

## Country Report for BOBLME Programme: THAILAND

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### 1. Introduction

#### 1.1 Country Background

Thailand is a typical tropical country, located between 20<sup>0</sup> and 6<sup>0</sup> North latitude, and between 97<sup>0</sup> and 106<sup>0</sup> East longitude. The country is bordered on the northwest by the Myanmar, on the east by Laos and Cambodia, and on the south by Malaysia. The total area of Thailand is 513,115 km<sup>2</sup>, of which 31 per cent can be classified as mountainous areas (ASEAN, 1986).

The large and varied interior of the country possesses rich aquatic resources. In addition, Thailand's coast line of 1,875 km includes the northern and western reaches of the Gulf of Thailand, which are relatively shallow waters rich in marine life, and the southwestern coastline extending 740 km along the Andaman Sea. These comprise essential nursery grounds for juvenile marine and brackish-water organisms of significant economic importance, and offer good potential for coastal aquaculture development.

The climate of Thailand is tropical, with an average high temperature of 32<sup>0</sup> C and low of 23<sup>0</sup> C. There are three overlapping seasons: the monsoon that lasts from July to October, after which it turns moderate to cool until February and warms up to sweltering heat until June.

A large majority of the over 62.3 million citizens of Thailand are ethnic Thais, along with strong communities whose ethnic origins lie in China, India and elsewhere. About 5.7 million people are registered in the capital city of Bangkok. Thai is the official language though English and some Chinese dialects are usually understood in business circles.

Thailand is one of the leading agricultural nations in the region, and is indeed one of only five countries which "Feed the World". The fishery sector of Thailand is a very important sector of agriculture. It has contributed a considerable portion to the Gross Domestic Product of the country in the last three decades. In addition, this sector has placed Thailand major world fishery commodities exporting countries. Despite rapid development of industrialization, agriculture continues to play an important role in the economy and the majority of Thais still earn their living in this sector. Thailand remains the world's leading exporter of rice, fishery commodities, rubber, canned pineapple and tapioca. The agricultural sector offers tremendous export potential, with abundant natural resources and a proven ability to produce for global markets. Agro-industry has much potential as the demand for convenience foods grows, offering opportunities for innovative products and value added processing.

#### 1.2 The Andaman Sea

The Andaman Sea is located on the west coast of Thailand with a total length of coastline of about 740 km extending southwards from the Myanmar border to the Malaysian border. The total sea area within the Exclusive Economic zone is 116,280 km<sup>2</sup>. Two tropical monsoons, i.e., northeast monsoon, which prevails from November to April, and southwest monsoon that prevail from May to October, influence this sea. Because of its general

physical conditions, the Andaman Sea has been identified as one of the world's large marine ecosystems. It is a non-enclosed area with a narrow continent shelf and well exposed to the deep oceanic waters in the northern part while the southern part has many large areas of mangrove forest and runoff. Owing to the favorable environmental conditions, the coastal and marine living resources in this area are abundant. The most important components of the ecosystem are mangrove forests, seagrass beds, coral reefs and fishery resources (Nootmorn et al., 2003).

There are many economic activities applying to the coastal area of the Andaman Sea, for instance, marine capture fishery (small-scale and commercial fisheries), coastal aquaculture (including mariculture), mining, transportation, tourism, industries, etc. These activities create several impacts on the marine living resources and environment of the Andaman Sea. For example, the marine capture fishery produced around one-third of the total marine capture fishery production of the country. In 2000, the marine fishery production of this area was 750,124 MT which accounted for 27 per cent of the total marine capture fishery (DOF, 2003). Owing to the heavy exploitation of fishing fleets, the fishery resources in the Andaman Sea have declined rapidly and many seagrass beds and coral reefs have been destroyed by destructive fishing gear, i.e., trawls and push nets.

