot whale	*Globicephala macrorhynchus*	St
Family Phocoenidae		
Finless porpoise	*Neophocaena phocaenoides*	Si, St

Note: Si-sightings; St-past strandings
Source: Ponnampalam et al., Specialist Report, 2010

PICTURE 3: BOTTLENOSE DOLPHINE
(photo courtesy by Syed Abdullah, Abdul Razak & Wan Jamel)
source: EPSP, 2010

SABAH

There are about a total of two (2) species of Mysticeti, 19 Odontoceti and one Sirenian that have been confirmed either residing or travelling through East Malaysian territorial waters (Jaaman, 2004). Sabah and Sarawak share the same species of marine mammals. The two most common species found in coastal waters are the Irrawaddy dolphin (*Orcaella brevirostris*) and the Indo-Pacific Humpbacked dolphin (*Sousa chinensis*) (Jaaman *et al*., 2001).

Other species that have been recorded in the open waters of East Malaysia include the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), Spinner dolphin (*Stenella longirostris*) and Pantropical spotted dolphin (*Stenella attenuata*) (Beasley, 1998).

In Sabah, boat surveys by Universiti Malaysia Sabah (UMS) in 1996 and 2002 in coastal and pelagic waters (including Spratly islands), recorded a total of eleven species of cetaceans i.e. Irrawaddy dolphin (*Orcaella brevirostris*), Indo-Pacific Humpbacked dolphin (*Sousa chinensis*), Finless porpoise (*Neophocaena phocaenoides*), Bryde's whales (*Balaenopteridae edeni*), Short-finned Pilot whales (*Globicephala macrorhynchus*), False Killer whales (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), Pantropical Spotted dolphins (*Stenella attenuata*), Spinner dolphins (*Stenella longirostris*), Common Bottlenose dolphins (*Stenella longirostris*) and Indo-Pacific Bottlenose dolphins (*Tursiops aduncus*) (SOMER, 2010).

The Irrawaddy dolphin and the Indo-Pacific Humpbacked dolphin often found in bay area (Brunei Bay, Sandakan Bay, Labuk Bay and Cowie Bay), estuarine area (Beluran River, Segaliud River, Kinabatangan River, Kalabakan River and Marumar River) and at islands (Jambongan Island, Berhala Island and Silumpat Island) (Jaaman, 2008, 2010).

Common Bottlenose dolphins have only been recorded from around the Spratly Islands, while Short-finned Pilot whales and Fraser's dolphins have been sighted mainly in the deep waters of the South China Sea, Sulu Sea and Sulawesi Sea. Sightings of Bryde's whales and False Killer whales have only been observed over the continental shelf waters of the South China Sea (Jaaman, 2010). Spinner dolphins, which are the most commonly occurring pelagic marine mammal species in Sabah waters, and Pantropical Spotted dolphins have been observed in the South China Sea and Sulawesi Sea but not in the Sulu Sea (SOMER, 2010).

Sightings of Indo-Pacific bottlenose dolphins in Sabah waters have been made mainly in the waters over the continental shelf areas of the South China Sea (Jaaman, 2010). In addition, there are several confirmed anecdotal reports of Melon-headed whale (*Peponocephala electra*) sightings from around the Spratly Islands as well as Killer whale (*Orcinus orca*). Common dolphin (*Delphinus delphis*) also reported sighting from Layang-Layang Island (Pilcher *et al.*, 1999).

On the other hand, Dugong (*Dugong dugon*) is the only species from the order Sirenian recorded in Sabah waters. The dugong population inhabiting the coastal waters of Sabah is reportedly in very low density. It is scattered across a wide range and estimated to number less than 200 individuals (Jaaman and Lah-Anyi, 2003).

Aerial surveys undertaken between 1996 and 2001 recorded three (3) sighting of dugong in the Brunei Bay and off Kudat, and one (1) in Labuan with total of 18 dugongs. All of the dugongs sighted were very close to shore. In addition, there were also in 4 occasions where a single dugong was observed from shore within the Kota Kinabalu harbour limit (Jaaman and Lah-Anyi, 2003).

Other aerial surveys conducted in 2000 and 2001 showed that total of 14 dugongs sighted at Sipitang, within the larger area of Brunei Bay (Jaaman and Lah-Anyi, 2003). Dugongs have also been sighted near Banggi Island, Balambangan Island and Malawali Island in the Kudat region (Ponnampalam *et al*., 2010).

While most of the marine species are listed as "data deficient" or "least concerned", two (2) species i.e. the Irrawaddy dolphin and Dugong are listed as "vulnerable" to extinction in the IUCN Red List of Threatened Species (Marsh, 2008).

Marine mammals face many threats to ensure its survival, especially from anthropogenic sources. There are two (2) species occupying Cowie Bay i.e. Irrawaddy dolphin and the Indo-Pacific Humpbacked dolphin that appear to be threatened due to disturbance caused by heavy vessel traffic and urban industrial development in the area (Jaaman, 2010).

The clearing of mangroves for aquaculture farms, firewoods and wood chips has led to sediment erosion, water pollution, and a loss of nursery habitat for young fish due to degradation of coral reefs and seagrass beds resulting from heavy siltation. Additionally, the rapid rise of Tawau and Sandakan as major ports and industrialized towns are likely to affect the habitat and behaviour of Irrawaddy dolphins that occupy those areas (Jaaman, 2010).

Many of the species, especially the Dugongs, have been hunted and were considered delicacy by the coastal inhabitants (Jakobsen *et al*., 2007). Dugongs are highly sought after, especially by the Bajau Laut community. Dolphins are also hunted for food but only by the Bajau Pelauh community in Semporna (SOMER, 2010). The hunting and trading of cetaceans by these indigenous maritime communities appears to be seasonal and still continues to occur in remote areas of Sabah i.e. Kudat, Sandakan, Semporna and Lahad Datu (Jaaman and Lah-Anyi, 2002).

Also, the use of gillnets and kelongs are the main causes of incidental catch of dugongs and inshore cetaceans, particularly of Irrawaddy dolphins and finless porpoises (Jaaman and Lah-Anyi, 2003). This has caused their numbers to dwindle in the past few decades. Based on interview surveys conducted between March 1997 and December 2004, incidental catches of marine mammals were also reported by fishermen from 310 (41%) and 99 (28%) of the total 753 fishing boat sampled in Sabah (Ponnampalam, 2010).

On the whole, dugongs are at risk of capture from gillnets, trawl nets and fish stakes, while cetaceans are at risk from the same gears and also purse seine nets. Species that are reported to be caught incidentally are Irrawaddy dolphins, Bottlenose dolphins, Stenellid dolphins (e.g. spinner dolphins), Indo-Pacific Humpback dolphins and Finless Porpoises (Jaaman *et al*., 2009; Jaaman, 2010). Overall, the magnitude of incidental catch is greatest in gillnets. Jaaman *et al*. (2009) reported that a total of 306 cetaceans and 479 dugongs were estimated to be incidentally caught annually by fishing fleets in Sabah. A total of 14 dugongs are estimated to be caught accidentally per year. The estimated number of by-catch in Sabah particularly in gillnets, may be unsustainably high (Jaaman *et al*., 2009).

Several actions have been taken to prevent the catch of marine mammals, including the enforcement of the two acts i.e. Wildlife Protection Act 1972 and Fisheries Act 1985 for the management of fisheries and protection of the marine mammals from direct or indirect catches. Other actions include the establishment of the Marine Protected Areas (MPAs), and the promotion of marine mammals as an attraction for the ecotourism industry.

SARAWAK

Marine mammals in Sarawak are protected by Federal and State Laws, which apply within the territorial sea and Exclusive Economic Zone (EEZ). At the Federal level, marine mammals are protected under the Fisheries Act 1985 (Part VI – Aquatic Mammals in Malaysian EEZ) and Fisheries Regulation 1999 (Control of Endangered Species of Fish). Under these legislation, it is illegal to catch, harass, possess, trade, kill, consume or transport any marine mammals, inclusive of body parts, without written permission from the Director - General of the Department of Fisheries Malaysia (DOFM). At the State level, marine mammals are protected under the Wild Life Protection Ordinance 1998 (Sarawak) in which the same regulations apply as in those at the Federal level.

Marine mammals and whale shark are known to inhabit the sea off Sarawak, including the Dugong, whales (Bryde's and Sei), dolphins (Irrawaddy, Indo-Pacific, Bottlenose, Fraser's, Long-snouted Spinner, Short-finned Pilot whale, Killer whale, Risso's and False Killer whale), Beaked whale, Pygmy Sperm whale, Finless Porpoise and the whale shark (Jaaman *et al*., 2001). Furthermore, Spinners (*Stenella longirostris*), Rough Toothed and Pacific Bottlenose (*Tursiopstruncates*) dolphins also seen further offshore, as are Melonheaded whales.

A study undertaken off Sarawak on August - September 2008 showed that a group of 5 – 7 individuals of Bottlenose Dolphin (*Tursiops* sp.) was sighted off Pulau Talang-Talang and Pulau Satang, Kuching (13 -14 m water depth) (Agrojati, 2010). Moreover, at deeper water (>30 m), Pantropical Spotted dolphin (*Stenella attenuata*) were sighted off Oya, Mukah, Kidurong and Similajau in a group of 3 – 5 individuals (Agrojati, 2010).

In 2009, during a research cruise on the Royal Malaysian Navy vessel *KD Perantau*, large groups of Indo-Pacific Bottlenose dolphins were sighted several times over shelf waters, and occasionally in the vicinity of oil and gas rigs (Ponnampalam *et al*., 2010). Spinner dolphins also have been sighted off Sarawak (Beasley, 1998; Ponnampalam *et al*., 2010) and mainly observed in open water at great distances away from any landmass (Ponnampalam, unpublished).

The estuaries and coastal waters along the West Coast of Sarawak from Kuching to Miri are home to large numbers of three (3) small marine mammals, the Finless Porpoise (*Neophocaena phocaenoides)*, Irrawaddy dolphin (*Orcaella brevirostris)* and the Humpbacked dolphin (*Sousa chinensis).*

Past studies indicated five (5) species of dolphins in Sarawak waters. There are Irrawaddy Dolphin (*Orcaella brevirostris*), Finless Porpoise (*Neophocaena phocaenoides*), Bottlenose Dolphin (*Tursiops aduncus*), Humpbacked Dolphin (*Sousa chinensis)* and one unidentified dolphin. The most prominent species is the Irrawaddy Dolphin, with 54 sightings compared to the 39 sightings for Finless Porpoise and 5 sightings for the other three species. The number of sighting for Irrawaddy Dolphin and Finless Porpoise increased from a previous survey (SOMER, 2010).

In addition, the Irrawaddy dolphin also frequently occurs in Kuching, Bintulu and Miri (Ponnampalam *et al*., 2010). Recent research under the Sarawak Dolphin Project (SDP) run by Universiti Malaysia Sarawak (UNIMAS) has shown that Irrawaddy dolphins have a statistically significant affiliation with areas of shallower depth and closer proximity to shore and river mouths than do Finless Porpoises and Indo-Pacific Bottlenose dolphins (Minton and Peter, 2010).

Additionally, a small number of sightings of the Irrawaddy dolphins in the Kuching area have been made as far as 8 km upriver (Ponnampalam *et al*., 2010). During SDP surveys, encounter rates for Irrawaddy dolphins and Finless Porpoises were found to be significantly higher in the Bintulu and Kuching regions than in the Miri area (Minton and Peter, 2009 and 2010).

Irrawaddy dolphins also have been recorded from the Rajang, Sematan, Bako, Igan, Muara Tebas and Saribas Rivers (Ponnampalam *et al*., 2010). In the Rajang and Saribas Rivers, Irrawaddy dolphins have been found present at more than 30 km upstream from the estuaries and in water salinity that was less than 5 parts per thousand (ppt). Indo-Pacific Humpback dolphin sightings have been recorded in Datu Bay, and the Baram and Rajang Rivers, as well as around Similajau and the Santubong and Buntal-Bako Bays, albeit infrequently. Furthermore, Finless Porpoises have also been recorded in the Saribas River, where a group of 10 individuals were observed feeding during a recent survey in April 2010. Other than that, Dugongs are found inhabiting the waters around Lawas and Labuan Island (Jaaman, 2000; Jaaman *et al*., 2000; Jaaman and Lah-Anyi, 2003; Bali *et al*., 2008).

PICTURE 4: SPINNER DOLPHINS
(picture courtesy of Dr. Louisa Shobhini Ponnampalam) source: EPSP, 2010

Populations of dugongs in Sarawak have declined significantly since the first record in 1931 and in the 1980s many believed that this species was extinct in Sarawak waters. However, a study on dugong (*Dugong dugon*) conducted from 1996 to 2001 indicated that 18 dugongs were observed in East Malaysian waters. All the dugong sighted was found very close to the shore (Jaaman and Yuhana, 2002). A study undertaken in 2007 indicated that at least 13 individual dugongs in three groups, seven (7) whales and 140 dolphins belonging to four (4) species were sighted from Lawas to Tanjung Datu. The survey also recorded sightings of two humpback whales (*Megaptera novaeangliae*) off Miri (SOMER, 2010).

Irrawaddy dolphin densities are highest in the Kuching study area, while Finless Porpoise densities are highest in the Bintulu/Similajau region. Observations of small calves of both species in both study areas, as well as feeding behaviour indicate that these nearshore waters are critical for feeding and breeding.

Higher encounter rates and sightings of larger than average groups (maximum count of 20 individuals) of Finless Porpoises in the Kuching area in April 2010 indicate a possible inshore movement – or convergence on nearshore estuarine habitats during that time (Ponnampalam *et al*., 2010). Moreover, direct counts during aerial surveys in 2000 – 2001, 2007 – 2008 and 2010 revealed between 14 - 31 individuals of cetaceans inhabiting Brunei Bay i.e. the waters of Lawas (Ponnampalam *et al*., 2010). Sightings of at least three (3) mother-calf dugong pairs were also observed during those surveys (SOMER, 2010).

Accidental by-catch of cetaceans and dugong has also been reported in Sarawak waters (Ponnampalam *et al*., 2010). An estimated 221 cetaceans and 14 dugongs are caught incidentally per year in Sarawak (Jaaman *et al*., 2005). In addition, dead dolphins were also reported at Piasau Boat Club, i.e. the Irrawaddy Dolphin (November 2007), Bottlenose Dolphin (March 2008) and Humpbacked dolphin (July 2008). On 22 April 2009, a dead carcass of a Finless Dolphin was found at Bungai beach (Minton and Peter, 2009). More than half of the estimated numbers of cetaceans caught were from the Southern region.
Furthermore, incidental reports of dolphin strandings have also been higher in the Miri region, with a total of six (6) reported dolphin carcasses/remains between 2007 and 2010, compared with two (2) in Similajau/Bintulu and two (2) in Kuching (SOMER, 2010). However, these numbers may be heavily biased by the effectiveness of reporting in different areas.

Drift nets and gill nets are known to present one of the most serious threats of entanglement to cetaceans worldwide (Read *et al*., 2006) and also within Sarawak (Jaaman *et al*., 2009b). Dolphins that are incidentally caught in fishing gear are sometimes known to be taken home by Melanau and Malay fishermen for family consumption, while there have been reports of some fishermen in Kuching selling incidentally caught dolphin meat for RM 2 – RM 6 per kilogram to local buyers (Jaaman and Lah-Anyi, 2002; Jaaman, 2008, 2010).

The current construction of an 8 km-long flood mitigation channel in the Kuching area is cause for concern for marine mammals. Once operative, the channel will have the potential to divert 392 million m^3 water from the Sarawak River basin into the Salak River (Mah *et al*., 2010). Previous studies of similar projects in the Sarawak River have shown that the operation of flood diversion channels can increase the total suspended solid (TSS) levels during flushing over a distance of 11 km upstream (Law *et al*., 2007). The phenomenon could seriously affect dolphin habitat, as the Salak River estuary yielded higher encounter rates with

Irrawaddy dolphins than any other area surveyed (Minton and Peter 2009, 2010).

The Similajau River estuary, which is important for Irrawaddy dolphins and finless porpoises (Minton and Peter 2009, 2010), also is affected by noise pollution, turbidity and chemical discharge as well as faecal contaminants from Sarawak Corridor of Renewable Energy (SCORE) project.

There is inadequate data on marine mammals in Malaysia waters; however, available information suggests that some, notably dugong, consists of small, fragile populations. In short, marine mammal population are formed through habitat destruction, and by-catch killing (SOMER, 2010). Knowledge of shark stocks is also limited. The primary threat to sharks (other than Whale Sharks) is by-catch and harvesting, including for sharks fin (SOMER, 2010).

Sea Cucumbers

The sea cucumber fishery in Peninsular Malaysia and in Sabah is artisanal. In Peninsular Malaysia, sea cucumber fishing is very small-scale and is limited to only a few localities, for example in Telok Nipah in Pangkor Island in the west coast of Peninsular Malaysia where sea cucumbers are harvested for use in traditional medicinal products (Choo, P.S., 2008). The harvesting of *S. horrens* from Pangkor Island is mainly by hand-picking during low spring tides, and is limited to about 20 days in a month.