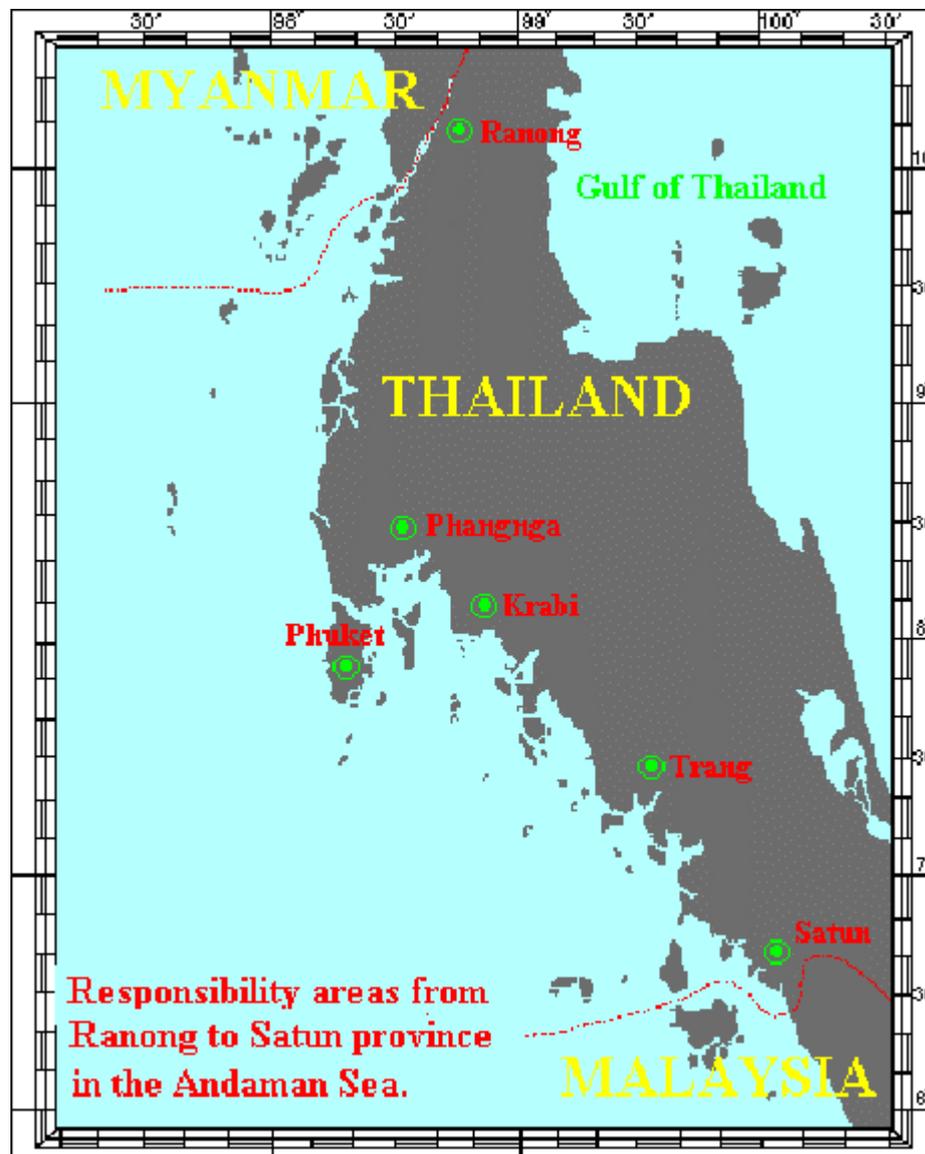


Figure 1. The Andaman Sea.

## 2. Status and Development Potential of the Coastal and Marine Environment and Its Living Resources

The coastal areas of the Andaman Sea are utilized by many groups of stakeholders ranging from fishers, both small-scale and commercial fishers, to mega-businessmen who have invested in hotel and entertainment businesses. In addition, the Andaman Sea is a very attractive spot for tourists both local and foreign due to its beautiful scenery and rich coral reefs. Thus more than 10 million tourists have visited the Andaman Sea annually (www.tourismthailand.org). With all of these activities the environment and coastal resources along the Andaman Sea are in a trouble. Although the sea water quality is still in good condition, some estuaries show signs of pollution. The coastal and marine environment and its living resources have suffered negative impacts from human activities, their status and development potential are described as follows.

### 2.1 Coastal and Marine Environment

#### 2.1.1 Status

There are 6 provinces located along the coast line, i.e., Ranong, Phangnga, Phuket, Krabi, Trang and Satun. These provinces are rich in natural resources and attract tourists from all over the country. The sea off the Phangnga, Phuket, Krabi and Trang provinces is influenced by semi-diurnal tides of approximately 3 m in spring and 1 m at neap tide. The water circulation is tidally dominated by a major flow in a northeasterly direction. During the northeast monsoon, the surface and subsurface flows in the near shore areas appear to move northwards at a speed of 2-4 cm/sec while during the southwest monsoon, the surface flow moves southwards at a speed of 5-8 cm/sec, gliding over the counter surface flow northwards of 2-5 cm/sec. (Limpsaichol et al., 1987)

Limpsaichol et al. (1987) have been summarized the water characteristics from Ranong to Phuket. The water in this area is influenced by deep sea upwelling resulting in high salinity (32.9-33.4 ppt), while the water from Phuket to Satun is influenced mainly by surface run-off resulting in a lower salinity (32.6-32.8 psu). The dissolved oxygen, pH and temperature values are 5.5-6.4 mg/l, 8.06-8.15 and 27.6-29.3 °C, respectively, and are fairly uniform along the coast.

The Southern waters are relatively well mixed, their total suspended solid values being 9.9-14.8 mg/l. Somewhat lower values are recorded in the northern water areas. The nutrient concentrations of nitrate and phosphate ranged between 0.12-3.40 and 0.08-0.87 ug/l, respectively. The surface water in the north is fertilized mainly by mangrove run-off (Limpsaichol et al., 1987) resulting in a primary production of 180-880 gC/m<sup>2</sup>/year (Janekarn and Hylleberg, 1987), while the surface water area in the south is fertilized by upwelling bottom water (Limpsaichol et al., 1987) resulting in a high primary production of around 700 gC/m<sup>2</sup>/year (Wium-Andersen, 1977)

PCD (2003) assessed the marine environment in the Gulf of Thailand and Andaman Sea from May 2002 to March 2003. The study revealed that the water quality, heavy metal content and total bacteria count have met the national standard of sea water quality. However, for the total coliform bacteria in the condensed area of tourists such as Patong Beach in Phuket Province and Ban Lamsak in Phangnga Province is higher than the standard. In conclusion, the marine environment in the Andaman Sea in general is in a good condition, the sea water quality in coral reefs and other resources conservation areas, swimming areas and water sport areas meet the established national standard.

## River

As reported by OEPP (2003b), the Andaman Sea coast has three major rivers opening into the sea.

1) Trang and Palian rivers. These rivers are short rivers similar to other rivers in this area. Their sources are in the mountains of Trang province, thus they are small and shallow rivers. The mouth of both rivers opens to the sea coast of Trang province, Trang River opens at Kantang district and the Palian River opens at Palian district and both form a common estuary. The estuary has a shallow muddy, sand-muddy bed, and some small rocky areas can be found.

The ecosystem of this area consists of a mudflat and mangrove areas where at least 90 species of bird are found. There are also 49 species of aquatic birds and 36 species are migratory birds. Some endangered species and nearly extinct species are also found in this area. This estuary is an important area for ecological study, fishing and coastal aquaculture.

2) Krabi River. The mouth of Krabi River opens at Muang district, Krabi province and its estuary area is about 114 km<sup>2</sup>. There are some small canals opening into this estuary. The estuary is covered with 102 km<sup>2</sup> of mangrove forest plus 12 km<sup>2</sup> of mudflat. The mudflat appears during low tide and some areas have a width of 2 km from the shore line.

The mangrove forests in this area are rather rich, comprising some large size of mangrove trees. The number of mangrove species found in this area was 19 species. The animals living in this area are aquatic birds (221 species), mangrove birds (138 species), local forest birds (137 species), endangered bird species, nearly extinct bird species, as well as mammals and fish (50 species)

## Swamp forests and wetlands

### *Swamp forest*

Swamp forests can be found only a limited areas of the Andaman Sea coast and most of them have been invaded. The records of the Royal Forest Department (RFD) for the year 2000 show that there are only 40 ha of swamp forest along the Andaman Sea coast. The Pruyon swamp forest in Trang province has been totally invaded by road construction works and the establishment of fishery households as well as shrimp farms.

### *Wetlands*

According to the report of OEPP (2003a), in 1989, the Royal Forest Department with the collaboration of World Conservation Union – IUCN has classified wetlands into:

- 1) Marine (brackish water, beach, coral reef)
- 2) Estuarine (delta, tidal marsh, mangrove forest, mud flat, seagrass bed)
- 3) Riverine (river, canal, stream, swamp forest)
- 4) Lacustrine (lake, large swamp, small reservoir)
- 5) Palustrine (marsh, bog, small swamp)

There are 3 large marine and estuarine areas in the Andaman Sea, i.e.,

- 1) Phangnga wetland
- 2) Sirinat National Park wetland
- 3) Taleban National Park wetland

However, for conservation and management purposes, the wetlands in the Andaman Sea has been classified into:

- 1) Lamson National Park wetland, Phangnga Province (31,500 ha)
- 2) Phangnga Bay, Phangnga Province (40,000 ha)
- 3) Sirinat National Park wetland, Phuket Province (9,000 ha)
- 4) Hat Nopparattara-Mu Koh Pipi National Park wetland, Krabi Province (38,996 ha)
- 5) Chaomai National Park wetland, Trang Province (23,092 ha)
- 6) Krabi estuary, Krabi Province (11,400 ha)
- 7) Trang estuary, Trang Province (area is not available)
- 8) Kapur estuary, Ranong Province (6,954 ha)
- 9) Kraburee estuary, Ranong Province (19,322 ha)
- 10) Palian-Langoo mangrove forest, Satun Province (31,200 ha)
- 11) Mangrove forest on the eastern coast of Phuket, Phuket Province (2,128 ha) (OEPP, 2003a)

### 2.1.2 Development Potential

The Andaman Sea is one of the most important region of the country. The main economic activity of this region is tourism which is the environmental-based activity. Therefore, the government has paid an attention on the conservation and management of marine and coastal environment for ensuring the sustainable of tourism industry. In order to maintain a good environment of this region, both central and local government agencies have established several projects for the conservation of marine and coastal environment of the Andaman Sea. With the collaborations and participations of the local people in the past two decades, many degraded environmental areas are recovered. However, for the sustainable development, the environmental carrying capacity should be keep in account in all economic activities.

Thai coastal areas in the Andaman Sea has connected with the Indian Ocean and neighboring countries, i.e., Myanmar and Malaysia. Therefore, the environmental transboundary effects should be considered although a case has not shown. Some activities in any country in the region may create transboundary effects to other countries or open sea. Thus, any development project in the Andaman Sea should minimized the environmental impacts in order to avoid the transboundary effects.

## 2.2 Mangrove Forests

### 2.2.1 Status

The coastal area of the Andaman Sea is one of the richest mangrove forest areas owing to many short rivers opening to this area, depositing mud sediment over a wide area. Mangrove forests can be found from Ranong to Satun provinces. The mangrove forests in Ranong, Phangnga and the west coast of Phuket provinces are estimated to be 50,000 – 90,000 ha, while on the east coast of Phuket, Krabi, Trang and Satun provinces the area is 80,000 – 140,000 ha, with the total area being about 180,000 ha from 1961 to 2000 (OEPP, 2003a). The largest mangrove forest can be found along the coast of Phangnga Bay, an almost closed bay surrounded by Phuket, Phangnga and Krabi provinces. The extent of this forest can be attributed to the location and physical characteristics of the bay. In 1996, it was reported that the mangrove forest in Phangnga Province accounted for 30,442 ha whereas for the Andaman Sea mangrove forest accounted for 132,904 ha which was larger than forest of the Gulf of Thailand. Compared to the length of coastal line, the density of mangrove forest in the Andaman Sea is much larger than that of the Gulf of Thailand.

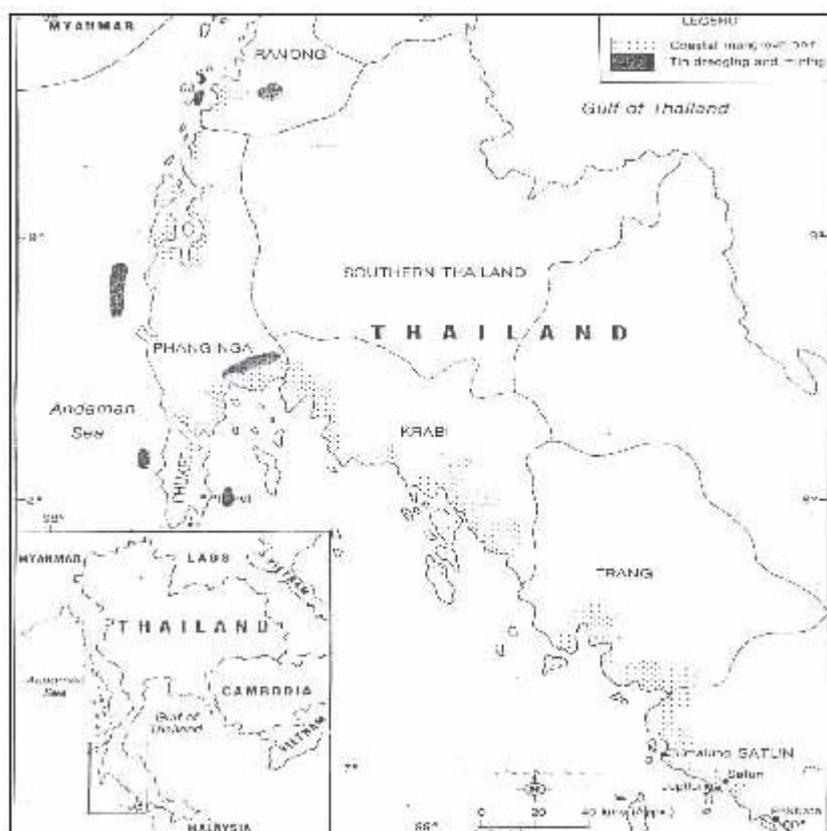


Figure 2. The coastal mangrove belt in the Andaman Sea (Limpassaichol, 1995)

The mangrove areas along the Andaman Sea coast have gradually decreased. From the assessment using LANDSAT image since 1975 to the latest data collected by the Royal Forest Department, the mangrove areas of the Andaman Sea have been destroyed to some extent. From the report of OEPP (2003b), the mangrove areas in Phuket (west coast), Phangnga and Ranong provinces show a declining trend from 88,000 ha in 1971 to 49,679 ha in 1996 but recovery to 70,730 ha in the year 2000 (see table 1). In addition, the mangrove area in Phuket (west coast), Krabi, Trang and Satun provinces has shown the same trend. The mangrove area declined from 143,400 ha in 1961 to 83,225 ha in 1996 and increased to 105,756 ha in 2000.