In Sabah, statistics collected from the mid-1990s onwards showed that 70–80 percent of the total landings are hand–picked (or diving without SCUBA) with the rest landed from trawling. Based on statistics from the Department of Fisheries Sabah, data collected before the mid-1990s indicated that more than 90 percent of the sea cucumber catches were landed by trawl as bycatch. Most of the sea cucumbers harvested by trawl gear are collected by trawlers of 10–24.9 and 25–39.9 gross tonnage fishing in waters within 30 nautical miles of the coast (Choo, 2004). Sea cucumbers in Sabah are landed in Semporna, Sandakan, Kudat, Kota Marudu, Kota Belud and Kota Kinabalu; however, from the mid-1990s there were no landings from Kota Marudu and Kota Belud, indicating that the species from the surrounding waters from these two areas may have been depleted (Choo, P.S., 2008).

The actual volume of sea cucumbers harvested by hand-picking are difficult to capture in official fisheries statistics since gleaners need not report their catches to a central authority; hence sea cucumber landings recorded in the Annual Fisheries Statistics, Sabah, are very likely underestimated and represented predominantly the bycatch from trawling (Choo, P.S., 2008). Statistics available from the Food and Agriculture Organisation (FAO) and also from the Department of Fisheries, Sabah (Table 5-4) show that sea cucumber landings declined almost ten-fold from the 1990s to the 2000s, from an average of around 1 000 tonnes (wet weight) in the 1990s to about 100 tonnes (wet weight) in 2000s .

A sea cucumber survey carried out in Sabah, East Malaysia, from July 1996 to December 1998 (Forbes and Ilias, 1999) showed that many of the high value species, such as *H. scabra*, were now rare, resulting in increased pressure on the stocks of middle-range and low-value species such as *T. anax, T. ananas* and *Stichopus* spp. Local information also suggested the population and average size of individuals of *T. anax* have decreased.

On the west coast of Peninsular Malaysia, reports from Langkawi Island indicated that there is historical evidence that a fishery once existed for *Stichopus* spp. (local name "*gamat*") but nowadays, any sea cucumber fishing undertaken is at best part-time and occasional (Baine and Choo, 1999). In 1994, in Pangkor Island located in the west coast of Peninsular Malaysia, in an hour of diving it was possible to collect a large bucket of *gamat*, however, nowadays, it is difficult to get even three big sea cucumbers (Pankor, 2004).

TABLE 5- 5: SEA CUCUMBER LANDINGS IN COMPARISON TO TOTAL LANDINGS OF FISH, CRUSTACEAN, MOLLUSC IN SOME SOUTHEAST ASIAN AND EAST ASIAN COUNTRIES (UNLESS SPECIFIED, ALL VALUES ARE WET WEIGHT)

Country/Species	Year	Sea cucumber (tonnes)	Marine fisheries (tonnes)	Sea cucumber landings (%)
Indonesia[1]	1990	1 722	2 285 450	0.075
(Southeast Asia)	2000	3 041	3 811 375	0.080
Holothuroidea	2001	3 517	3 963 422	0.089
(see Appendix I for	2002	3 057	4 038 767	0.076
commercial species)	2003	3 014	4 349 860	0.069
	2004	6 930	4 501 070	0.154
	2005	6 240	3 993 990	0.156
Philippines[1]	1990	4 023	1 623 057	0.248
(Southeast Asia)	2000	730	1 741 079	0.042
Holothuroidea	2001	791	1 813 188	0.044
(see Appendix I for	2002	801	1 899 661	0.042
commercial species)	2003	979	2 036 580	0.048
	2004	1 006	2 071 123	0.049
	2005	762	2 167 889	0.035
Malaysia[2]	1990	1 200	587 875	0.204
(Southeast Asia)	2000	159	1 285 696	0.012
Holothuroidea	2001	165	1 231 287	0.013
(see Appendix I for	2002	139	1 272 105	0.011
commercial species)	2003	100	1 283 256	0.008
	2004	122	1 331 645	0.009
	2005	139	1 209 601	0.011
Republic of Korea[1]	1990	2 491	2 717 000	0.092
(East Asia)	2000	1 419	1 817 854	0.078
Apostichopus japonicus	2001	900	1 984 751	0.045
	2002	833	1 665 730	0.050
	2003	1 281	1 635 366	0.078
	2004	1 154	1 565 035	0.074
	2005	1 135	1 622 462	0.070
Japan[1]	1990	6 426	10 145 435	0.063
(East Asia)	2000	6 975	4 918 742	0.141
Apostichopus japonicus	2001	7 229	4 651 452	0.155
	2002	7 259	4 302 774	0.169
	2003	8 517	4 610 570	0.185
	2004	9 268	4 341 326	0.213
	2005	9 373	4 742 574	0.215
China[3]	2001	358.44 (dry weight)	14 379 457	–
(East Asia)	2002	470.23 (dry weight)	14 305 218	–
Holothuroidea and	2003	–	14 293 783	–
Apostichopus japonicus	2004	–	14 473 187	–
	2005	–	14 792 598	–

Sources: [1] FAO; [2] Choo, 2004 (for 1990, Sabah landed 400 tonnes which included also sea urchins while Peninsular Malaysia landed 800 tonnes. Sea cucumber landings from 2000 onwards comprised landings solely from Sabah and extracted from the Annual Fisheries Statistics, Sabah (Anon. 2000 to 2005); 3. Chen, 2004 (sea cucumber landings in dry weight).

Studies in marine parks along the east coast of Peninsular Malaysia, where illegal fishing is uncommon, showed healthy populations of sea cucumbers. A survey conducted by Coral Cay Conservation (CCC) in the Redang Island Marine Park during March–September 2004 using the CCC baseline transect technique showed that sea cucumbers had the highest overall invertebrate abundance of 0.41 using the semi-quantitative DAFOR1 ordinal scale (Comley *et al.*, 2004). The survey conducted by CCC indicated that the extraction pressure of sea cucumbers was low in the Redang Island Marine Park (Comley *et al.*, 2004). One of the leading sea cucumber wholesalers in Singapore noted that sea cucumbers were plentiful along the east coast of Peninsular Malaysia because few Malaysians were financially desperate enough to want to collect them (Butcher, 2004).

TABLE 5- 6: SEA CUCUMBER SPECIES IN MALAYSIA

Species	Location (Island)				
	Pangkor	Sembilan	Tioman	Payar	Langkawi
Stichopus variegatus	×	×	×	×	×
Stichopus chloronotus			×	×	
Stichopus horrens				×	
Stichopus sp. 1			×	×	
Stichopus sp. 2			×		
Stichopus sp. 3				×	
Thelenota ananas			×		
Actinopyga echinites			×		
Actinopyga lecanora			×		
Actinopyga miliaris			×		
Bohadschia argus			×		
Bohadschia graeffei			×		
Bohadschia marmorata			×	×	
Holothuria atra	×	×	×	×	×
Holothuria coluber			×		
Holothuria edulis			×		
Holothuria impatiens			×		×
Holothuria hilla			×		
Holothuria leucospilota			×	×	×
Holothuria sp. 1		×			
Holothuria sp. 2			×		
Synapta recta			×	×	
Synapta sp. 1				×	

Source: Baine and Forbes (1996; unpublished report)

Other threats facing sea cucumber population in Malaysia includes habitat loss, lack of information and inaccurate resources statistics, inaccurate trade statistics and confusion in commodity codes and threats of global warming / climate change (Choo, P.S., 2008).

Pollution from unsustainable development (land clearing which cause sedimentation) is the main threat on the survival of sea cucumbers in waters off Pangkor and Langkawi islands (Choo, P.S., 2008). Overfishing and degradation of natural habitats as a result of destructive fishing methods and pollution are the main problems for sea cucumbers in Sabah (Biusing, 1997).

In Sabah, data on sea cucumbers landings are probably under-estimated due to the complexity of the fishery, which has led to constraints in obtaining reliable catch and effort data (Biusing, 1997).

In the absence of reliable catch statistics on some aquatic organisms, trade statistics may be used to provide useful information on the exploitation rates and an indicator of resource status. However, there is a tendency for trade figures to be under-reported for tax evasion purposes (Choo, P.S., 2008). The use of different commodity codes for the same type of products makes comparison of trade statistics difficult. Researchers encountered difficulties with the Standard International Trade Classification (SITC) commodity codes used in Sabah, Malaysia. There were some distinct changes in the category code and the introduction of a new category "*fit for human consumption*" in 1996 which appeared to have replaced the category "*other than fresh, chilled or frozen*", hence creating some confusion in the trade statistics (Choo, 2004).

Lastly, the threat brought by global warming / climate change does not exclude the sea cucumber population. However, information on the impacts of this phenomenon is limited (Choo, P.S., 2008). Global warming may affect sea cucumber fisheries by influencing the stocks and the global sea cucumber supply. Coral reefs, which are important habitats for sea cucumbers may be affected by global warming, and thus, damage to coral reefs will in turn reduce recruitment of sea cucumbers. Higher sea temperature is a major cause of coral bleaching and damage to reef ecosystems. Changing sea temperature and current flows will likely bring shifts in the distribution of sea cucumber stocks with some areas benefiting while others incurring losses (Choo, P.S., 2008).

Humphead Wrasse

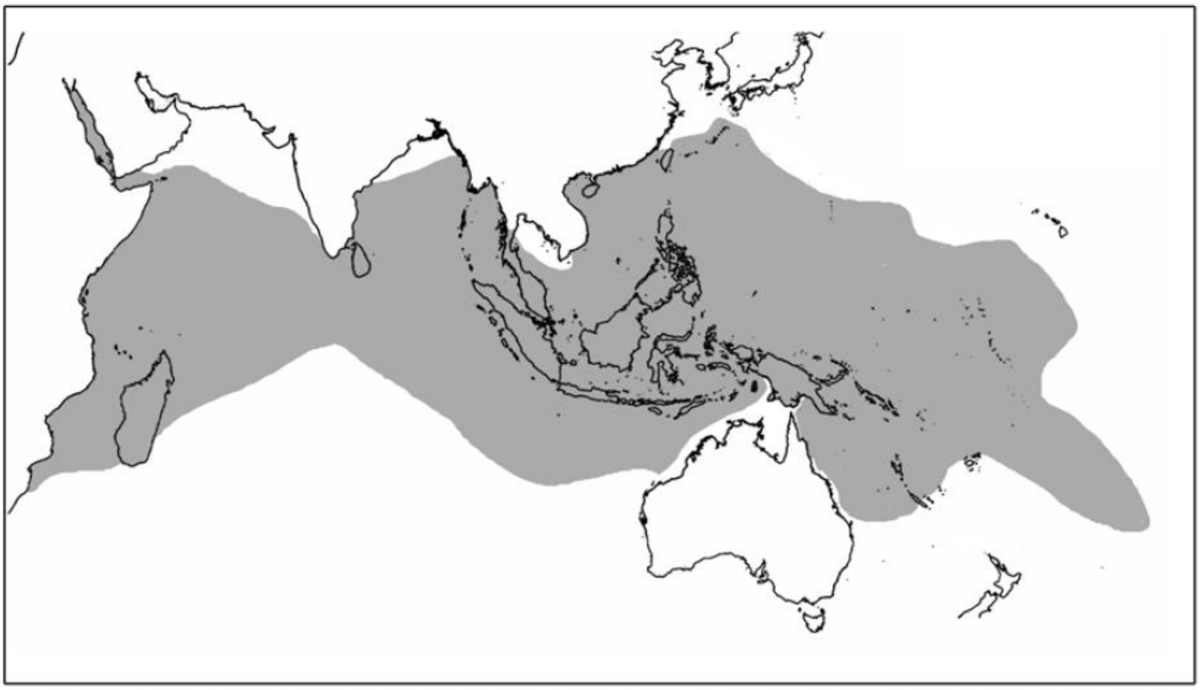
The live reef fish trade in Asia Pacific region is a lucrative business and is said to have threatened marine species due to overexploitation and habitat destruction (National Coastal Resources and Marine Environmental Profile of Malaysia, 2010). One of the live reef fish species that is over-exploited is the humphead wrasse (*Cheilinus undulates*). At the 13th Conference of the Parties to the CITES in October 2004, the humphead wrasse, was listed in the Appendix II of the Convention, hence regulating international trade of this species under permit system which requires exporting and re-exporting countries to authorise trade. Please refer to Figure 5-3 for the distribution of humphead wrasse.

The Humphead wrasses (also known as Napoleon or Maori wrasse) are among the most beautiful, yet bizarre-looking, fish in the sea. Humpheads occur patchily throughout the lndo-Pacific and Indian Ocean regions. Though widely distributed, they are not abundant in the wild. Late sexual maturity (they breed only in the fifth year or later); slow growth, predictable spawning sites, hermaphroditism (sex reversal) and rarity make them highly vulnerable to over-exploitation.

Humpheads can grow up to 2.3m in length and 190kg in weight, and live up to 40 to 50 years. Once a female reaches a size of 20 to 22kg, it turns into a male and thrive to be the dominant male. Humpheads are omnivores and feed on molluscs, fish and crustaceans, among others. As humphead numbers decline, the reef ecology will change. Spiny sea urchins and crown-of-thorns starfish have invaded many reefs because humpheads, which prey on them, have declined in numbers. Unlike some species of groupers, humpheads have not been commercially bred yet. Farming efforts have failed to go beyond the larval stage.

An extensive series of underwater visual census at more than 30 sites around Sabah (the major supplier and source of this species in Malaysia) found that, due to extensive and uncontrolled fishing, only 2 sites had more than 1 humphead wrasse per km, most of them in smaller sizes (IUCN Red List). Based on a report commissioned by WWF-Malaysia, an argument surfaced that spawning aggregations may have ceased in the area as a result of overfishing. With the exception of Layang-Layang Island, where an estimated 350 humpheads were recorded. In the late 1990s, an estimated 70 humpheads were recorded in west Sabah and Sipadan Island. These locations are protected by the Royal Malaysian Navy and by dive resorts. Global reef checks show the species have disappeared from even the best reefs over most of its range. In Peninsular Malaysia's east coast, in islands such as Redang, Tioman and Tenggol, divers report that humpheads have vanished from reefs.

FIGURE 5- 4: DISTRIBUTION OF HUMPHEAD WRASSE



source: IUCN Red List

MARINE WATER POLLUTION

Malaysia's territorial waters cover 549 500km2 (MOSTI, 1997) and have more than 100 islands with a total coastline length of 4675 km (Peninsular Malaysia, Sabah and Sarawak). Land-based and sea-based pollution sources pose threats to important marine resources such as coral reefs, mangroves, seagrasses and fisheries. Malaysia's marine habitats are rich in natural resources and any unmanaged development in coastal areas and islands creates significant impacts on these sensitive environments as well as their associated organisms.

Malaysia's coastal and marine sources of pollution are related to manufacturing, maritime and shipping, agriculture, urbanization (organic waste, sewage and garbage), and oil and gas activities.

The manufacturing sector is the major contributor to metal pollution (electroplating, etching, metal components) (Rahman and Surif, 1993) where the semiconductor and electronics industry alone in 1992 released 69,000m^3 of sludge per annum containing heavy metals (Hamid and Sidhu, 1993). Copper (Cu) from pig farms are known to contaminate coastal sediments and fauna (molluscs) (Ismail and Rosniza, 1997). Besides tin (Sn), port and shipping activities are responsible for Lead (Pb), Copper (Cu) and As (Arsenic) in the Straits of Malacca (Abdullah *et al*., 1999).

Heavy metals in marine sediments (Table 5-6) show that Lead (Pb) in Peninsular Malaysia is higher than natural global values in places like Kemaman, Tanjung Karang, Penang (Wood *et al*., 1993) while Zinc (Zn) and Pb were higher by magnitudes of 2 to 3 times respectively in the Johor Straits and this was attributed to traffic (petrol and tyre wear) between Malaysia and Singapore (Wood *et al*., 1997).

TABLE 5-7: HEAVY METAL CONCENTRATION IN SEDIMENTS IN THE COASTAL AND MARINE WATERS OF MALAYSIA (μg/g dry wt; with Fe and Al in %)

Location	Heavy Metals									Sediment Type
	Pb	Cd	Cu	Zn	As	Cr	Ni	Fe	Al	
Terengganu Coast	4.09-19.8		1.65-36.6	5.23-41.1		11.1-106		0.66-7.59	0.06-1.08	Sand
Kemaman Coast	4.90-70.0	0.11-0.61	1.87-22.5	13.0-135.0		17.6-66	3.6-19.4	1.02-6.79	1.17-12	Clay-Sand
Kemaman Mangroves		0.09-1.15								Clay
South China Sea, off Sabah	2.0-41.0		20.0-50.0			38.0-59.0	24.0-47.0	1.33-2.34	2.36-3.81	Clay-Sand
South China Sea	1.01-56.5	0.06-0.94	1.78-56.8	11.6-137.0		10.1-125.0	5.63-58.0	0.1-3.54	0.06-7.22	Clay-Sand
Juru, Malacca Straits	17.3-35.5	0.04-0.24	9.3-43	36.7-83.7	0.9-12.3	7.0-77.7	21.0-34.0	6.6-3.60	1.8-9.4	Clay
Johor Straits	19.0-160.0	0.08-0.32	11.0-63.0	54.0-334.0	6.5-39.2	13.0-61.0	21.0-32.0	1.74-3.7	3.08-12.34	Clay

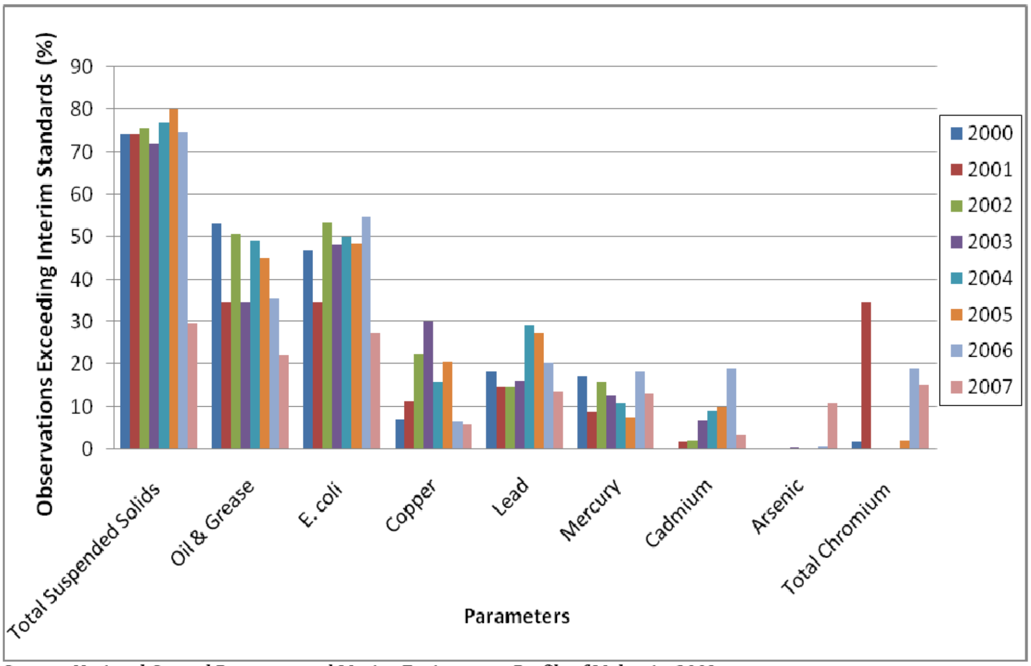
(adapted from Shazili et al., 2006), (Data for the South China sea areas have been combined)(Pb-Lead; Cd-Cadmium; Cu-Copper; Zn-Zinc; As-Arsenic; Cr-Chromium; Ni-Nickle; Fe-Iron; Al-Aluminium).

Water quality parameters from 233 stations in Peninsular Malaysia and East Malaysia (2000-2007) showed that stations with contaminants exceeding the Interim Marine Water Quality Standards (IMWQS) were 56.9% for total suspended solids, 44.1% for *Escherichia coli* and 43.6% for oil and grease (Table 5-7 and Figure 5-8). The marine water contaminants exceeding the IMWQS from islands and the various states in 2007 was *E.coli*) with the coastal waters of Kedah, Penang, Johor, Terengganu and Labuan being the most polluted by the bacteria while higher total suspended solids were reported in the coastal waters of Kedah, Penang and Labuan SOMER (2010).

TABLE 5- 8: WATER QUALITY PARAMETER FROM 233 STATIONS FOR MALAYSIA IN 2007.

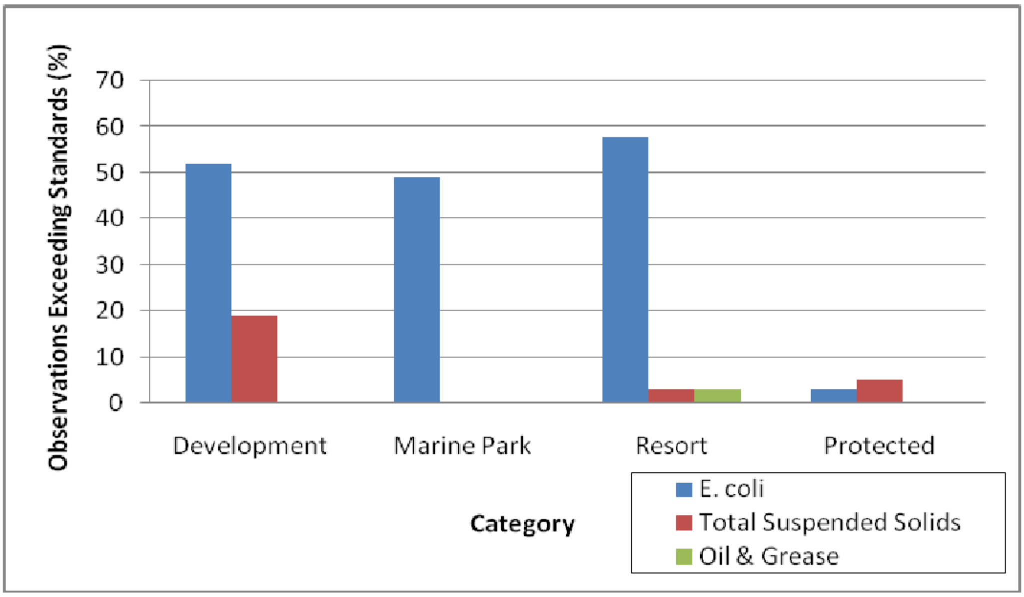
State	No. of station	No. of samples	Percentage of Readings that Exceeded the Interim Marine Water Quality Standards								
			Total Suspended Solids	Oil & Grease	*E. coli*	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury
Perlis	2	20	88	31	100	0	0	0	0	6	13
P. Langkawi	7	35	46	40	26	0	0	0	0	0	23
Kedah	3	12	33	8	22	0	0	0	0	0	8
P. Pinang	25	160	28	40	49	0	0	1	2	6	9
Perak	13	66	66	82	48	0	7	7	28	24	0
Selangor	14	67	91	63	54	0	0	0	0	0	14
N. Sembilan	13	52	100	58	50	0	0	0	0	0	2
Melaka	9	54	94	NA	65	NA	0	NA	0	0	NA
Johor	51	155	56	15	55	0	0	0	34	2	3
Pahang	11	80	6	83	31	0	0	0	0	48	14
Terengganu	19	76	45	59	36	0	41	0	25	80	13
Kelantan	10	40	73	88	45	0	20	0	0	68	0
W.P. Labuan	5	23	23	0	54	NA	0	0	0	69	NA
Sabah	26	78	22	0	5	0	0	0	12	40	0
Sarawak	25	90	84	43	22	0	0	0	0	20	12
Total	223	1,008									
Average (%)			56.9	43.6	44.1	0	4.5	0.6	6.7	24.2	8.5

FIGURE 5- 5: MARINE WATER QUALITY STATUS, 2000 – 2007



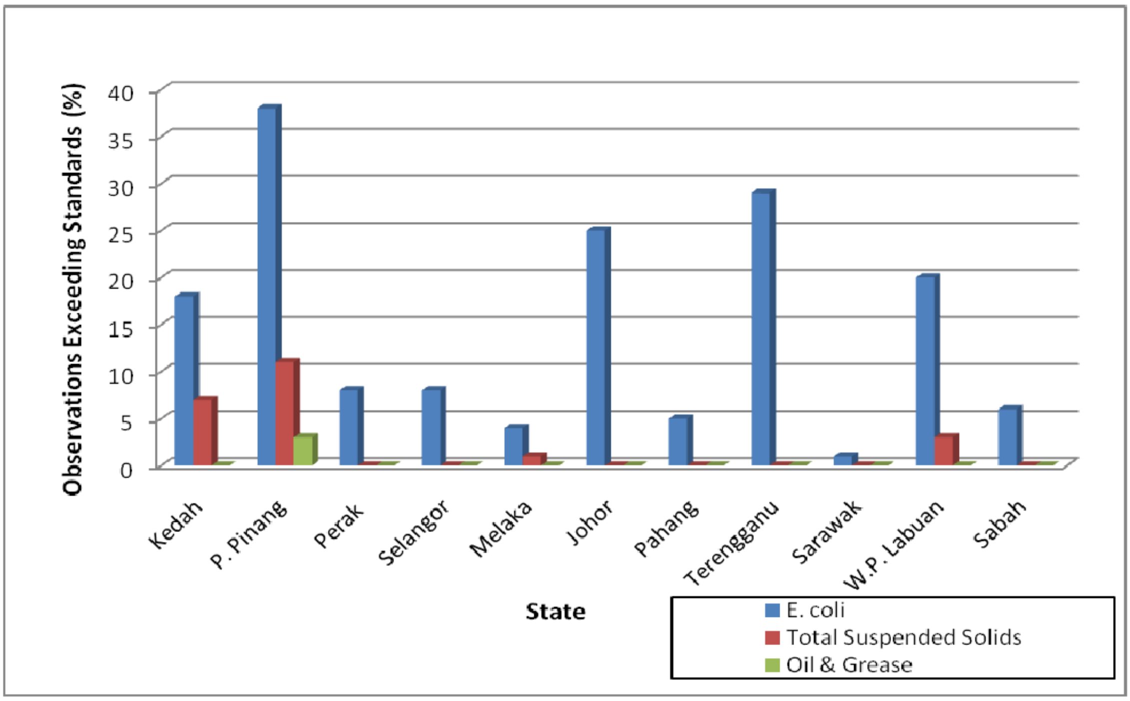
Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2009

FIGURE 5- 6: ISLAND MARINE WATER QUALITY STATUS, 2007



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2009

FIGURE 5- 7: MARINE WATER QUALITY STATUS BY STATE, 2007



Source: National Coastal Resources and Marine Environment Profile of Malaysia, 2009

Encouragingly, in November 2010, the Department of Environment (DOE) published the new Malaysian Marine Water Quality Criteria and Standard to replace the IMWQ standards. This new criteria and standard takes into consideration the uses and ecosystem type in marine waters. It now have segregated the parameters in terms of the beneficial uses in marine and coastal waters into four classes – (i) Class 1: Preservation, Marine Protected Areas, and Marine Parks; (ii) Class 2: Marine life, fisheries, coral reefs, recreational and mariculture; (iii) Class 3: Ports, oil and gas fields; (iv) Class E: Mangroves, estuarine and river-mouth water. Table 5-9 below illustrates the various parameters and its acceptable value in accordance to the classes. However, the publication of data based on the new criteria and standard is yet to be published.

Although States enjoy jurisdiction out to three nautical miles seaward from the low-water line, spatial zonation planning does not extend into the marine area, and marine water quality objectives are not taken into consideration at the planning stage. Consequently, there is no linkage between land-based activities and nearby water quality. Although the DOE publishes the marine water quality data annually, there is no administrative or legislative consequence in the event that the set parameters have been exceeded (DFR, 2010).

TABLE 5- 9: MALAYSIA MARINE WATER QUALITY CRITERIA AND STANDARD

Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
BENEFICAL USES	Preservation, Marine Protected areas, Marine Parks	Marine Life, Fisheries, Coral Reefs, Recreational and Mariculture	Ports, Oil & Gas Fields	Mangroves Estuarine & River-mouth Water
Temperature (°C)	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient	≤ 2°C increase over maximum ambient
Dissolved oxygen (mg/L)	>80% saturation	5	3	4
Total suspended solid (mg/L)	25 mg/L or ≤ 10% increase in seasonal average, whichever is lower	50mg/L (25 mg/L) or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 30 % increase in seasonal average, whichever is lower
Oil and grease (mg/L)	0.01	0.14	5	0.14
Mercury* (µg/L)	0.04	0.16 (0.04)	50	0.5
Cadmium (µg/L)	0.5	2 (3)	10	2
Chromium (VI) (µg/L)	5	10	48	10
Copper (µg/L)	1.3	2.9	10	2.9
Arsenic (III)* (µg/L)	3	20(3)	50	20 (3)
Lead (µg/L)	4.4	8.5	50	8.5
Zinc (µg/L)	15	50	100	50
Cyanide (µg/L)	2	7	20	7
Ammonia (unionized) (µg/L)	35	70	320	70
Nitrite (NO2) (µg/L)	10	55	1,000	55
Nitrate (NO3) (µg/L)	10	60	1,000	60
Phosphate (µg/L)	5	75	670	75
Phenol (µg/L)	1	10	100	10
Tributyltin (TBT) (µg/L)	0.001	0.01	0.05	0.01
Faecal coliform (Human health protection for seafood consumption) - most Probable Number (MPN)	70 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)	200 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)
Polycyclic Aromatic Hydrocarbon (PAHs) ng/g	100	200	1000	1000

**MWQS in parentheses are for coastal and marine water areas where seafood for human consumption is applicable.*

Developments in Marine Resource Management

Rehabilitation and Restoration of threatened habitats

Mangrove Restoration

The total mangrove area in Malaysia has been reduced from 800,000ha in the early 1950s to about 695,000ha in 1973 and further reduced to about 575,180ha in 2004, representing a loss of 25% in 50 years (Tan, 2005).

Many mangrove reserves, which were gazetted during the colonial period, have since been degazetted for other uses. Of the total, 85% have been gazetted at forest reserves, wildlife sanctuaries, RAMSAR sites, state and national parks (Tan, K.H., Jurgenne, H.P., 2006). The unprotected stateland mangroves are estimated to be 100,000ha.

Peninsular Malaysia

Post 2004 tsunami tragedy has prompted the Malaysian Government to increase conservation and protection efforts along the coastal areas. A Special Task Force Committee on Operational Tree Planting Programme with Mangrove and Other Suitable Tree Species along The National Coastlines were formed under the Ministry of Natural Resources and Environmental (NRE) on 7 February 2005. Under the main committee, two technical committees were formed to pool the execution of replanting efforts - Technical Committee on Planning and Implementation (JTPP) and Technical Committee on Research and Development (JTRD).

The Program is a long term development plan to ensure sustainability of mangrove forests. Table 5-10 below summarises the total area involved in mangrove replanting program and number of trees planted over the period 2005-2010. The highest number of mangrove trees planted was in 2008.

TABLE 5- 10: SUMMARY OF PHYSICAL CUMULATIVE TREE PLANTING PROGRAMME (2005-2010)

State	2005		2006		2007		Total	
	Area (ha)	No. of trees	Area (ha)	No. of trees	Area (ha)	No. of trees	Area (ha)	No. of trees
Peninsular Malaysia	169.30	476,602	88.45	350,105	177.90	532,788	435.65	1,379,495
Sabah	-	-	15.00	166,665	186.00	420,465	201.00	587,130
Sarawak	-	-	10.00	22,220	35.00	77,770	45.00	99,990
Total	**169.30**	**476,602**	**113.45**	**538,990**	**398.90**	**1,031,023**	**681.65**	**2,066,615**

State	2008		2009		2010		Total	
	Area (ha)	No. of trees	Area (ha)	No. of trees	Area (ha)	No. of trees	Area (ha)	No. of trees
Peninsular Malaysia	355.05	1,130,317	282.84	991,614	222.26	733,817	1,295.00	4,235,243
Sabah	200.84	223,165	157.43	189,089	115.90	117,793	675.17	1,117,175
Sarawak	64.40	153,638	86.60	176,732	90.70	79,385	286.70	509,745
Total	**620.29**	**1,507,120**	**526.87**	**1,357,435**	**428.86**	**930,995**	**2,256.87**	**5,862,163**

source: http://bakau.forestry.gov.my/index.php?option=com_content&task=view&id=83&Itemid=56

PICTURE 5: MANGROVE REPLANTING SITE AT PANTAI TUJUH, TUMPAT, KELANTAN

FIGURE 5- 8: LOCATION OF MANGROVE RE-PLANTATION ACTIVITIES IN PENINSULAR MALAYSIA

source: Department of Forestry Malaysia, 2012

SABAH

The Sabah Forestry Department has conserved most if not all Mangrove Forests under Class V[3] for marine life conservation and as a natural means of protection against coastal erosions. Exploitation activities on mangrove forests in Sabah currently are at a minimal rate mainly from the collection of charcoal, fire-wood and timber piling for local usage (Sabah Forestry Department, 2010). However, in order to secure and sustain the mangrove forests, the Federal Government has approved a "*Replanting Project of Mangroves & Other Suitable Species On The Coastal Of Sabah Under The 9th Malaysian Plan*". Replanting efforts are focused on natural mangrove forests and coastal areas mainly in the East Coast of Sabah such as Sandakan, Lahad Datu, Kunak, Semporna and Tawau (Sabah Forestry Department, 2010). Whereas in the West Coast of Sabah, it is focused on beaches and forest reserves that have been identified as suitable for the purpose of the project such as Kota Kinabalu, Kota Belud, Tuaran, and Beaufort (Sabah Forestry Department, 2010). For the past five years, a total area of 583.54 ha (in various districts near the coastal beaches and forest reserves) have benefited from the project. In 2009, the state of Sabah was allocated a total of RM1mill from the Sabah Development Corridor (SDC) project to replant mangroves. Targeted areas include Tawau, Semporna and Beaufort.

TABLE 5- 11: MANGROVE REPLANTING DEVELOPMENT (2006-2010)

Year	Area	No. of saplings
2006	15 ha	16,665
2007	168 ha	184,100
2008	200.84ha	223,133
2009	158.07ha	175,616
2010	43.88ha	35,918

source: Sabah Forestry Department Annual Report 2010

Based on Sabah Forestry Department Annual Report 2010, there are eight (8) replanting sites under its mangrove forest management & restoration program.