Table 1. Mangrove areas along the Andaman Sea coast, 1961-2000.

Unit : ha

Province	1971	1975	1979	1986	1989	1991	1993	1996	2000
Ranong Phangnga Phuket (west coast)	88,000	75,300	71,308	58,026	56,808	52,980	50,024	49,679	70,730
Phuket (east coast) Krabi Trang Satun	143,400	116,400	106,848	89,762	85,362	95,371	83,743	83,225	105,756
<b>TOTAL</b>	<b>231,400</b>	<b>191,700</b>	<b>178,156</b>	<b>147,788</b>	<b>142,170</b>	<b>148,351</b>	<b>133,767</b>	<b>132,904</b>	<b>176,486</b>

Source: Royal Forest Department

The management of mangrove forests in the past was mainly done by the Royal Forest Department through laws and regulations. In 1977, the National Mangrove Resource Committee was established. The activities that have been carried out by this Committee were: approval of all applications for any activities in mangrove areas, zoning system establishment, resolving problems of encroachment, marine national park establishment, providing financial support for research activities and coordinating with international research programs, establishment of a research center, establishment of a mangrove data center, organizing National Mangrove Symposium and promoting public awareness of mangrove forests.

In order to increase the efficiency of mangrove forests management, the Cabinet issued a cabinet resolution on 15 December 1987 that divided all public mangroves into three zones according to their condition and degree of utilization at that time. These three zones are:

*Conservation Zone*: All utilization and disturbance are prohibited in this zone; this includes:

- (a) Areas for preservation of economic plants and animals.
- (b) Nursing grounds for plants and animals.
- (c) Areas susceptible to damage and erosion.
- (d) Historic areas.
- (e) Areas with local uniqueness.
- (f) National parks, tourist areas, wildlife sanctuaries, non-hunting areas.
- (g) Wind shield areas.
- (h) Areas significant for research.
- (i) Areas significant for environment and ecological preservation.
- (j) Areas more than 20 m from natural rivers and streams, or more than 70 m from the sea coast.

*Economic Zone A*: Only sustainable uses of mangrove trees are permitted; this includes:

- (a) Concession areas.
- (b) Community forest.
- (c) Mangrove plantations.

*Economic Zone B*: This area is degraded mangrove in which other land uses and development are allowed but which must consider the environment; this includes:

- (a) Agriculture.
- (b) Industry.
- (c) Urban areas.
- (d) Trading and commercial areas.
- (e) Piers and harbors.
- (f) Others.

Table 2. The status of mangrove land use along the Andaman Sea coast in 1993 in the 3 zones defined for national mangrove by Cabinet Resolution on December 15, 1987.

Unit: ha

Types of Land Use	Conservation Zone	Economic Zone A	Economic Zone B	Total
Mangrove	19,762	109,399	4,687	133,847
Shrimp ponds	1,104	2,547	297	3,947
Urban areas	43	82	31	154
Other/unclassified	8,503	37,274	10,443	56,221
<b>Total</b>	29,412	149,302	15,458	194,169
<b>Country Total</b>	42,678	199,689	130,081	372,449

Source: OEPP (2003a)

### 2.2.2 Development potential

In the last two decades, Thai society has paid more attention to a reforestation program for mangrove forest. The reforestation programs in many areas are under the patronage of the royal family. Thai people and some private agencies contributed their efforts and money to the reforestation program. Since the Andaman Sea coast is a major tourist spot in the country and local people particularly the fishers in this area realize that the mangrove forest area is their source of income and food, most of the stakeholders are willing to join the mangrove forest conservation and management efforts. The stakeholders who have participated in the mangrove reforestation program are;

- Fishers (both small-scale and commercial)
- Tour operators
- Teachers and students
- Government services
- Coastal community members
- NGOs
- Researchers
- Tambon Administrative Organization

The figures of the Royal Forest Department show that the mangrove forests along the Andaman Sea coast are increasing annually. This success can be credited to the fruitful contribution of all stakeholders in the area and it is a significant sign that this trend will continue to increase.

## 2.3 Seagrass Beds

### 2.3.1 Status

Seagrass beds are distributed in the shallow water areas, often at the fringes of the mangrove at an approximate 5 m water depth. Many economically valuable fish species, such as groupers, as well as mollusks and crustaceans use these areas as nursing grounds. Seacows (*Dugong dugong*), a marine mammal, also depend on seagrass beds. The seagrass is sensitive to turbidity and damage has been recorded in turbid zones (Nootmon, 2003).

Chansang et al. (1988) and OEPP (2003a) reported that there are 29 km<sup>2</sup> of seagrass beds along the coast of the Andaman Sea. The largest seagrass beds are located from Chaomai Beach to Muk Island as well as off Talibong Island in Trang Province. Other extensive seagrass beds are found in Phangnga Bay and in Lanta Bay, Krabi Province.

The species of seagrass in the Andaman Sea were studied by Chansang and Poovachiranon (1994). The species recovered were;

*Halophila decipiens*  
*Halophila beccarii*  
*Halophila ovalis*  
*Halodule pinifolia*  
*Syringodium isoetifolium*  
*Halodule uninervis*  
*Cymodocea serrulata*  
*Cymodocea rotundata*  
*Thalassia hemprichii*  
*Enhalus acoroides*