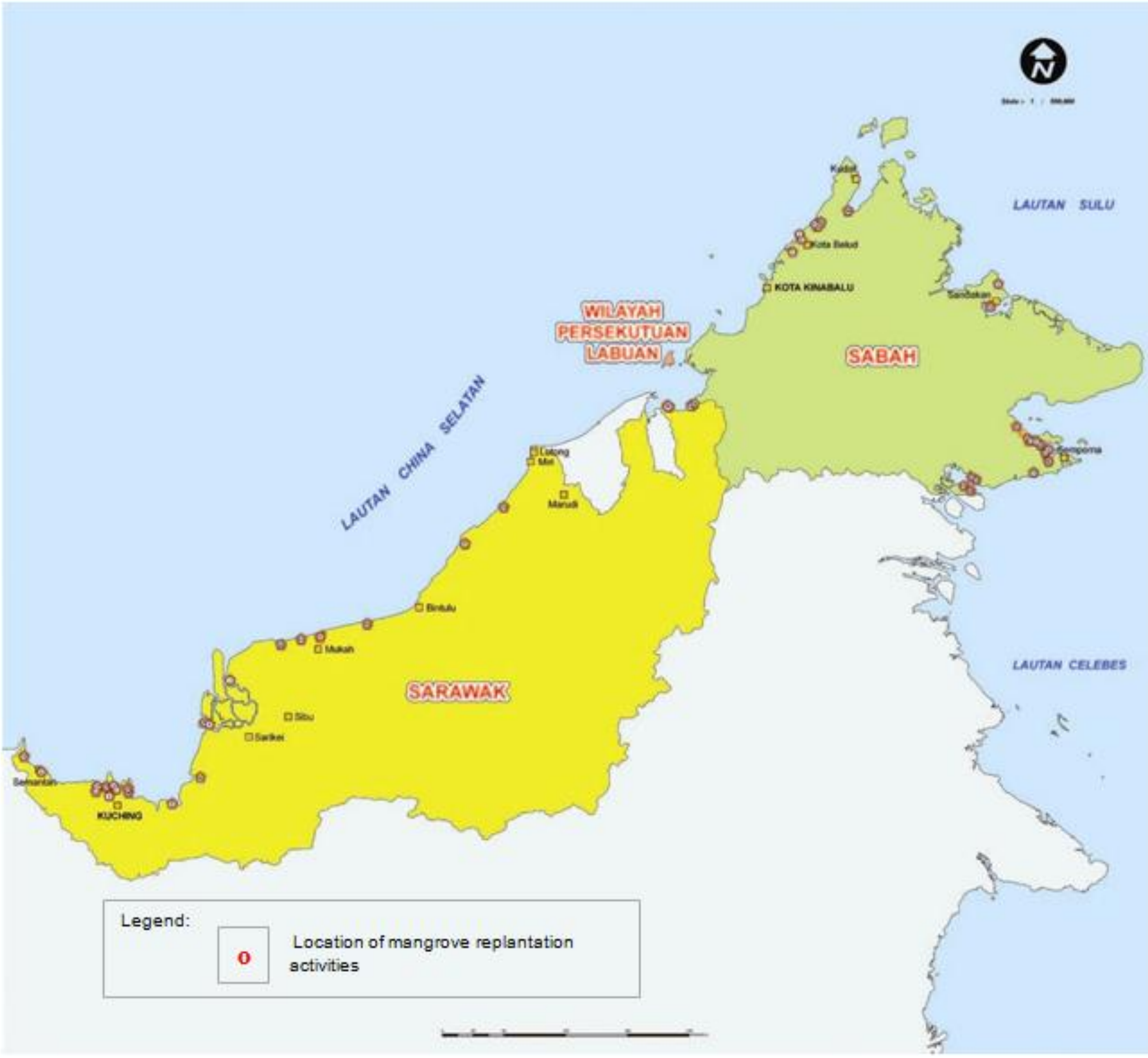
i. **Sibyte Forest Reserve (Sandakan):** Planting efforts started in 2006 until 2010 and encompassed an area of 41.30ha. A total of 45,883 mangrove saplings were planted and the percentage of surviving mangrove saplings exceeded more than 90%. The method of planting was by distances of 1' x 1' foot, 2' x 2' feet and 3' x 3' feet, depending on the suitability of the planting site.

ii. **Beaches of Meruntum and Putatan (Kota Kinabalu):** Planting works were set in the areas of Meruntum Beach, Lok Kawi (1.5ha) and Putatan Beach (3.5ha). A number of 5,500 mangrove saplings including other coastal species were planted. Species that have been planted in the beaches of Meruntum are:

- Rhu Laut (*Casuarina equisetifolia*)
- Nyatoh Laut (*Planchonella*)
- Bintangor Laut (*Calophyllum inophyllum*)
- Marabahai (*Pongamia pinnata*)
- Putat Laut (*Barringtonia asiatica*)
- Sempilau Laut (*Gymnostoma nobile*)
- Nyatoh (*Mimusops elengi*)
- Ketapang (*Terminalia cattapa*)

[3] Under the Forest Enactment, 1968 (revision of 1984) there are seven classes of forest reserves. Four of these may be regarded as protected areas. The first of these are the Class I Protection Forests, the main function of which is to safeguard water supplies, soil fertility and environmental quality. Danum Valley and Maliau Basin, which are managed by Sabah Foundation are two such Class 1 Forest reserves. Class V is mangroves. Class VI, Virgin Jungle Reserves, comprise some 50 relatively small areas intended to provide undisturbed forest for research purposes and the preservation of gene pools. The forth conservation class is Class VII, Wildlife Reserves, which are for the protection of wildlife.

FIGURE 5- 9: LOCATION OF MANGROVE RE-PLANTATION ACTIVITIES IN SABAH AND SARAWAK



source: Department of Forestry Malaysia, 2012

- Berbaru (Hisbiscus tiliaceus)
- Pinang Lema`as (Adonia sp)

The total planted sapling of other coastal species amounted to 500 saplings. The percentage of failure was estimated to be less than 8%. The species of mangroves planted in the beaches of Meruntum were of the Bakau Kurap (*Rhizophora mucronata*) Bangkita (*Rhizophora apiculata*) and Tirog (*Ceriops decandra*). The percentage of failure during the first six months was less than 10%. 350 of the mangrove saplings planted were already 6-8 months old at the time of planting. Growth failure increased in the first 8-9 months up to 120 saplings or 30%, due to barnacle infestations.

iii. **Mangrove Replanting in Semporna Forest Reserve (Kunak):** Over the past five years under the 9th Malaysia Plan project, an area of 75.57ha has been planted with mangrove saplings. The locations of the mangrove replantation are largely centered on abandoned shrimp ponds. The locations are at Pangkalan Madai as well as within the Kuala Tingkayu Forest Reserve, Kg Panggi Hujung and Kg Sapang which are located within the Semporna Forest Reserve in the district of Kunak. 83,960 propagules and mangrove saplings have been planted in the areas, not including any replacements of dead saplings. The survival rate is exceptionally high in these areas, as much as of 80% of the saplings survived and are still growing. The type of mangrove trees planted are the Bakau Kurap (*Rhizophora mucronata*) and the Bangkita (*Rhizophoraapiculata*) species.

PICTURE 6: MANGROVE REPLANTING AT MERUNTUM BEACH IN KOTA KINABALU

iv. **Mangrove Replantation in Semporna Forest Reserve (Semporna):** An area of 253.89ha has been replanted on within the Semporna Forest Reserve since 2005. Planting works were done by locals with 95% survival rate among the planted saplings. Mangrove species planted were of the Bakau Kurap (*Rhizophora mucronata*) and Bangkita (*Rhizophora apiculata*) species.

v. **Mangrove Replantation in Semporna Forest Reserve (Tawau):** A total of 99,333 propagules and mangrove saplings have been planted in this section. The 3 x 3 feet method was utilized in this site, spanning over an area of 89.40ha. The area was once a natural mangrove forest that was encroached and destroyed by irresponsible parties to make way for oil palm in the surrounding areas, notably in Sg. Burung and Sebatik Island. Planting works in this section have been completed and the saplings are reported to have an 80% survival rate. Species chose for these areas are the Bakau Kurap (*Rhizophora mucronata*) as well as the Bangkita (*Rhizophoraapiculata*) species.

vi. **Mangrove Replantation in Sulaman Lake Forest Reserve (Kota Kinabalu):** In Kota Kinabalu, the replanting project was done over an area of 39.83ha in the Sulaman Lake Forest Reserve. The species chosen for this area is the Bangkita (*Rhizophora apiculata*) species. Survival rate at this site was 95%.

PICTURE 7: REPLANTING AREA IN PULAU SEBATIK WITHIN THE TAWAU FOREST RESERVE, TAWAU

vii. **Mangrove Replantation in Padas Damit Forest Reserve (Beaufort):** Plantation works in this district encompassed an area of 26.28ha within the Padas Damit Forest Reserve and was carried out by Metadan Jaya Company.

viii. **Mangrove Replantation in Kudat and Marudu Bay Forest Reserve**: Throughout the RMK-9 a total area of 29.22ha were replanted with mangrove saplings within the Forest Reserves of Kudat and Marudu Bay. Kudat is the first district to have been planted with Rhu saplings in this project, over an area of 8ha. Planting sites are focused on areas which were once lush with rhu trees that had been consumed by forest fires.

PICTURE 8: REPLANTING IN KUDAT AND MARUDU BAY FOREST RESERVE, KUDAT

There is a need for training for a more innovative planting technique to ensure higher success rate in high-risk areas.

During the course of the replanting program, there are several issues and challenges cited by the Sabah Forestry Department. Some of it are vandalism due to lack of understanding, plantation costs are inconsistent due to the variable geographical differences of the planting sites, plant sites on coastal areas are naturally exposed to the risk of sea erosion as well as strong waves.

Threats include opening of mangrove forests for new settlements, illegal and unauthorised intrusions into mangrove forest reserves (mainly illegal immigrants), encroachment into mangrove areas for aquaculture activities such as prawn ponds; encroachments and erection of barriers within the mangrove forest reserves by land applicants for palm oil plantations and increasing pressure on mangrove forests to be opened for land application by individuals (Sabah Forestry Department Annual Report 2010).

Coral Reefs Rehabilitation

Restoration of coral reefs in the South China Sea can be traced back to the 1990s as a response to the widespread degradation of reef habitats. Several restoration techniques was introduced and some still in use; (i) coral transplantation, (ii) substrate modification, and (iii) non-coral species stock enhancement (Chou, 2009). Nevertheless, the general consensus seems to favour protection and management approaches and thus efforts should focus on strengthening it. Restoration is often more costly and tend to have its own set of limitation, but is necessary in the event of extensive reef loss.

Restoration efforts have expanded over the recent years and most of the projects are broadly classified as improving the existing condition of reefs that are impacted by human activities (Chou *et al,* 2009).

Southeast Asia has extensive experiences with artificial reefs but the real benefits have never been fully quantified (Chou, 1997). Artificial reef and reef restoration projects continue to be active throughout Southeast Asia (SEAFDEC, 2005).

Reef restoration continues to play an important role and efforts are likely to intensify (Jaap and Hudson, 2001). However, viable approached and technologies are in relatively early stages of development, and for most cases are currently difficult to implement over large spatial scales (Edwards and Gomez 2007). Levels of understanding are still largely based on personal experiences (Precht, 2001).

Restoration techniques and initiatives

Transplantation of entire colonies

Coral transplantation seems to be the most common and widespread technique used among the Southeast Asian countries. Transplantation of whole colonies from sites that were designated for development is a popular management response widely practiced by both government and non-governmental organisations. Other projects make use of coral fragments instead of entire colonies, and this appears to be a more widely adopted option. The long-term survival and adaptability of transplants are important considerations determining a project's success (Yap, 2003).

A project in Peninsular Malaysia has transplanted about 100 branching coral colonies to a 20m × 10 m area thirty meters from the original site. Wire mesh was placed at the bottom to ensure that the transplanted colonies stayed upright during the six months of monitoring and a 70% survival rate was recorded (Chou *et al,* 2009). Malaysia's marine parks authority adopted this technique for the restoration of small shallow reefs (less than 6 m depth) damaged by boat grounding or anchor drop (Chou *et al,* 2009). There are intentions to further refine the technique and increase survival rate by levitating transplants half a meter above the bottom.

Substrate modification

Stabilization of the bottom substrate or the provision of artificial substrate may be necessary if the bottom is damaged, become unstable with loose rubble or silted over to prevent larval recruitment and survival (Chou *et al,* 2009). This approach, to an extent, is similar to the artificial reef concept, except that it is applied only when substratum damage has occurred. Various structural configurations have been used ranging from simple cover slabs to high profile complex structures (Chou *et al,* 2009). Materials used varied from PVC tubing to concrete and fibreglass.

Malaysia has developed a set of criteria prior to selection of artificial reef structure. It takes into consideration the ease of transportation, has to be low-cost and non labour-intensive. Trials in mid-1990s used PVC tubing of different designs and size (Chou *et al,* 2009). One design was finally adopted for further testing. In 1995, five units were installed at 5m depth within reef areas at two sites (Pulau Perhentian and Pulau Redang) in Terengganu. The study showed that coral colonization on PVC material was slow, taking 10 years to achieve the desired size (Chou *et al,* 2009).

Lessons learned

In 2008, a review was carried out by members of the Coral Reef Working Group of the UNEP/ GEF Project "*Reversing Environmental Degradation in the South China Sea and Gulf of Thailand*" by expert individuals who have been involved with reef restoration programs. It documents the experiences of Malaysia, Indonesia, Philippines, Singapore, Thailand and Viet Nam in reef restoration within the coastal waters of the South China Sea (Chou *et al,* 2009).

A common observation is that prevention and mitigation of coral reef degradation are more effective tool / management options than restoration. Restoration cost can be substantial and impractical for large areas. In Thailand, it is recognized that local governments and communities should prevent coral reef damage in the first place as they are likely to lack resources to repair reefs, except for small-scale damage (Yeemin *et al*. 2006). The high cost currently limits Indonesia's initiatives to training, awareness raising and community participation, most of which are facilitated through the Coral Reef Rehabilitation and Management Program (COREMAP).

Coral transplantation in Malaysia is viewed as costly if a rigorous procedure is to be followed to ensure good survival. This has prompted a management response in Malaysia recognizing that the best option is to zone the damaged area to be rehabilitated and control its use to allow natural regeneration, which is considered to be the most cost effective, requires minimal intervention, and does not involve introduction of artificial structures (Chou *et al,* 2009). The Malaysian experience indicates that rehabilitation of coral at sites impacted by water quality change is not economical because of low survival rate. This view is shared by Thailand, stressing that site selection should consider the intensity of human induced physical changes and avoid areas that are too heavily impacted (Chou *et al,* 2009).

Natural coral fragments should be used in reef restoration projects to ensure good survival rate, as they are likely to be lost through high mortality. It is also useful for techniques and methods employed to be simple and making use of locally available low-cost materials.

Based on experiences in Malaysia, live coral is only suitable for transplanting to nearby area, of less than 100 metres away (if it is moved underwater). Coral colonisation on artificial structures installed at shallow depths of 3 to 5 metres is slow.

The long-term success of reef restoration projects should be further investigated and further research is useful for identifying appropriate strategies. For example, transplanted species should be selected for their tolerance of future environmental changes and sustainable exploitation. Basic data on coral biology (fragmentation, reproduction, settlement, recruitment and partial colony mortality) are urgently required for better selection of species and restoration techniques for a particular situation. Techniques for using natural planula larvae in reef restoration should be developed, e.g. using artificial substrates for coral settlement, coral cultivation and rearing planula for settlement in the field but cost may negate benefit until cheaper solutions are developed (Chou *et al,* 2009). Also, there is a need to consider bottom sand movement during monsoon seasons.

Community involvement is paramount to the success of reef restoration efforts and it has the added benefit of raising awareness (Chou *et al,* 2009).

Valuable lessons have been learnt based on several Southeast Asian countries' experiences and most agreed that information sharing coupled with regular synthesis of what works where, when and why, will help to improve reef restoration strategies and techniques throughout the region (Chou *et al,* 2009). For example, Malaysia has formulated guidelines for transplanting corals based on its experiences (Appendix 6-1).

It is also noteworthy that reef restoration has increased the awareness of coastal communities to reef management and offers ample opportunities for direct community participation and ownership (Chou *et al,* 2009).

Based on existing experience, it appears best if reef restoration to be attempted only after seriously considering the following:

1. Does site condition favour restoration?
2. Will restoration have a lasting effect?
3. Is there a management framework in place for the restoration site?
4. Has the adopted technique been tested on a pilot scale at site?
5. Is the technique scientifically sound and tested?
6. Will there be long-term monitoring?

Two recent international reef restoration projects targeted field research in the region to address many of the open questions in restoration science and to examine the scientific validity of different techniques in use. The World Bank/GEF Coral Reef Targeted Research and Capacity Building for Management Project, now in its second phase, has a component dealing with reef remediation and restoration focusing on long-term efficacy and cost- effectiveness of restoration interventions, larval recruitment and coral transplantation. Most of the research was conducted in Bolinao (Philippines). The recently concluded European Commission INCO-DEV project "*Developing ubiquitous restoration practices for Indo-Pacific coral reefs*" conducted field investigations in Bolinao, Phuket and Singapore. It had a strong focus on restoration using nubbins and small coral fragments. The results from both projects will help to strengthen the scientific understanding of reef restoration that will benefit all stakeholders and make reef restoration more effective (Chou *et al,* 2009).

Two other coral rehabilitation projects have been undertaken by Reef Check (RCM) with cooperation from research institutions and government agencies, both located in Pangkor Islands in 2009 and 2011. For further reading, please refer to Appendix 6-2 and 6-3.

Restocking Efforts

There are no re-stocking efforts / programs for fisheries in Sabah.

Emerging Issues for Marine Resource Management

Mariculture

Mariculture is a specialized branch of aquaculture involving the cultivation of marine organisms for food and other products in the open ocean, an enclosed section of the ocean, or in tanks, ponds or raceways which are filled with seawater. An example of the latter is the farming of marine fish, including finfish and shellfish e.g. prawns, or oysters and seaweed in saltwater ponds. Non-food products produced by mariculture include fish meal, nutrient agar, jewellery (e.g. cultured pearls), and cosmetics.

Environmental Effects

Mariculture has rapidly expanded over the last two decades due to new technology, improvements in formulated feeds, greater biological understanding of farmed species, increased water quality within closed farm systems, greater demand for seafood products, site expansion and government interest. As a consequence, mariculture has been subject to some controversy with regards to its social and environmental impacts. Commonly identified environmental impacts from marine farms are:

1. Wastes from cage cultures;
2. Farm escapees and invasives;
3. Genetic pollution and disease and parasite transfer;
4. Habitat modification.

As with most farming practices, the degree of environmental impact depends on the size of the farm, the cultured species, stock density, type of feed, hydrography of the site, and husbandry methods (Wu, R.S.S., 1995).

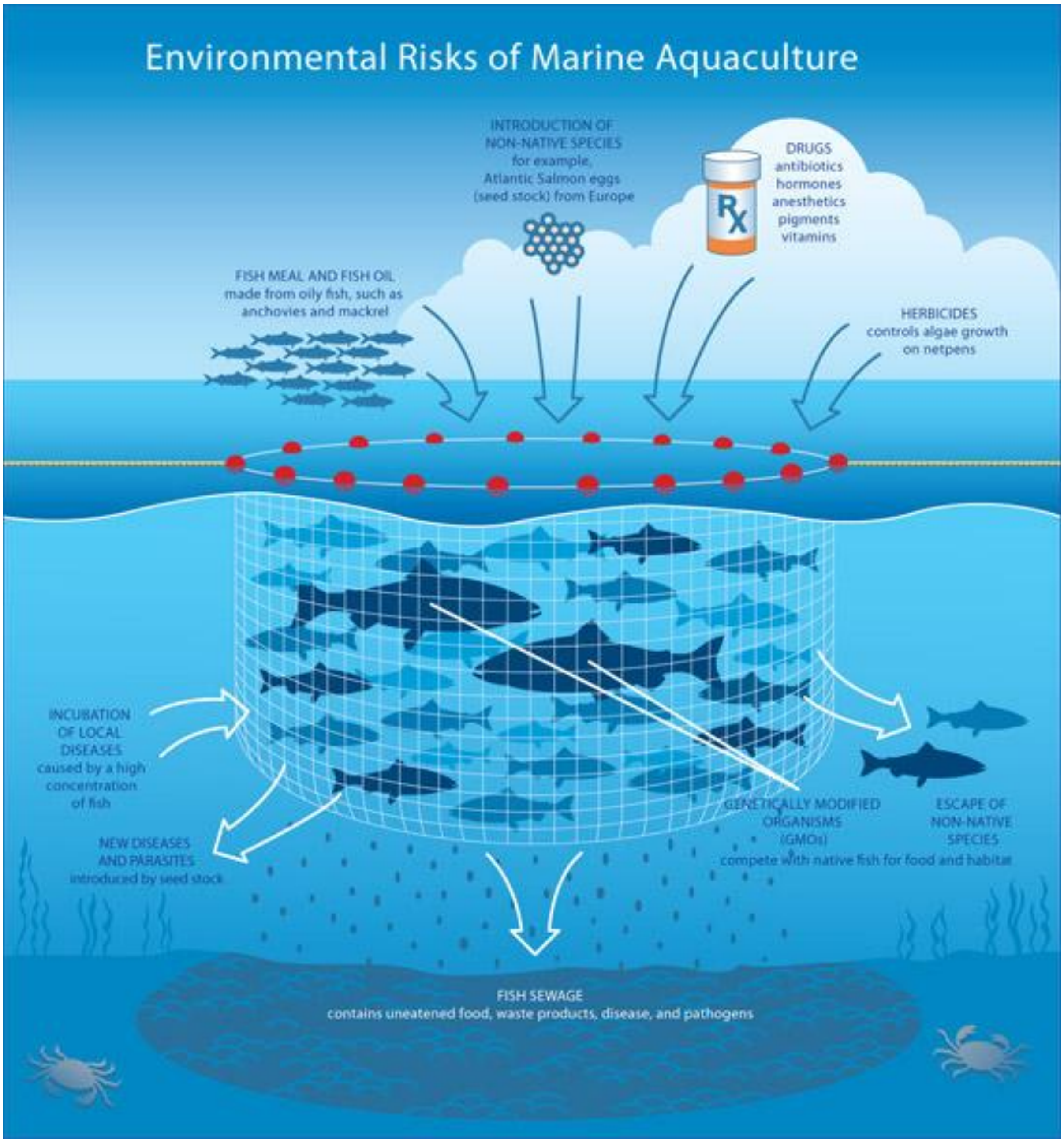
Wastes from cage cultures

Mariculture of finfish can require a significant amount of fishmeal or other high protein food sources (Jennings, S., 2001). Originally, a lot of fishmeal went to waste due to inefficient feeding regimes and poor digestibility of formulated feeds, which resulted in poor feed conversion ratios. In cage culture, several different methods are used for feeding farmed fish – from simple hand feeding to sophisticated computer-controlled systems with automated food dispensers coupled with in situ uptake sensors that detect consumption rates. In coastal fish farms, overfeeding primarily leads to increased disposition of detritus on the seafloor (potentially smothering seafloor dwelling invertebrates and altering the physical environment), while in hatcheries and land-based farms, excess food goes to waste and can potentially impact the surrounding catchment and local coastal environment. This impact is usually highly local, and depends significantly on the settling velocity of waste feed and the current velocity (which varies both spatially and temporally) and depth (Jennings, S., 2001).

Farm escapees and invasive species

The impact of escapees from aquaculture operations depends on whether or not there are wild close relatives in the receiving environment, and whether or not the escapee is reproductively capable (Black, K.D., 2001). Escapees can adversely impact local ecosystems through hybridization and loss of genetic diversity in native stocks, increase negative interactions within an ecosystem (such as predation and competition), disease transmission and habitat changes (from trophic cascades and ecosystem shifts to varying sediment regimes and thus turbidity).

FIGURE 5- 10: ENVIRONMENTAL RISKS OF MARINE AQUACULTURE



source: Carayannis, G.P., 2000

The accidental introduction of invasive species is also of concern. Aquaculture is one of the main vectors for invasive species following accidental releases of farmed stocks into the wild (Naylor, R.L. *et al*, 2001). Molluscan farming is another example whereby species can be introduced to new environments by 'hitchhiking' on farmed molluscs. Also, farmed molluscs themselves can become dominant predators and/or competitors, as well as potentially spread pathogens and parasites (Naylor, R.L. *et al*, 2001).

Genetic Pollution and Disease and Parasite Transfer

One of the primary concerns with mariculture is the potential for disease and parasite transfer (Jennings, S., 2001). Farmed stocks are often selectively bred to increase disease and parasite resistance, as well as improving growth rates and quality of products. As a consequence, the genetic diversity within reared stocks decreases with every generation. Such genetic pollution from escaped aquaculture stock can reduce the wild population's ability to adjust to the changing natural environment. Also, maricultured species can harbour diseases and parasites (e.g. lice), which can be introduced to wild populations upon their escape. Also, non-indigenous species, which are farmed, may have resistance to, or carry, particular diseases (which they picked up in their native habitats) which could be spread through wild populations if they escape into those wild populations. Such 'new' diseases would be devastating for those wild populations because they would have no immunity to them.

Habitat modification

With the exception of benthic habitats directly beneath marine farms, most mariculture causes minimal destruction to habitats. However, the destruction of mangrove forests from the farming of shrimps is of concern (Jennings, S., 2001). Globally, shrimp farming activity is a small contributor to the destruction of mangrove forests; however, it can be devastating locally.

Others

In addition, nitrogen and phosphorus compounds from food and waste may lead to blooms of phytoplankton, whose subsequent degradation can drastically reduce oxygen levels. If the algae are toxic, fish as killed and shellfish contaminated (UNEP, 2002).

Sustainability

The development of mariculture is dependent on the culmination of good science and research in major fields such as nutrition, genetics, system management, product handling and socio-economics. One approach is the use of closed systems that have no ties with the local environment. However, the investment and operational coast are currently higher than open cages system, thus limiting its use as hatcheries.

Potential Benefits

Sustainable mariculture promises economic and environmental benefits. Economies of scale imply that ranching can produce fish at lower cost than industrial fishing, leading to better human diets and the gradual elimination of unsustainable fisheries. Maricultured fish are also perceived to be of higher quality than fish raised in ponds or tanks, and offer more diverse choice of species. Consistent supply and quality control has enabled integration in food market channels.

Mariculture in Sabah

Development of mariculture in Sabah is still in its initial phase (Komilus *et al*, 1999) which consists of culture of tiger prawns in brackishwater ponds, fish culture in cages, fish culture in brackish water ponds, seaweed culture and mollusc culture (in order of importance).

Seaweed farming was a priority with the Sabah Department of Fisheries (DOFM Sabah) with the aim to provide alternative income-generating activity / business among the fishing community. This effort was initiated with the establishment of a demonstration farm within the Semporna Island Project area in 1980 (SIP). Since then, many fishing folk (especially the Bajau) have switched from fishing to seaweed cultivation as their main income activity (Komilus *et al*, 1999). However, DOFM Sabah recognised a number of constraints and problems that needs to be addressed. DOFM Sabah stressed the importance of guidelines (e.g. infrastructure provisions, marketing, local processing plants set-up) and regulations (Komilus *et al*, 1999). Additionally, it is important for the farmers to diversity and venture into other forms of mariculture such as live fish cage culture, and giant clams. Seaweed production has increased to 11,130 metric tonne compared to 9,027 metric tonne (2007). The 23.2% increase contributes to the increase in the wholesale value to RM44.5million in comparison to RM22.6mill in 2007. This is due to an encouraging increase in the market price (DOFM Sabah, 2008). Please refer to Table 5-14 and 5-15 for seaweed production figures and production by districts. Semporna contributes to the highest production of seaweed at 95% of total seaweed production in Sabah.

The production of brackishwater production has increased by 14.7% from 2007 figures (Please refer to Table 5-12). However, the wholesale value has decreased despite the increase in quantity from RM162million (2007) to RM135million (DOFM Sabah, 2008). Conversely, production of tiger prawns reduced dramatically from 1,225 to 769 with wholesale value down to

RM18mill from RM29mill (2007) due to decrease in demand and prices (Table 5-14). However, production of whiteleg shrimp has increased more than double with wholesale value of RM62mill from previous year's value of RM31mill (2007) (Table 5-15).

The demands for live fish in Sabah and for exports have increased dramatically over the last few decades. Prices have gone up and buyers are willing to pay for it. In 2008, export value of the live fish category amounted to 52.12million in comparison to import value of RM4million (Table 5-18).

TABLE 5- 12: ESTIMATED PRODUCTION OF BRACKISHWATER CULTURE (1997-2008)

Tahun *Year*	**Pengeluaran** *Production* **Tan Metrik** *Metric Tonnes*	**Nilai Borong** *Wholesale value* **[RM'000]**
1997	3,229.00	67,488.40
1998	3,025.29	84,254.39
1999	2,445.43	105,365.28
2000	2,926.97	65,965.35
2001	6,422.53	71,572.13
2002	3,492.65	176,063.24
2003	3,372.66	95,297.80
2004	3,240.74	93,446.31
2005	3,000.84	83,418.17
2006	4,373.93	56,177.89
2007	6,813.76	161,491.32
2008	**7,821.98**	**135,307.16**

source: Department of Fisheries, Sabah (2008)

TABLE 5- 13: ESTIMATED AQUACULTURE PRODUCTION FROM BRACKISHWATER SYSTEM BY DISTRICT, 2008)

DAERAH *District*	TERNAKAN AIR PAYAU/*Brackishwater Fish Culture*									JUMLAH *Total*
	KOLAM/*Ponds*		SANGKAR	SIPUT SUDU	TIRAM	KANDANG IKAN	KETAM LEMBUT	ABALON	BALAT	
	IKAN *Fish*	UDANG *Prawn*	IKAN *Cages*	*Mussels*	*Oyster*	*Pen Culture*	*Mud Crab*	*Abalone*	*Sea Cucumber*	
Sandakan	2.35	-	83.95	-	-	5.69	-	-	-	**91.99**
Tawau	71.06	4,171.05	6.70	25.00	14.30	-	-	-	-	**4,288.11**
Beluran	1.23	-	-	-	-	-	-	-	-	**1.23**
Semporna	-	306.15	-	-	-	55.58	-	-	-	**361.73**
Lahad Datu	-	13.46	105.30	-	-	-	-	-	-	**118.76**
Kunak	11.60	37.76	0.10	-	-	5.00	-	-	-	**54.46**
Kota Belud	0.64	431.31	2.66	-	16.50	-	-	-	-	**451.11**
Pitas	0.48	-	-	-	-	-	-	-	0.83	**1.31**
Kota Marudu	-	-	0.57	198.00	10.00	-	-	-	-	**208.57**
Kudat	0.05	77.15	64.98	2.00	0.25	-	-	0.30	-	**144.73**
Matunggong	-	88.08	-	-	-	-	-	-	-	**88.08**
Papar	-	87.90	-	-	-	-	5.10	-	-	**93.00**
Kuala Penyu	-	344.15	447.06	-	-	-	-	-	-	**791.21**
Beaufort	160.03	399.63	0.08	-	-	-	-	-	-	**559.74**
Tuaran	-	12.87	14.34	162.00	180.00	-	16.90	-	-	**386.11**
Kota Kinabalu	-	-	-	-	-	-	-	-	-	**-**
Banggi	-	-	-	-	-	23.36	-	-	2.87	**26.23**
JUMLAH PENGELUARAN *Total Production*	**247.44**	**5,969.51**	**881.35**	**387.00**	**221.05**	**89.63**	**22.00**	**0.30**	**3.70**	**7,821.98**
NILAI BORONG (RM'000) *Wholesale Value (RM'000)*	**3,164.64**	**80,860.08**	**41,238.54**	**1,741.50**	**1,105.25**	**6,401.15**	**616.00**	**13.50**	**166.50**	**135,307.16**

Nota : Pelbagai - Termasuk Ikan Tanda, Dengkis, Upak/Cermin dan Talang.
Note: Others - Includes Snaper, Rabbitfish, Horse Mackeral and Queenfish.

source: Department of Fisheries, Sabah (2008)

TABLE 5- 14: ESTIMATED BRACKISHWATER PRAWN PRODUCTION - TIGER PRAWN (PENAEUS MONODON), 1997-2008

Tahun *Year*	**Pengeluaran** *Production* **Tan Metrik** *Metric Tonnes*	**Nilai Borong** *Wholesale value* **[RM'000]**
1997	2,900	72500
1998	2,717	94,579
1999	1,843	53,364
2000	2,064	60,099
2001	5,441	163,216
2002	2,889	92,446
2003	2,865	86,639
2004	2,241	73,768
2005	1,599	39,996
2006	1,630	32,617
2007	1,225	29,392
2008	**769**	**18,452**

TABLE 5- 15: ESTIMATED BRACKISHWATER PRAWN (PENAEUS VANNAMEI)

Tahun *Year*	**Pengeluaran** *Production* **Tan Metrik** *Metric Tonnes*	**Nilai Borong** *Wholesale value* **[RM'000]**
2005	3.66	43.92
2006	740	8,880
2007	2,628.28	31,539.36
2008	**5,200.68**	**62,408.16**

source: Department of Fisheries, Sabah (2008)

TABLE 5- 16: ESTIMATED PRODUCTION OF SEAWEED, SABAH (1997-2008)

Tahun *Year*	**Pengeluaran** *Production* **Tan Metrik** *Metric Tonnes*	**Nilai Borong** *Wholesale value* **[RM'000]**
1997	1,825.89	1,861.89
1998	1,785.00	3,570.00
1999	3,008.38	6,616.11
2000	4,031.20	6,853.04
2001	4,715.71	7,545.14
2002	2,562.49	4,356.23
2003	2,760.80	5,384.56
2004	3,095.69	5,572.24
2005	3,142.62	5,342.45
2006	4,320.00	6,912.00
2007	9,026.85	22,567.13
2008	**11,129.83**	**44,519.32**

source: Department of Fisheries, Sabah (2008)