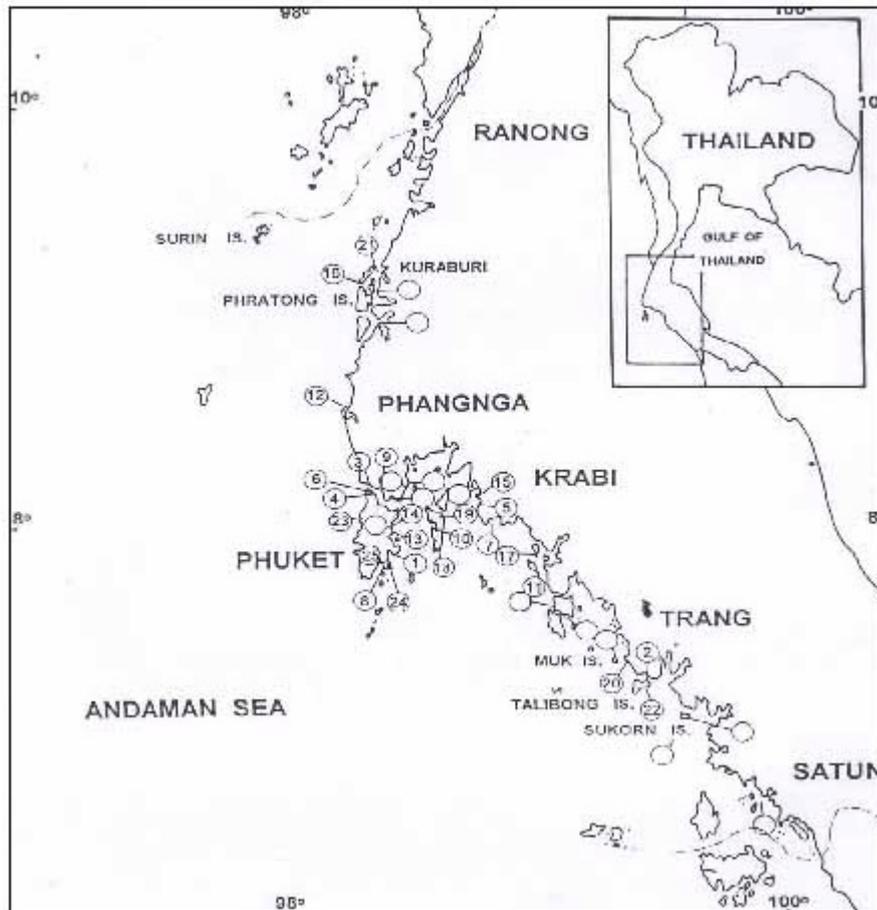


Figure 3 Distribution of seagrass beds along the Andaman Sea (Chansang and Poovachiranon, 1994)

Seagrass beds in the Andaman Sea are more abundant than in the Gulf of Thailand in terms of plant density and area covered. The biomass of the seagrass in the Andaman Sea was at a maximum of 1,200 g dry wt/m<sup>2</sup>. Degraded seagrass beds were found near the East coast of Phuket Island where human impact activities occurred. The richest seagrass beds found in the southern part of the Andaman Sea; Chaomai Beach and Talibong Island of Trang Province.

Seagrass beds along the Andaman Sea coast are divided into three geomorphological types, i.e., mangrove associated seagrass beds, seagrass beds on shallow sandy bottoms and coral associated seagrass beds (Poovachiranon, S. et al, 1994).

### 2.3.2 Development potential

Although the seagrass communities are disturbed by natural and human activities which results in the decline of the seagrass areas in the Andaman Sea, the seagrass communities still have a potential to develop, in the other words to recover. The small-scale fishers have realized that the seagrass bed is a good spawning ground and nursing area for many high value aquatic animals such as crabs and shrimps, and particularly as the feeding ground of the Dugong. Therefore, in collaboration with the public sector and NGOs, the local small-scale fishers in many communities have engaged in a seagrass plantation program. At present, many seagrass beds in Phangnga and Trang provinces have increased annually and the fishers can catch more fish from these areas.

## 2.4 Coral Reefs

### 2.4.1 Status

The Andaman Coast also possesses a considerable extent of coral reefs. Although large areas of the reefs have been damaged by natural and mainly by economic activities, such as, fishing, tin mining and tourism, however, the coral reefs in this area are in better condition than coral reefs in the Gulf of Thailand. In this habitat, 240 species of reef fish, including economically important species, have been recorded. The healthiest reefs are found around the islands of Phangnga, Krabi and Trang Provinces (Nootmon et al., 2003).

Phongsuwan (2002) reported the status of coral reefs, particularly on the edge-slope zone, in the Andaman Sea off more than 130 islands and a few places off the mainland shore by the “Manta-tow method”. It is estimated that the total area of these reefs is about 75 km<sup>2</sup>. The ratio of percentage cover of live to dead coral is applied for status ranking,  $\geq 3:1$  meaning a very healthy reef, 2:1 meaning a healthy reef, 1:1 meaning a fairly healthy reef, 1:2 meaning a poor reef, and  $1 \geq 3$  meaning a very poor reef. For overall estimation of reef status in the reef edge-slope zone, actual values are reported as very healthy 12.0%, fair 33.6%, poor 26.5%, and very poor 23.3% of the total reef area.

OEPP (2003b) reported that in 1999 the coral reefs in the Andaman Sea covered an area of 78.56 km<sup>2</sup>. Coral reefs can be found along the coasts of islands. The largest coral reef can be found in Surin Islands and follow by reefs in Adang-Ravee Islands. Healthy coral reefs appear around several small islands along the coast, i.e., Torinla, Kangkao, Yoong, Bugelaboat, Kradan, Bava, Burad, Kata and Butang. On the other hand, poor coral reef areas were found close to the mainland or the islands located close to the mainland, for instance., Rad, Talibong and others.

Nootmon et al. (2003) cited Chansaeng et al. (1988) that in the offshore island belt from the Rok Islands, in Trang province, to Phi and Hong Islands, in Krabi and Phangnga Provinces respectively, more than half of the coral reefs were found to be alive and in good condition during the study. The genus *Porites* appears to be dominant, both in number and percentage coverage, and is followed by *Acropora*. The study also found that the reef degradation is mainly caused by starfish (*Acanthaster planci*) invasions, storm damage, dynamite fishing, boat anchoring for tourism activities and sedimentation smothering.