TABLE 5- 17: ESTIMATED PRODUCTION OF SEAWEED BY DISTRICTS, SABAH, 2008

DAERAH *Districts* / **BULAN** *Month*	**SEMPORNA**	**LAHAD DATU**	**KUNAK**	**BANGGI**	**JUMLAH** *Total*
Januari	768.90	30.00	-	3.73	**802.63**
Februari	832.80	40.00	-	3.98	**876.78**
March	938.70	40.00	-	3.21	**981.91**
April	843.50	40.00	-	2.68	**886.18**
Mei	952.60	30.00	-	5.05	**987.65**
Jun	904.70	40.00	4.40	5.62	**954.72**
Julai	-	45.00	-	1.02	**46.02**
Ogos	1,024.50	35.00	3.15	3.36	**1,066.01**
September	1,063.00	45.00	5.14	5.11	**1,118.25**
Oktober	1,073.40	43.00	6.08	1.05	**1,123.53**
November	1,093.00	48.00	8.10	0.94	**1,150.04**
Disember	1,079.30	50.20	5.57	1.04	**1,136.11**
JUMLAH PENGELUARAN *Total Production*	**10,574.40**	**486.20**	**32.44**	**36.79**	**11,129.83**
NILAI BORONG (RM'000) *Wholesale Value (RM'000)*					**44,519.32**

source: Department of Fisheries, Sabah (2008)

TABLE 5- 18: IMPORT AND EXPORT OF FISHERY COMMODITIES, 2008 (LIVE FISH)

S.I.T.C Kod Komoditi *(Commodities Code)*	**KETERANGAN KOMODITI** *(Description Of Commodities)*	**IMPORT/Imports**		**EKSPORT/Exports**	
		Kuantiti *(Quantity)*	**Nilai** *(Value)*	**Kuantiti** *(Quantity)*	**Nilai** *(Value)*
	LIVE FISH				
034 110 010	Other live ornamental fish, marine.	0.23	8,953	18.60	155,000
034 110 011	Other Carp, alive.	0.70	44,306	0.00	0
034 110 030	Other live ornamental fish, freshwater fish.	56.26	1,559,939	0.30	4,000
034 110 050	Trout, alive.	0.22	7,700	0.00	0
034 110 070	Eels *(Anguilla spp.)* , alive	0.00	0	0.00	0
034 110 090	Carp breeder, alive.	0.01	2,091	0.00	0
034 110 130	Milkfish or Lapu Lapu fry for breeding.	1.51	80,901	0.00	0
034 110 150	Milkfish or Lapu Lapu fry o/t for breeding.	0.00	0	9.17	537,144
034 110 170	Other fish fry, for breeding, alive.	34.51	823,853	0.00	0
034 110 190	Other fish fry, o/t for breeding, alive.	2.21	230,404	0.26	17,680
034 110 210	Other marine fish, alive.	2.31	71,574	41.63	1,825,965
034 110 230	Other freshwater fish, alive.	13.91	11,693	0.00	0
034 111 100	Ornamental Fish Fry, alive.	149.27	572,262	4.42	14,734
034 111 900	Other ornamental fish, o/t fry, alive	0.71	63,181	26.83	678,963
034 112 100	Trout fry, alive	0.00	0	6.19	484,610
034 112 900	Trout, o/t fry, alive	5.00	12,407	0.12	9,600
034 113 900	Eels, *(Anguilla spp.)* o/t fry alive.	4.06	6,836	0.00	0
034 114 100	Carp fry, alive	0.09	34,231	0.00	0
034 114 900	Carp, o/t fry, alive.	5.95	274,939	0.00	0
034 119 000	Other live fish, o/t trout, Eels or Carp.	0.81	30,061	668.72	43,159,026
034 119 110	Marine fish fry, alive	0.00	0	0.00	0
034 119 190	Other marine fish, alive	0.00	0	0.00	0
034 119 210	Freshwater fish, fry, alive	0.00	0	0.00	0
034 119 290	Other freshwater fish, alive o/t fry.	0.00	0	0.00	0
034 119 310	Fish live, other marine fish, milk fish, breeder.	0.05	5,861	0.00	0
034 119 390	Fish live, other than marine fish, milk fish, other than for breeding.	5.11	154,364	120.18	5,234,367
	JUMLAH/Total	**282.91**	**3,995,556**	**896.43**	**52,121,089**

source: Department of Fisheries, Sabah (2008)

Harmful Algal Blooms

Harmful algal bloom (HAB) occurrences are a serious situation and are on the rise all over the world (Anderson 1989, Lam and Ho 1989; Maclean 1989 and Shumway 1995). An estimated 2000 cases of human poisoning were recorded annually (Hallegraeff 1993). Threats of HABs include human fatalities, economic losses to both to the natural fisheries and also cultured species (Corrales and Maclean 1995; Okaichi 1991; Shumway 1990; Smayda 1991 and Choo 1996).

With this threat in mind, trade in seafood, especially shellfish, has been subjected to stringent controls by importing countries. Limits and regulations on marine phycotoxins exist in at least 21 countries (Van Egmond and Van Den Top 1991). The European Union, for example, requires exporting countries strictly adhere to regulations on toxin residues in seafood and requires plankton sampling in shellfish culture areas to be conducted.

Countries importing Malaysian shellfish, especially molluscs, require certification to declare that the seafood not contain HAB toxins above the level stipulated in their regulations.

Status of Harmful Algal Blooms in Malaysia

Sabah

Sabah experiences the most incidences of HAB blooms, especially in the west coast of Sabah (mainly in Sipatang, Kuala Penyu, Binsuluk and Kota Kinabalu). HAB that causes red discolouration of the coastal waters in Sepanggar Bay, Kota Kinabalu were first observed in January 2005. The species responsible for the bloom was *cochlodinium polykrikoidas*, and is responsible for the high mortality rate of fishes in cage cultures.

The causative organism is of the *Pyrodinium bahamense* vars. *compressum*. Molluscs affected by HAB blooms include *Meretrix* sp., *Perna viridis, Gafrarium* sp., *Donax* sp., *Tridacna* sp., *Anadara granosa*, *Crassostrea* sp., *Atrina* sp. *Spondylus* sp. and *Olivia* sp. Apart from molluscs, planktivorous fish, such as *Sardinella* (sardines, local name selayang/curut) and *Decapterus* sp. (round scad, local name tamban) have been reported to accumulate HAB toxins in the gut and the gills. According to the Annual Fisheries Statistics (Anon. 2001), Sabah has a relatively important sardine fishery; in 1999, 16,145 tonnes of sardines and 14,973 tonnes of round scads were caught in the coastal waters. At an average ex-vessel price of RM1.81/kg, the sardine fishery in 1999 was worth RM29, 222,450, and the round scads fishery at an average ex-vessel price of RM1.51/kg was worth RM22, 609,230.

Harmful algal bloom in Sabah coastal waters usually occurs after a short period of dry season followed by heavy rain and strong winds (Wang et al, 2008). Sepanggar Bay receives nutrients from aquaculture and anthropogenic activities. Located near port facilities and a naval base, the area is exposed to the risk of ballast water transport marine organisms.

Sarawak

No HAB incidences have been reported in Sarawak. A study carried out in Kuching Bay and Brunei Bay does not present any *Pyrodinium* (Pang and Yong, 1995). Mouse bioassay conducted for PSP toxins on several species of molluscs show negative results.

Peninsular Malaysia

In Peninsular Malaysia, HAB blooms remain sporadic. Since the first report of a paralytic shellfish poisoning (PSP) incidence in Melaka in November 1993, there has been no recurrence of another outbreak in this locality. The culture of mussel in Melaka has since picked up, after the setback experienced in 1993. In 1999, Melaka produced 329.29 tonnes of mussels (Anon. 2001) versus the 1993 production of 58.1 tonnes (Anon. 1994). In September 2001, the first PSP incidence was reported in the east coast of Peninsular Malaysia, in Tumpat, Kelantan. The causative organism was *Alexandrium minutum* with another species, *Alexandrium* sp. yet to be identified (Lim et al. 2001). One fatality and one hospitalized case were reported after a meal of the clam, *Polymesoda* sp. locally known as the lokan, which was collected from the wild.

Climate Change Impacts and Adaptation Measures in Malaysia

The Intergovernmental Panel for Climate Change (IPCC) 2007 report on the "Science of Climate Change" has noted small increases in temperature and rainfall throughout the Southeast Asia Region in the last decade.

Outputs generated by the Atmosphere-Ocean General Circulation Models (AOGCMs), in the Scientific Report analysed by the Malaysian Meteorological Department (MMD), indicates that all the models projected an increase in temperature but the degree of increase varies from model to model.

Observed Climate Change

Temperature increase for Peninsular Malaysia is estimated between 1.1°C and 3.2°C, for Sabah and Sarawak between 1.0°C and 3.8°C. As for the change in rainfall, there is no clear trend shown by all of the selected models due to the high variability in the precipitation-modulating factor. Based on the MMD's surface observation stations data, annual rainfall change (percentage) for the periods 2000 - 2007 relative to the period 1990 – 1999, indicated that the west coast of Peninsular Malaysia has recorded an increase of 6 - 10 % in rainfall amount, whereas a decrease of 4 – 6 of rainfall amount over central Pahang and coastal Kelantan. As for East Malaysia, Sarawak recorded an increase of 6 – 10 % in rainfall amount whilst Sabah registered an increase of more than 10% (MMD, 2009).

Data on sea level rise collected over a 20 year period (1986-2006) from an area at the southern tip of the Peninsula, (Tanjung Piai in Johor), indicated an increase at the rate of 1.3 mm/year (NC2, 2011).

The Malaysian Meteorological Department expects more extreme hydrological conditions to occur (UNEP, 2010). Please refer to Table 5-19 for summary of observed climate change.

Projected Climate Change

The lack of downscaled climate projections was one of the main constraints to spatial details in quantitative vulnerability and adaptation assessments (NC2, 2011). A significant achievement since the Initial National Communication (INC) in 2000, was the development of a dynamic downscaled (9km resolution) model, the *'Regional Hydro-Climate Model for Peninsular Malaysia (RegHCMPM)'* to generate climate and hydrological projections. A similar model for Sabah and Sarawak has been developed and is due to be completed by the end of 2010.

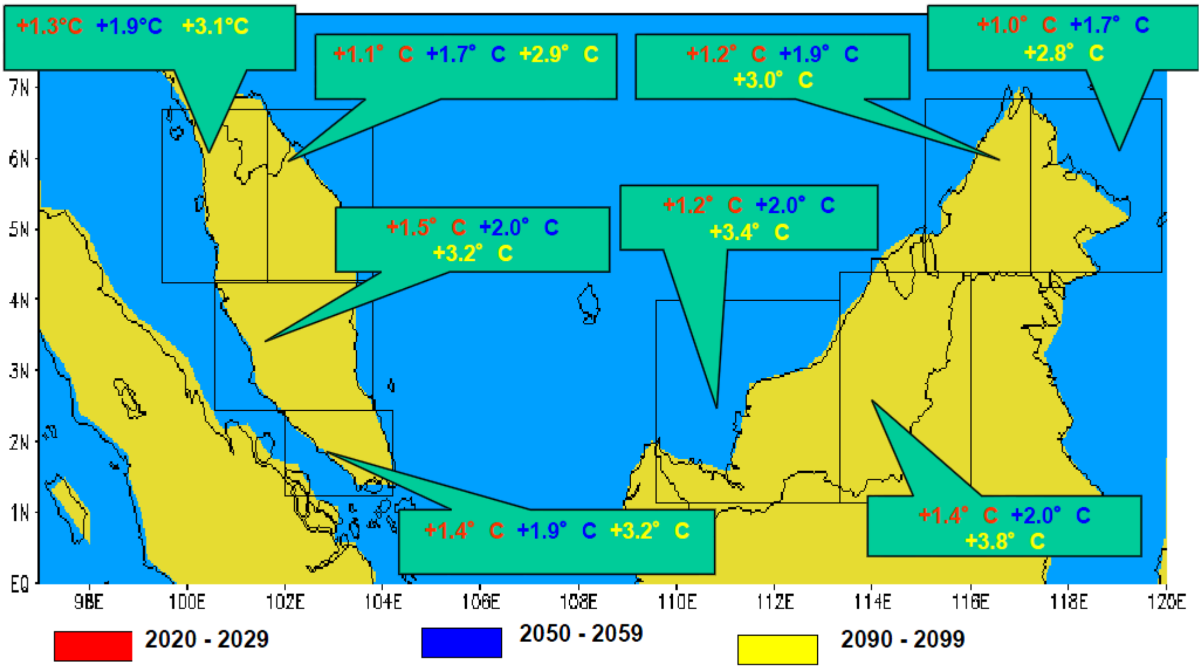
Another projection model, 'Providing Regional Climates for Impacts Studies (PRECIS)', developed by the Hadley Centre for Climate Prediction and Research, UK Meteorological Office (Hadley Centre) has also been used for climate projections. However while it can be downscaled to 25 km resolution, due to computing resource limitations, it was only downscaled to 50 km resolution (NC2, 2011).

Based on both of these models, surface temperature is projected to rise while rainfall and river flows are projected to experience greater fluctuation. This trend appears to continue beyond 2050.

The RegHCM-PM model was used to produce hydroclimate projections up to the year 2050 whilst the PRECIS model was used to produce climate change scenarios up to 2099. Based on both of these models, surface temperature is projected to rise while rainfall and river flows are projected to experience greater fluctuation. This trend appears to continue beyond 2050.

The projections based on the medium range emission scenario indicate a 1.5°C to 2.0°C increase in surface air temperature by 2050.

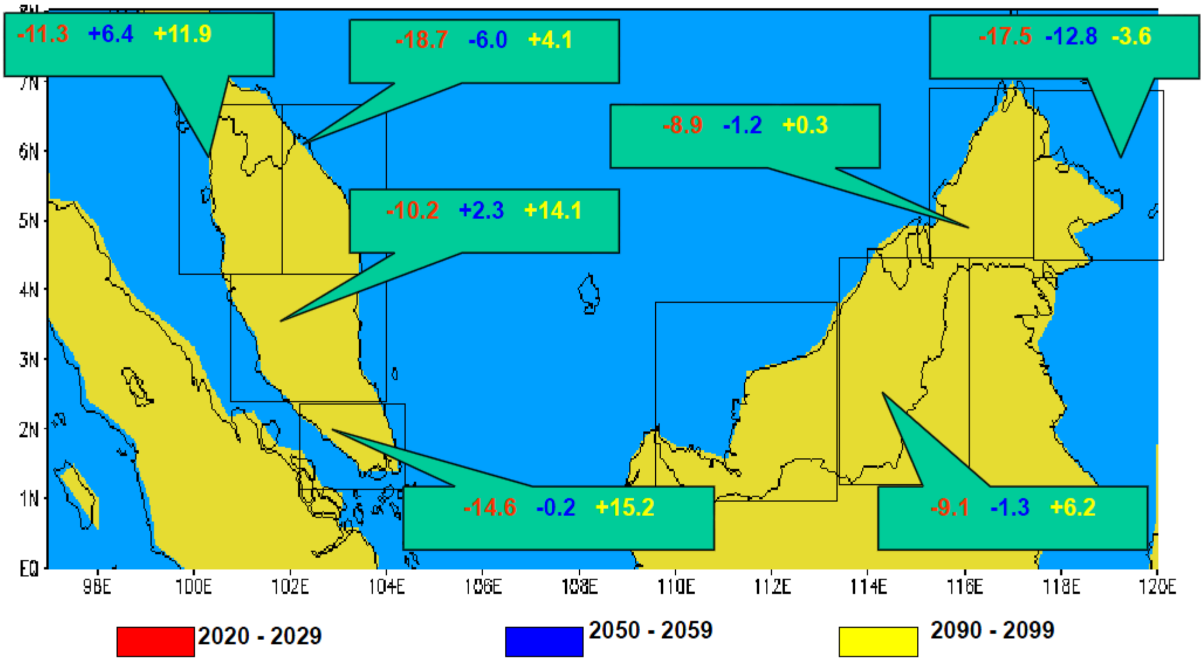
FIGURE 5-11: ANNUAL MEAN TEMPERATURE ANOMALY



RELATIVE TO 1990 - 1999

source: Kok Seng, Y., et al

FIGURE 5-12: ANNUAL MEAN RAINFALL ANOMALY (%)



RELATIVE TO 1990 – 1999

source: Kok Seng, Y., et al

There appears to be no significant change in the annual wet and dry cycles but there could be extremes within and between these cycles in terms of maximum and minimum rainfalls. The frequency of extreme weather is also projected to increase.

Based on the RegHCM-PM projections, some indicative changes in rainfall patterns projected for Peninsular Malaysia by 2050 are as follows (NC2, 2011):

- The northeast region shows the greatest projected increase in average annual rainfall at 9 percent.
- The central region shows the greatest projected reduction in average annual rainfall at 5 percent.
- The northeast region is projected to experience the greatest increase in maximum monthly rainfall, an increase of 50 percent.
- For Sabah and Sarawak, regional rainfall projection has been obtained using the PRECIS regional climate model only.

The baseline period considered is from 1961-1990. The changes in projected rainfall by 2050 are as follows (NC2, 2011):

- The eastern part of Sabah shows the only projected reduction in average annual rainfall at around -6 percent.
- The western part of Sabah shows projected increase in average annual rainfall at around 2 percent.
- The eastern part of Sarawak shows projected increase in average annual average annual rainfall at around 5 percent.
- The average annual rainfall in the western part of Sarawak is projected to increase by about 11 percent.

These projected increases in rainfall could lead to river flow increases of between 11 percent and 47 percent for Peninsular Malaysia with low flow reductions ranging from 31 percent to 93 percent for the central and southern regions. A study has been initiated to project sea-level rise in Malaysia based on global sea level rise projections rainfall at around 5 percent.