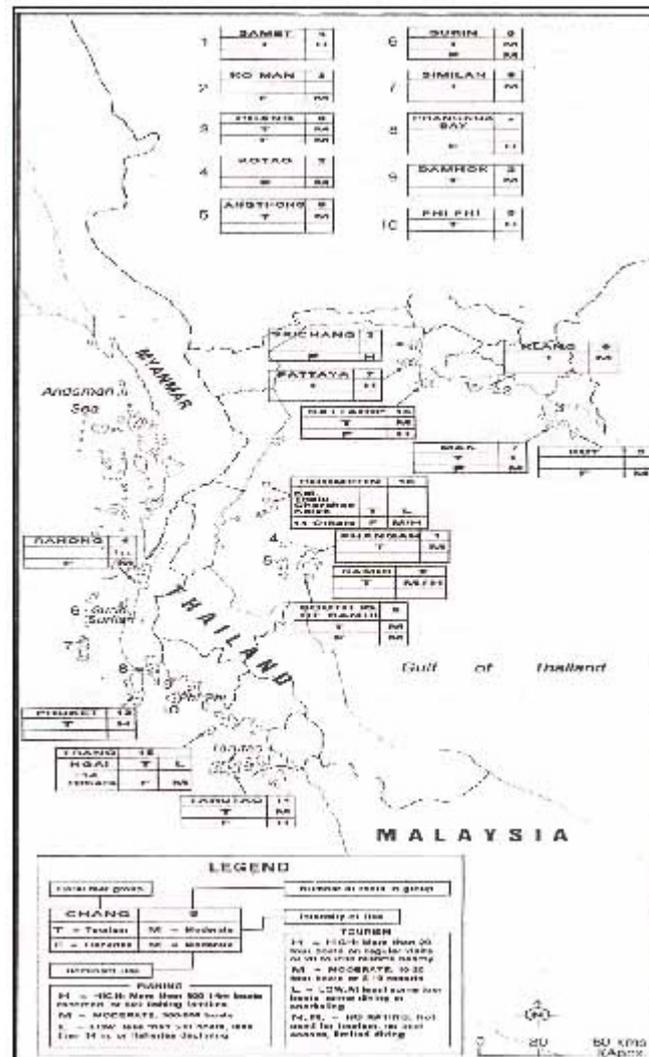


Figure 4 The coral reefs of Thailand (Limpaichol, 1995)

### *Coral reefs off Ranong Province*

Although there are many islands in Ranong Province, it is hard to find a coral reef. There are only 2.57 km<sup>2</sup> of coral reef in the province because the sedimentation is rather high and this area faces against the Southwest monsoon. The corals found in this area are those that can grow in shallow water and strong wave conditions.

### *Coral reefs off Phangnga Province*

Phangnga Province is the province where coral reefs are richest and healthiest. Coral reefs cover 25.6 km<sup>2</sup>, the largest area of reefs in the country. This is due to the geographic diversification from shallow water to deep water,

## 2.4.2 Development potential

Since the tourism industry along the Andaman Sea has boomed since the 1970s. At the beginning of this development, there was hardly any awareness of coral reefs conservation. Thus, many coral reef areas were destroyed by boat anchoring and collection of coral. In addition, the Andaman Sea is an open sea thus the coral reef can often be destroyed by natural disasters. Conservation of coral reefs can be ensured through effective management. Some measures such as limiting entry or seasonal closure of areas should be

applied for coral reefs conservation. More marine protected areas (MPA) should be declared urgently for coral reefs protection purposes. The coral installation program that has been experimented in the Gulf of Thailand may not be applicable to the Andaman Sea due to the differences in environmental conditions.

At present, the local people have realized that coral reefs in their areas are a source of their income through fishing and tourism. Thus, the local people actively participate in the coral reefs conservation programs and the collaboration of tour operators on coral reefs protection result to the declining of coral reefs degradation.

## 2.5 Marine Fauna and Fishery Resources

### 2.5.1 Status

#### *Marine fauna*

The density of macrobenthic fauna on the coastal seabed of the Andaman Sea ranges from 200 to 1,000 animals/m<sup>2</sup>. The majority are mollusks, Echinodermata and Chordata (Chatananhawej and Bussarawit, 1987). The benthic fauna has been studied along the coast and found to have an average biomass of 26.5 g/m<sup>2</sup> in Phangnga, Krabi and Trang provinces. Polychaetes dominated in number and an average density of 256 ind/m<sup>2</sup> was recorded. Crustaceans and mollusks also made up a considerable part of the bottom fauna, recording densities of 224 and 138 ind/m<sup>2</sup>, respectively. Only a few echinoderms occurred. Fish and other animals were found at a density of 23.7 and 48 ind/m<sup>2</sup> each and with a biomass of around 1 g/m<sup>2</sup>. The bottom of the seabed consisted mainly of a silt-clay fraction (40%) (Chansaeng et al., 1988 cited by Nootmon et al., 2003).

Of the 49 fish families in the Andaman Sea, 25 set larvae along the Thai coasts. Of these, 64 per cent belong to economically important species. Zooplankton occurred with an average density of 682 ind/m<sup>3</sup>, corresponding to a biomass of approximately 20 mg/m<sup>3</sup>. Clupeoids are the most abundant planktonic crustacean, comprising 30 per cent of the biomass, while Brachyura larvae, shrimps and bivalves comprise 1.2-10.7, 0.9-2.6 and 0.2-5.5 per cent of the biomass, respectively (Boonruang, 1985). A spawning ground of Chub Mackerel was found in the sea area around Phi Phi Island, south of Lanta Yai Island and east of Yao Yai Island. Fish larvae abound in March and April (Sutthakorn and Saranakmukul, 1986).

#### *Marine Fishery Resources*

The Thai exclusive economic zone in the Andaman Sea is classified as the 7<sup>th</sup> fishing area of the country. The major fishing grounds have been limited to a depth of less than 200 m owing to the size of Thai fishing vessels. The rich fishing grounds are generally located along the coastal areas with a water depth range from 10 to 100 m.

Marine fishery in the Andaman Sea is similar to that in the Gulf of Thailand. It is classified into small-scale fishery and commercial (industrial) fishery. The small-scale fishery refers to the fishery that operates fishing without boat, with non-powered boat, out-board powered boat and inboard powered boat of less than 5 GT. The fishing gear used by the small-scale fishery are small-scale bamboo stake trap, traps, gillnets, set bag net, small push net, lift net, hooks and lines and other stationary gears. The small-scale fishers operate their gears in estuaries, bays and inshore waters. The commercial fishery refers to the fishery that operates fishing with inboard powered boat of 5 GT and above. It employs high efficient fishing gears, i.e., trawls, purse seines, large-scale push net, encircling gill net and large driftnet. (Juntarashote, 2002).