Given the changes, there are four (4) areas of concern in the event of climate change (UNEP, 2011):

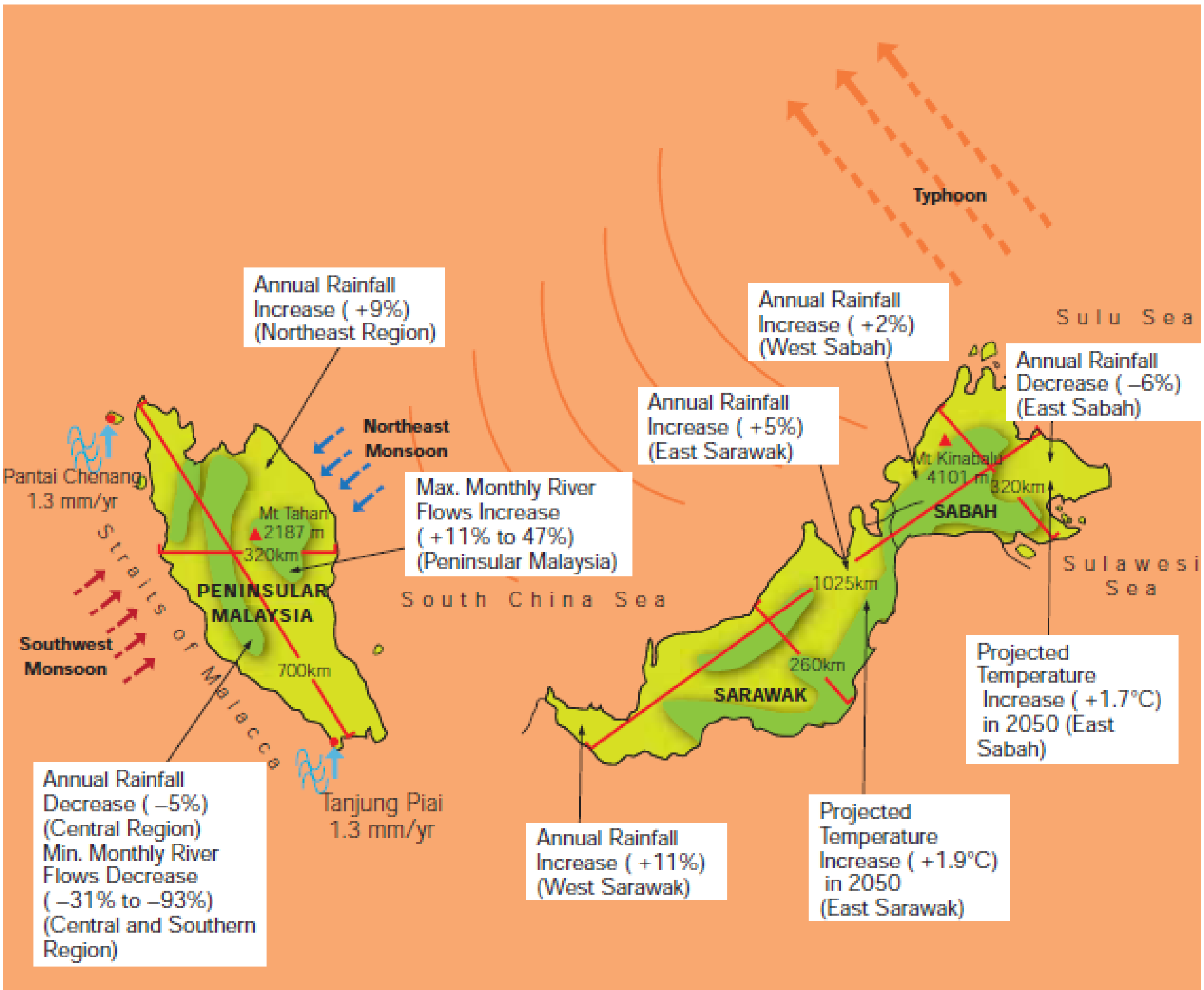
- Climate-induced degradation of forest, marine and freshwater resources;
- Climate-induced increases in certain hydro-meteorological and geo-morphological events;
- Climate-induced decline in food production capacities and other environmentally driven economic systems; and
- Climate change ethics – justice issues such as environmentally induced displacements and migrations, the deprivation and sustenance of certain livelihood activities, and the safety and well-being of the more marginalised sectors of society.

TABLE 5- 19: SUMMARY OF OBSERVED CLIMATE CHANGE IN MALAYSIA

OBSERVED INCREASE IN MINIMUM, MEAN & MAXIMUM SURFACE TEMPERATURE TREND FOR MALAYSIA
LARGER INCREASE IN MINIMUM SURFACE TEMPERATURE COMPARED TO MEAN & MAXIMUM SURFACE TEMPERATURE. HIGHEST INCREASE OF MINIMUM TEMPERATURE AT A RATE OF 2.0°C/50-YR FOR SABAH, 1.5°C/50-YR FOR PEN. MALAYSIA AND 1.1°C/50-YR FOR SARAWAK
OVERALL, NO EVIDENT OF INCREASE OR DECREASE HAS BEEN OBSERVED FOR RAINFALL IN MALAYSIA, BUT: INCREASE NUMBER OF DAYS OF EXTREME RAINFALL EVENTS INCREASE NUMBER OF DAYS OF EXTREME WIND EVENTS INCREASE IN NUMBER OF THUNDERSTORM DAYS

source: Kok Seng, Y., et al

FIGURE 5- 13: CLIMATIC PATTERNS AND PROJECTED CHANGES



Area

Peninsular Malaysia	131,590 km^2
Sabah	73,711 km^2
Sarawak	124,449 km^2
Total Malaysia	329,750 km^2

Coastline length

Peninsular Malaysia	2031 km
Sabah	1743 km
Sarawak	1035 km
Total Malaysia	4809 km

Source: 2NC, 2010

TABLE 5- 20: OBSERVED AND PROJECTED CLIMATE CHANGE

	Observed	Projected (by 2050)
Temperature	0.6-1.2 °C per 50 years (1969-2009)	• 1.5-2 °C increase
Rainfall (amount)	no appreciable difference	• (-) 5% to (+) 9% change in regions within PM • (-) 6% to (+) 11% change in regions within Sabah and Sarawak
Rainfall Intensity	Increased by 17% for 1 hour duration and 29% for 3 hour duration (2000-2007 compared to1971-1980)	• Increase in extremes within wet cycles • Increase in frequency of extreme weather
Sea Level Rise (SLR)	1.3 mm/yr (1986-2006, Tanjung Piai, Johor)	• 0.5m rise (Global high worst case at 10mm/yr)

Source: 2NC, 2011

Climate Change Vulnerabilities

Mangrove Forest

In all areas, increased rainfall result in waterlogged soils and soil nutrient leaching that could lead to tree mortality. Mangrove forests along the low-lying coastlines are vulnerable to sea level rise. This vulnerability is anticipated to be exacerbated by the projected temperature rise and changes in rainfall patterns.

Sea Level Rise

Sea level rise is expected to cause the following:

- Inundation of coastal areas resulting in socio-economic loss or changes
- Saline intrusion that will affect agriculture
- Changes in salinity of coastal waters that will impact upon marine and aquatic life as well as aquaculture

The National Coastal Vulnerability Index (NCVI) Study which was completed in 2007 assessed the vulnerability of coastal areas to sea level rise based on physical, biological and socio-economic parameters.
The study was conducted at two pilot sites i) Tanjung Piai to Sungai Pulai, Johor and ii) West Coast, Langkawi. These sites were chosen based on its various land-uses.

Tanjung Piai is located at the southern-most tip of the Asia continent with a multitude land use which includes agriculture, port and maritime activities. A portion of the coast has also been gazetted as a Ramsar site. Tanjung Piai's mud coast is fringed by mangroves and, being on the southern-most point, fronting both the Straits of Melaka and the Straits of Johor. A large stretch of agricultural land along this coastal belt is protected by bunds (embankments) with drainage outlets regulated by tidal control gates.

Pantai Cenang, in Langkawi is a sandy coast with mixed development that includes rural housing, tourist facilities (hotels and restaurants) and an airport that is protected by breakwaters. Sea level rise recorded in both these areas over 20 years was in the region of 1.3 mm/year. Global data indicated an average increase of 2 mm/year over the last century.

As the NCVI study results are superimposed on the global-high (worst case) projection for SLR of 10mm/year (1 meter by the end of the century), an estimated 1,820 ha of coastal land at Tanjung Piai and 148ha at Pantai Cenang, Langkawi will be inundated. The affected areas include mudflats, mangroves and riverbanks. Furthermore, coastal roads and bunds are expected to be damaged by erosion.

Increase in intensity, duration and frequency of storms

Changing climate patterns are expected to increase the intensity; duration and frequency of storms thus increase risks of erosion especially near coastal settlements and increased sedimentation at jetties and river mouths.

Sea Surface Temperature Increase

Increase in sea surface temperature (SST) is one of the main stressors for aquatic life such as coral reefs; mostly thrive at optimum temperatures of 25°C to 29°C. Higher than normal water temperatures may set off corals to expel zooxanthellae [4] living within their

[4] Zooxanthellae directly or indirectly experience the stress their containing corals undergo. Exposure to air during low tides and damage from solar radiation in shallow water environments are two of the ecological stressors coral and zooxanthellae face. Temperature changes now provide the most stress to the zooxanthellae-coral relationship. A one to two Celsius degree temperature rise for five to 10 weeks and a three to five degree

polyps and cause coral bleaching. Additionally, sea-surface temperature will affect the physiology of aquatic life which in turn has a direct impact on biodiversity and productivity. More studies however are required to fully understand changes in local sea surface temperature and aquatic vulnerabilities (NC2, 2011).

Prolonged coral bleaching events may harm coastal economies such as tourism and fishery industries.

Climate Change Adaptation Measures

Malaysia has been fully engaged with the climate change community – committing itself to steep Green House Gas (GHG) reductions, although, it has been less active and has been more 'reactive' than 'proactive' in climate change adaptation needs. Only in recent times, in Malaysia's Second National Communication (NC2) to the United Nations Framework Convention on Climate Change (UNFCC) that serious consideration have been given on adaptation needs – beyond flood control and disaster risk reductions in major population centers within the country.

In support of this, a Regional Climate Change Adaptation Knowledge Platform for Asia, also known as the Adaptation Knowledge Platform (AKP) was formed[5]. A scoping study was conducted (report published in October 2011) with Malaysian stakeholders to plan focal actions in response to Malaysia's climate change adaptation needs.

Studies presented in the NC2 indicated to a moderate increase in average temperature, from 1°c to 2°c, which would be good to some sectors of agriculture production, but for most, would be detrimental; e.g. rice production would drop in the range of 4.6% to 6.1% (at +1°c change); and 9.6% to 10% (at +2°c change) (Siwar, et al, 2009). In consideration of Malaysia's natural resources, it is highly likely that climate variation will exceed environmental thresholds where habitats and ecosystems unable to recover, and worse, cause significant losses in biodiversity.

There are several proposed adaptation needs that have been put forward in the scoping study. These are based on themes; i.e. Drought; Flood and erosion; Agriculture production losses; Health losses; Forest and Biodiversity losses; and Coastal and marine habitat losses.

In brief, the following are proposed adaptation needs for coastal and marine habitats.

TABLE 5- 21: PROPOSED ADAPTATION NEEDS FOR COASTAL AND MARINE HABITATS IN MALAYSIA

Retreat Approach	Abandonment of land and structures in vulnerable areas and resettlement of inhabitants; the prevention of development near coastal areas through the imposition of more stringent setback limits, land acquisition, land use restriction and prohibition of reconstruction in areas damaged by storms; and taking measures to enable wetlands to migrate inlands (assisted flora migration).
Accommodation Approach	Continued occupancy and use of vulnerable areas. This constitutes a compromise between retreat and protection. This would entail modification of drainage systems, specifications of minimum floor elevation and piling depth as well structural bracing for building code; allowing changes in land use such as conversion of agricultural land to aquaculture uses; prohibiting filling of wetlands, damming of rivers, and mining of coral and beach sands; and allowing natural resources, such as mangroves and coral reefs to be left to their natural processes to cope with sea level rise.
Protection Approach	Defence of vulnerable areas, especially population centres, economic activities and natural resources. These include engineering responses that involve defensive measures to protect areas against inundation, tidal flooding, and effects of waves on infrastructures, soil erosion and loss of natural resources such as mangroves. Consequently, hard measures such as seawalls and groynes and soft measures such as beach nourishment and wetlands / mangroves creation are possible adaptation measures.

Source: NC2, 2011

Much of Malaysia's adaptation responses are in the form of improved ecosystem management,

decline for five to 10 days have produced coral bleaching events.
Source: http://en.wikipedia.org/wiki/Zooxanthella

[5] The AKP was formed to respond to the demands for effective mechanisms for sharing information on climate change adaptation, and for developing adaptive capacities in Asian countries.

water resource management, and secured agricultural production. Little attention has been given to autonomous climate change adaptation in practice; rather focus is placed on assessments and planned strategies to achieve productivity in resource use and optimisation of economic benefits (UNEP, 2011).

Regional Adaptation Measures

Within the context of 'Environmental Sustainability', and on the regional front, climate change adaptation needs within the marine environment through Malaysian participation in the Coral Triangle Initiative (CTI) has been mentioned in the 2nd National Communication to the UNFCCC Report. A CTI Region-wide Early Action Plan for Climate Change Adaptation (REAP-CCA) has been completed. Some of the key areas of cooperation amongst country members are:

- Climate Change Assessment;
- Improving Livelihoods and Food Security;
- Infrastructure protection and coastal & marine ecosystems;
- Governance and management opportunities; and
- Preparation for disasters.

National Adaptation Measures

On the home front, efforts have also been taken to ensure sustainable development and management of coastal areas especially to cope with impacts of climate variability and change including sea level rise. The implementation of the Integrated Shoreline Management Plan (ISMP) for Malaysia by local authorities have started in selected coastal areas in the states of Pahang, Melaka, Negeri Sembilan, Pulau Pinang, Labuan and Miri (Sarawak). Two other ongoing ISMP related projects are in Sabah and Johor.

Climate change adaptation in the coastal zone also means attaining an in-depth understanding of storm patterns, intensity, duration and frequency. This includes (UNEP, 2011):

- Research on storm surges to help establish quantitatively the trends of storm surges and wave patterns therefore facilitating the understanding of long-term coastal evolution; and
- Research on coastal reforestation to develop optimal planting methods and the creation of robust coastal forests that can strengthen the stability of coastlines and contribute to biodiversity enhancement.

Several other related programs include the '*Conserving Marine Biodiversity through Enhanced Marine Park Management and Inclusive Sustainable island Development'* study by Marine Park Department while the '*Integrated River Basin Management in Peninsular Malaysia'* are underway.

Table 5-22 below lists the various action plans in the National Plan of Action (NPOA) for the Coral Triangle Initiative that are on-going and have been completed in relation to the climate change adaptation goal.

TABLE 5- 22: CTI-NPOA LISTS OF ACTION PLANS UNDER CLIMATE CHANGE ADAPTATION GOAL

Actions	Lead Actor	NPOA Target Date
Complete ISMP implementation for Malaysian coastlines	Department of Irrigation and Drainage (DID)	2015
Complete National Coastal Vulnerability Index for coastal assets and major urban centres in Peninsular Malaysia	Department of Irrigation and Drainage (DID)	2011
Complete the National Coastal Zone Physical Plan for Peninsular Malaysia	Dept. of Town and Country Planning	2010
Increase the number of data collection stations in Malaysian waters, and expand the type and amount of data collected	Dept. of Survey and Mapping	2015

Source: NPOA, 2009 – updated 2012

Climate Change Adaptation Capacity Development Strategy

Acknowledging the gaps in the current climate change adaptation strategy in Malaysia, below are two specific knowledge building priorities that have been identified; (1) building capacity on assessing and evaluating climate change vulnerabilities for climate change adaptation responses; and (2) defining the economics of climate change adaptation to support, if not promote, climate change adaptation actions (UNEP, 2011).

Based on the findings in the 2nd National Communication to the UNFCCC, a preparatory workshop and investigative project both entitled '*Economics of Climate Change in Malaysia'* have been initiated by the United Nations Development Programme, Malaysia in 2010 and due to be completed by end of 2012. The objective of the study is to enable policy and decision makers to formulate appropriate policy measures to address climate change impacts based on a sound economic assessment. The project is designed with three (3) main components (UNDP, 2010); (i) enhancement of the climate change database to encompass spatial, sector and temporal data; (ii) the development of economic models; and (iii) preparation of policy options for mitigation and adaptation actions.

However, there are some elements that have yet to be addressed in term s of knowledge development / capacity needs (UNEP, 2011):

- Research to develop the understanding of and associated framework for assessment to be incorporated within vulnerability assessments/ models;
- Limitations of ecological and biological sustainability/ stability under climate change;
- Climatology: Enhancements on micro and macro scales to improve the understanding of climate vulnerabilities and impacts, and on how assessments should reflect these 'new' understandings;
- Research on sectors vulnerable to climate change (water, transport, agriculture) and energy (dam-catchment areas) – and the identification of adaptation needs;
- Cost-benefit analysis (Benefit: economic evaluation of ecosystems and services) vis-à-vis vulnerabilities and costs associated with losses expected; and
- Ecological resilience and land use studies – identification of costs and benefits to rehabilitation, and or adaptation into other land uses i.e. options vs. resilience gained in holistic terms, e.g. economics, human safety, food security, shoreline stabilisation, infrastructure protection, etc.