The marine fishery resources in the Andaman Sea can be classified according to their habitats into two main groups, i.e., pelagic and demersal resources. Purse seines, drift gillnets and surrounding nets are used for exploiting the pelagic resources. There are 20 species of pelagic resources that are considered important economical species. The demersal resources that include demersal fish, crustaceans, cephalopods and other mollusks are mainly exploited by trawlers, push nets, bottom gillnets, traps and hooks and line. Approximately 30 families comprising more than 300 species have been recorded (Nootmon et al., 2003).

There were many attempts to assess the state of demersal resources stock. It was found that the maximum sustainable yield (MSY) in the coastal areas of a depth ranging from 10 to 90 m was 154,000-230,000 MT (Isarankura, 1971; Marr et al., 1976; Bhatia and Chullasorn, 1980; Bhatiyasevi, 1997). The pelagic resources stock was estimated by Bhatiyasevi (1997). The MSY was reported to be 136,602 MT and it seems that most of the pelagic resources in this area are still not fully exploited. Thus an increase in pelagic resources production is viable but an increase in fishing effort should be done carefully.

In order to understand the changes of catch rates of trawlers in this area, the Department of Fisheries conducted surveys by means of her research vessel. The surveys found that the catch per unit of effort of demersal resources caught by the research vessel that conducted the monitoring survey in Phangnga bay and adjacent areas in 1966 was 238.9 kg/hr. It decreased to 105.3, 64.6 and 37.5 kg/hr in 1971, 1978 and 1987-1988, respectively. Thus, it may be concluded that the demersal resources in this area had been fully exploited since 1971 when the catch rate dropped to half of the original abundance.

It is reported that at least 10 economically important species, including *Rastrelliger brachysoma*, *R. kanagurta*, *Scomberomorus commerson*, *Auxis thazard*, *Euthynnus affinis*, *Katsuwonus pelamis*, *Thunnus albacores* and *Loligo spp.*, which are commonly exploited by several countries boundary the Andaman Sea coast frequent inshore and coastal waters of more than one country or straddle the exclusive economic zones thereof. Knowledge of their biology, bionomics and migratory behaviors or transboundary movement is fragmentary; likewise, the data on the state of exploitation of these transboundary resources are limited (Nootmon et al., 2003).

The migration pattern of *R. brachysoma* is reported by BOBP (1987). The Indo-Pacific mackerel stock was divided into 3 stocks, i.e. the first stock was distributed in the eastern of Sumatra Island of Indonesia through the south-west of Penang, Malaysia. The second stock distributed between the Myanmar-Thailand boundary waters, and the third distributed in Phangnga Bay through the north of Penang.

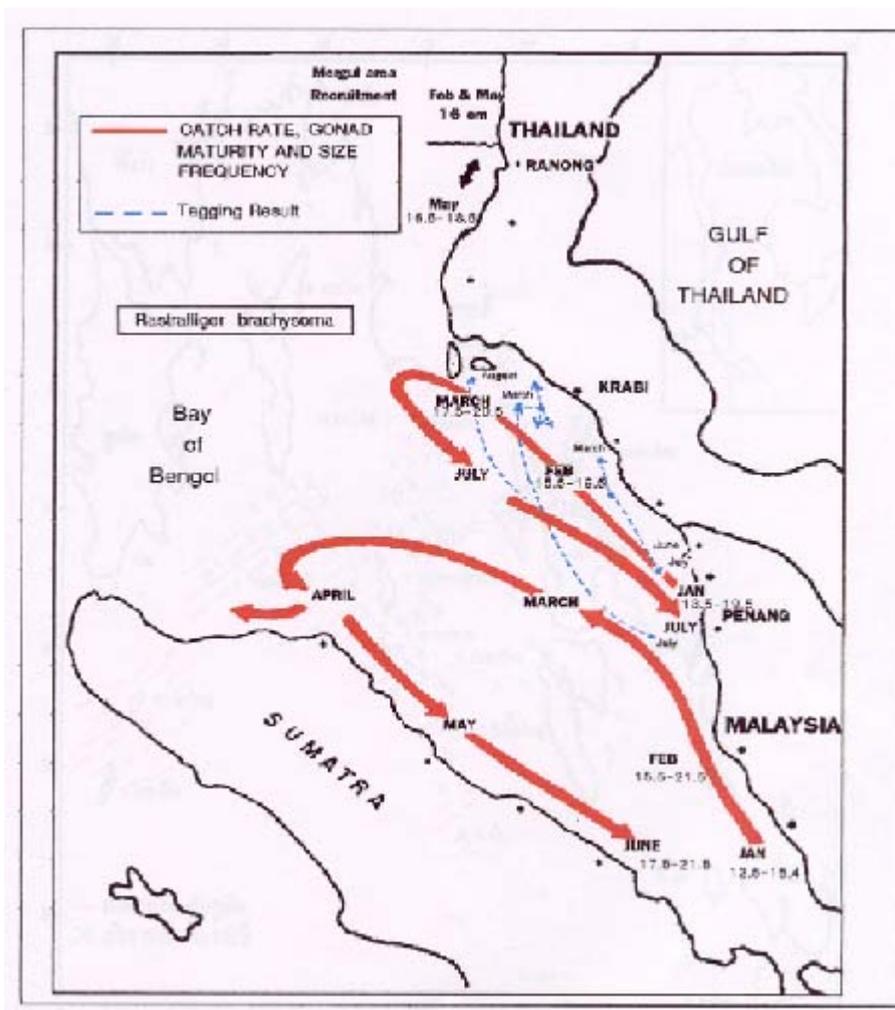


Figure 5. Distribution and migration pattern of Indo-Pacific mackerel in Malacca Strait (BOBP, 1987).

#### Fishery Production

The fishery production from the Thai EEZ in the Andaman Sea is reported by the Department of Fisheries annually. The marine fishery production contributes more than 80 per cent of the total fishery production of the country. However, it should be kept in mind that the marine fishery production of Thailand derives from the catches within Thai EEZ and from the waters of neighboring countries as well as from high sea. According to the fishery statistic collection standard, any fish caught by Thai fishing vessels and landed in Thailand will be treated as fishery production of Thailand regardless of whether they were caught in Thai fishing areas or other country fishing areas. Thus, it is impossible to identify how many MT of Thai marine fishery production have been caught outside the Thai EEZ.