Climate Change and Coral Reefs

Reef-building corals have already been pushed to their thermal limits by increases in temperature in tropical and subtropical waters over the past 50 years. The incidence of coral bleaching is now frequent around the world. Many species associated with coral reefs have a limited capacity to adapt quickly to environmental change, so the rate at which these changes occur is critical to the level of impact (Hoegh-Guldberg et al. 2007). In the context of the other stresses on coral reefs, such as excessive fishing, physical harm from tourism, physical damage from increased storm intensity and declining coastal water quality etc., increases in acidity and temperature may push reefs from a coral- to algae-dominated state.

At a carbon dioxide concentration of 450ppm, the diversity of corals on reefs will decline under the combined effects of elevated temperature and ocean acidity. Atmospheric carbon dioxide concentrations as low as 500 ppm will result in coral communities that no longer produce calcium carbonate to be able to maintain coral reef structures (Garnaut, 2008). Much of the mitigation measures needed to protect coral reefs will depend on effective coordination of an international response to carbon emissions; however, Malaysia can help to strengthen its reefs by reducing other stressors to the maximum extent possible (SOMER, 2010).

Ocean Acidification

As the concentration level of CO2 increases in the atmosphere, more carbon is absorbed into the ocean. In the past 200 years, the ocean has absorbed more than half of the carbon dioxide produced by burning fossil fuels and through cement production (The Royal Society, 2007). The absorption of this carbon is making the ocean more acidic. The surface water (down to 100m depth) has decreased by approximately 0.1pH in the industrial era, which represents a 30% increase in the concentration of hydrogen ions. If global Co2 emissions continue to rise on current trends, the average pH of the ocean could fall by

0.5 units by 2100 (The Royal Society, 2007). Such a level would be the lowest seen for millions of years; moreover, the rate of change is likely to be 100 times greater than any experienced in that time. Ocean acidification is irreversible in our lifetime. If carbon emissions were to be removed completely tomorrow, the oceans would take tens of thousands of years to return to the state they were in only 200 years ago (The Royal Society, 2007).

The chemistry of ocean acidification is well known and the magnitude of acidification can be predicted with a high level of confidence; however, the consequences for life at sea are not at all clear. Around 250 million years ago, during the period of the 'Great Dying' at the boundary of the Permian and Triassic periods, ocean acidity is believed to have fallen to around 7.8 pH (a level that is possible by the end of this century). At that time, which is believed to have also been a period of climate change, 70% of all terrestrial species, and 90% of marine species became extinct (Science Daily, 2008).

There may be a misconception that Malaysia need not be concerned about ocean acidification because carbon is absorbed into the oceans mostly in the cold waters of the higher latitudes. However, such a conclusion does not consider possible disruptions to the global marine food web that could arise from a decrease in the amount of plankton in the ocean. Little is known about the possible effects of acidification on the reproduction of plankton; however, sharp reductions in calcium carbonate associated with a lower pH level could affect the calcification process needed to form the shell of much zooplankton. Also, corals are aragonite calcifiers, which are the most susceptible to disruption from lower pH levels in sea water. In the context of warmer seas and more severe storms, corals that are weakened through acidification may not be able to survive.

Invasive Species

Increase in travel, trade and tourism associated with globalisation and expansion of the human population have facilitated the movements of species beyond its natural bio-geographical barriers, and many of these alien species have become invasive. Invasive alien species (IAS) is considered to be one the main source of biodiversity loss. IAS causes substantial environmental and economic damages, and these impacts are exacerbated by climate change, pollution, habitat loss and human –induced disturbance.

The introduction of a few invasive species increases global homogenisation of biodiversity, thus reduces local diversity and uniqueness.

IAS changes the community structure and species composition of native ecosystems by out-competing indigenous species for resources. IAS also have indirect effects in nutrient cycling, ecosystem function and ecological relationships between native species.

Based on the Biological Diversity Clearing House Mechanism [6] set up by Ministry of Natural Resources and Environment (NRE), a checklist of invasive organism in Malaysia has been prepared by the Global Invasive Species Database (CHM, 2011). As of November 2011, there are 12 species of algae; 45 species of aquatic plants and 32 species of molluscs that have been classified as invasive in Malaysia.

Ballast Water

Ballast water [7] is essential for safe and efficient modern shipping operations. Unfortunately, it poses several ecological, economic and health threats due to the multitude of marine species carried in ships' ballast water. These include bacteria, microbes, small invertebrates, eggs, cysts and larvae of various species. The transferred species may survive the long journey across bio-geographical borders and establish a

[6] The CHM is a mechanism set up for the efficient exchange of information on biological diversity in Malaysia between involved persons and institutions. In addition, the service enables facilitation in international access to information on the status of biodiversity studies and biodiversity management in Malaysia. Source: http://chmfrim.optima.my/About-CHM/CBD-Cross-Cutting-Issues/Invasive-Alien-Species.aspx

[7] Since the introduction of steel hulled vessels around 120 years ago, water has been used as ballast to stabilize vessels at sea. Ballast water is pumped-in to maintain safe operating conditions throughout a voyage. This practice reduces stress on the hull, provides transverse stability, improves propulsion and manoeuvrability, and compensates for weight lost due to fuel and water consumption. Source: http://www.imo.org/ourwork/environment/ballastwatermanagement/Pages/Default.aspx

reproductive population in the host environment, becoming invasive, out-competing native species and multiplies into pest proportions.

Quantitative data indicated the rate of bio-invasions is continuing to increase at an alarming rate and new areas are being invaded all the time (IMO.org).

In February 2004, the International Conference on Ballast Water Management for Ships' was held at IMO's Headquarters in London. The Conference adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Ballast Water Management Convention - BWM). The Convention is yet to be in force as it requires ratification by 30 states (representing 35% of world merchant shipping tonnage). As at Feb 2012, the number of contracting parties is at 33 (the combined merchant fleets of which constitute approximately 26.46 % of the gross tonnage of the world's merchant fleet.

Malaysia ratified the BWM Convention on the 27th September 2010 and shall enforce the requirements of the Convention on all Malaysian and foreign ships operating in Malaysian waters beginning 27th September 2011 (Malaysia Shipping Notice, 2011).

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APPENDICES

APPENDIX 6-1: GUIDELINES FOR TRANSPLANTING CORALS (MARINE PARK AUTHORITY, MALAYSIA)

Corals experience stress and will ultimately die if exposed for extended periods to poor water quality with high sediment load. Water quality could be affected by coastal development projects. Marine Park Authority is tasked with preserving coral reefs in the vicinity of such projects. Its first priority is to consider all things possible to avoid the construction or to minimise identifiable changes in order to avoid harming the natural reef systems. As a last measure but not promoting it as a feasible option, corals need to be translocated to a suitable and safe location. Not all coral types can be transplanted and only the fast growing branching *Acropora* spp. are suitable.

These guidelines were tested, revised and finally adopted for used in future transplantation of coral for restoration of small reef areas.

a) Survey the area and document existing species and relative abundances.

b) Locate a suitable new receiving location for the corals that has similar water quality and substrate quality parameters.

c) Before commencing any coral transplanting project, a written approval must be obtained from the Director, Marine Parks Section, Ministry of Natural Resources and Environment, Malaysia. Conditions are imposed, and amongst others, the transplantation work will have to be monitored and supervised by staff of Marine Parks.

d) The location where the source of coral transplants is to be gathered must be approved by the Director, Marine Parks Section, Ministry of Natural Resources and Environment, Malaysia.

e) Coral transplants must be removed manually and the use of mechanized equipment is prohibited.

f) Diver care and prudence should be adhered to during the collection of coral transplants. Divers are prohibited from trampling on the coral, handling or touching coral other than that to be transplanted. Churning of sediment should be avoided during the operation.

g) Before removing the transplants, mark the north orientation on the coral. Transplanted coral should be aligned with the original orientation prior to removal.

h) Coral transplants should be selected from a coral reef that is healthy, i.e. more than 80% of the surface is in good condition, not broken or of poor health.

i) During the transfer process, coral transplants should not be raised more than 2 meters above the original depth where the transplants were collected from. Avoid sudden changes in depth during the transfer process.

j) Coral transplants should be placed on a substrate of dead corals, or platform, preferably half a meter above the sea bed. Coral transplants should not be placed on living coral as a base.

k) Distance between each clump of coral transplants should be more than 0.5 meters for branching corals and 0.2 meters for boulder corals.

source: Chou, 2009

APPENDIX 6-2: A COMMUNITY BASED APPROACH TO CORAL REEF REHABILITATION THROUGH CORAL TRANSPLANT

Introduction

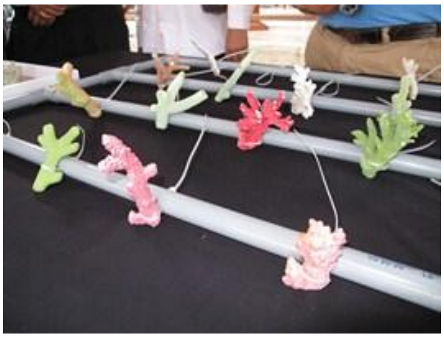
In June 2011 Reef Check Malaysia (RCM) along with The Department of Marine Parks Malaysia (DMPM) and Kee Alfian from National University of Malaysia (UKM) introduced a coral reef rehabilitation programme. This came after the success of RCM's coral transplant pilot project in Pangkor the previous year. The project was designed to be community based involving local dive operators, villagers and DMPM staff on the island.

Project phases

The Rehabilitation project consists of two phases. The initial phase is the growing of nubbins in a nursery under strict monitoring and maintenance and the second phase consist of transferring the nubbins from the nurseries to damaged reefs surrounding Tioman. Nubbins were collected from donor site and Renggis Island was chosen as the donor site as it had a large and healthy reef.

Nurseries

Nubbins collected from the donor site were attached to PVC frames (image below) that were secured to the seabed at the nursery site. Two nurseries were setup, one near the Tekek village and the other off the beach at Air Batang. Initially the nurseries were maintained and managed by DMPM staff and East Divers in Tekek, and by B&J Divers in Air Batang. RCM later hired a local villager specifically to assist in maintaining and monitoring both nurseries. Monthly growth rates and survival rates of the nubbins are being monitored to track the growth of the nubbins.



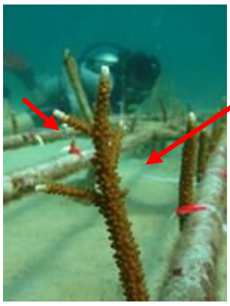
Mock nursery frame with attached nubbins

Appreciation of Dive operators involved in the programme

Progress

Nubbins at both nurseries are showing positive survival and growth signs with many starting to branch out as well. Natural coral recruits started to attach on the nursery frames and other marine organisms have also started to take up residence around the nursery, thus creating mini ecosystems of their own. Once ready, the nubbins will be transferred along with the entire frames to damaged reefs in order to promote the recovery of those reefs.

The Reef Rehabilitation programme has also been gaining popularity and interest among local villagers, resort owners and dive operators, with some indicating that they would like to get involved in this programme as well.



Nubbins branching out Corals naturally attached on frames Nubbins overgrown cable
ties

Conclusion

The reef rehabilitation programme was initiated to not only rehabilitate damaged reefs in Tioman but more importantly to promote and instil the act of conservation within the hearts of the local community living on the island. So far corals growth rate and responses from the villagers have been positive and it is hope that this project will continue to flourish.

APPENDIX 6-3: REEF REHABILITATION IN PANGKOR

Introduction

In 2009, Reef Check Malaysia (RCM) started to work with snorkelling guides at Pangkor Island, having observed poor operating procedures among some of the guides. From observations and discussions with some of the guides, it has became clear that the main snorkelling site used by the guides – at Giam Island, just off Pangkor Island – has been substantially degraded by external factors (river pollution/sedimentation and resort development) and local factors (poor supervision of snorkelers and poor boating practices).

After conducting site investigations with scientists from National University of Malaysia (UKM) and University of Singapore, it was decided that a small reef rehabilitation project will take place. This would involve taking live coral fragments (called "nubbins") from other areas (healthy reefs around Pangkor Laut) and transporting them to Mentagor Island to rehabilitate the reef there.

Methodology

RCM together with scientific colleagues developed an approach which is methodological and is designed to ensure the greatest survival rate of coral transplants. The approach involves three stages: 1) site selection; 2) preparation of a "coral nursery"; and 3) transplantation. This approach to rehabilitation focuses on creating a "mini-ecosystem", where the individual nubbins are grouped into a certain number in a nursery to form a mini-ecosystem rather than transplanted as individual coral nubbins. Once ready, the nursery will be transplanted as a whole mini-ecosystem to the transplant site. The objective is to increase the survival rate of the nubbins when transplanted.

Involvement

The project is a joint effort between several stakeholders: 1) local snorkelling guides; 2) Pangkor Laut Resort; 3) Reef Check Malaysia; and 4) coral scientists from National University of Malaysia and University of Singapore.

Progress

The first stage of the project was completed in November 2010. The first part of the programme involved the establishment of a small scale coral nursery at PLR, comprising three plastic pallets with a framework to house coral fragments (Figure 1). Nubbins were collected from healthy reefs around Pangkor Laut and transported to the nursery (Figure 2), located at a sheltered location of the Resort's main jetty.

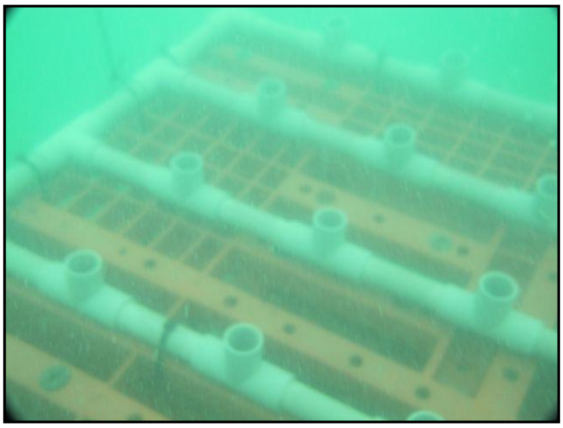


Figure 1: Plastic pallets with a framework to house coral fragments

Figure 2: Coral nursery populated with nubbins

In February 2011, the nurseries were inspected and found to be in good condition, with survival rates up to 85%. Each of the three pallets had started to establish a mini ecosystem, with small fish and various invertebrates taking up residence.

During visit in April 2011, the condition of the nurseries was found to have deteriorated. Two possible causes have been identified: 1) the nurseries were deeper in the water than planned, resulting in less sunlight penetration which corals need to produce nutrients; and 2) the nurseries were too close to the bottom, which is very silty, resulting in some nubbins being smothered by fine silt. Steps were taken to improve the location of the nurseries and replenish lost nubbins.

In August 2011, the nurseries were inspected and found to have improved, with survival rate up to 60-70%. Each of the three pallets once more started to establish a mini ecosystem, with small fish and various invertebrates taking up residence.

In October 2011, some recent mortality was observed, probably due to the jetty refurbishment at the Resort. However, the overall results of the nursery trial have been sufficiently encouraging to continue with the rehabilitation efforts. Subsequently, the coral nurseries were transported from the nursery site at Pangkor Laut Resort to the final rehabilitation site selected at Mentagor Island and one of the pallets was completely repopulated with live nubbins (Figure 3).

Figure 3: Repopulating coral nursery

A subsequent visit in November 2011, found the transplants to be in very good condition, with survival rate of 100% and signs of growth. The nurseries have been successful in establishing a mini ecosystem, with small fish and various invertebrates taking up residence. This provides an early indication that the transplant site is suitable.

In January 2012, the transplants were found to be still in very good condition, with survival rate of 100% and signs of growth (Figure 4). In addition, the nursery frames have been successful in maintaining a healthy ecosystem, with larger number of fish and invertebrates taking up residence. The survival of all the nubbins on the populated frame showed that the site was suitable for transplanting, thus the remaining two frames were populated with new nubbins.

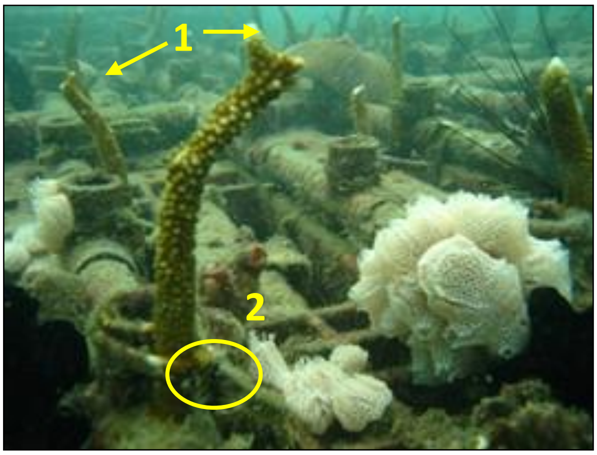


Figure 4: Growing coral. 1. Branching of nubbins; 2.Cable ties overgrown by nubbins

Conclusion

The reef rehabilitation project has shown to be a success in Pangkor. It was designed to be community based and in that sense has achieved its target, 100%. The rehabilitation site is now monitored and managed by the local snorkelling guides and many resort owners are also actively promoting its existence. It is hopeful that the project will continue to be a success, gain attention and promote conservation among the local community thus paving way for further rehabilitation activities.