From 1985, the marine fishery production of Thailand in the Andaman Sea has shown an increasing trend owing to the increasing of fishing efforts. The catches increased from 312,568 in 1985 to 406,891, 654,824 and 815,434 MT in 1989, 1992 and 1995, respectively. In 1998, the production reached the maximum of 906,546 MT and dropped to 805,643 and 750,124 MT in 1999 and 2000, respectively (see Table 3).

The marine fishery production from the Andaman Sea has contributed a considerable portion of the total fishery production of the country since 1991.

From 1985 to 1990, it contributed less than 20 per cent of the total and increased to around one-third of the total since 1995. However, from 1999 to 2000 the production declined both in terms of quantity and proportion to the total. The variation in fishery production from the Andaman Sea may depend on the catch in Myanmar waters. The year that Myanmar opens fishing grounds for Thai fishing vessels, the production of that year will shown increased.

Table 3. Marine fishery production of Thailand by fishing areas, 1985-2000.

Unit: MT

Year	Total	Gulf of Thailand	Andaman Sea	Percentage to the Total
1985	2,057,753	1,745,185	312,568	15.2
1986	2,348,572	1,945,072	403,500	17.2
1987	2,601,929	2,174,942	426,987	16.4
1988	2,337,215	2,001,645	335,570	14.4
1989	2,370,548	1,963,657	406,891	17.2
1990	2,362,218	1,923,163	439,055	18.6
1991	2,478,607	1,820,687	657,920	26.5
1992	2,736,352	2,081,528	654,824	23.9
1993	2,752,486	1,929,672	822,814	29.9
1994	2,804,426	1,996,542	807,884	28.8
1995	2,827,447	2,012,013	815,434	28.8
1996	2,786,125	1,903,555	882,570	31.7
1997	2,679,492	1,831,129	848,363	31.7
1998	2,708,968	1,802,422	906,546	33.5
1999	2,725,207	1,919,564	805,643	29.6
2000	2,771,000	2,020,876	750,124	27.0

Source: Department of Fisheries

### 2.5.2 Development potential

A development potential of fishery in the Andaman Sea is rather limited due to the degradation of the fish habitat and fisheries resources depletion in Thai waters. However, there is a possibility of developing fishery in the Andaman Sea by promoting overseas fishery and environmental friendly aquaculture. In order to reduce the total amount of fishing effort in the Andaman Sea, Thailand should seek collaboration with her neighboring countries in joint venture fishery. In some countries, such as Myanmar, Thai investors may invest not only in capture fishery but also in the linkage industry both downstream and upstream. The total amount of fishing effort in Thai waters should limited to the available fishery resources of the country. Also, all of the destructive fishing gears both small-scale and commercial scale should be completely eliminated. Regarding coastal aquaculture, the farmers have to follow good aquaculture practice (GAP) as established by the DOF. In addition, the DOF should establish specific aquaculture zones in order to avoid the sea water pollution problem.

## 3. **Threats to the Coastal and Marine Environment of the Country and Its Living Resources**

### 3.1 Threats to Coastal and Marine Environment and their causes

#### Threats

The threats to coastal and marine environment can be ranked as follows:

(1) Land-based activities. In the past half century, the provinces along the Andaman Sea coasts have rapidly developed in agriculture, industry and service sectors. The tourism industry is boomed in every province and many hotels and resorts, restaurants, shops and entertainment parlors are installed along the coasts. The installment creates several impacts to the coastal environment and the wastes from the service sector in some areas are mainly dumped into coastal area and finally transfer into the sea. The agriculture sector also releases chemical fertilizers and insecticides to the coastal and marine environment. Urbanization and shrimp farming expansion in coastal areas result to the degradation of coastal and marine environment. Food processing industry is the main industry in this area and they discharged wastes from their production lines into the coastal areas.

(2) Fishing. Fishery in the Andaman Sea is classified into small-scale and commercial fisheries and they employed various types of fishing gear. Trawls and push nets are popular gears among the fishers due to their fishing efficiency. However, these gears create a severe impact to the coastal and marine environment through their operations. Several sea beds, seagrass beds, and coral reefs are destroyed by both small-scale and large-scale of trawls and push nets. In addition, dynamite and cyanide fishing create an impact to the coastal and marine environment.

(3) Discharge of wastes from shrimp farms. Shrimp farms in the Andaman Sea coast are intensive farm that produce high quantity of shrimp by using various types of chemical for growth rate acceleration and diseases protection. These chemicals are released into the public waters and discharged into the coastal areas. The untreated water from the farms also discharged directly into the coastal areas.

(4) Oil spill. Along the Andaman Sea coasts there are many piers for fishing vessels and tour boats, and harbors for cargo vessels and navy base. Therefore, in each day there are many boats and vessels have visited the piers and harbors. Some oil and fuel are spilled from boats and vessels and distributed into coastal areas. Thai government has an intention to develop this area to be a marina and fishing port of the country then the oil spill will be a considerable threat to the coastal and marine environment.

### Causes

Causes of the above threats are:

- (1) Lack of awareness. The majority pay less attention on coastal and marine environment conservation. They have a believe that the environmental conservation is a duty of the government.
- (2) Difficulties on law enforcement. Law enforcement for the conservation of resources and environment, especially to control trawls and push nets, is hardly to get a success due to the limited number of staffs and patrol boats.
- (3) Domestic waste water, sewer, suspend solids, industrial wastes from both small-scale and large-scale. These result from lack of treatment facility owing to lack of funding for investment and operation.
- (4) The investors tend to minimize their operation costs by not operating their waste water treatment system.
- (5) Unregulated shrimp farming. Without an appropriate regulation, the shrimp farm can create some impacts to marine and coastal environment.
- (6) The government set the tourism in the Andaman Sea at the top priority.
- (7) Degradation of mangrove forests through the expansion of shrimp farms and urbanization.
- (8) Increasing of the population along the Andaman Sea coasts.
- (9) Too many tourists.
- (10) Marine tin mining.

### 3.2 Threats to Coastal and Marine Living Resources and their causes

#### ***Mangrove Forests***

##### Threats

The threats to mangrove forest areas in the Andaman Sea are ranked as follows.

(1) The conversion of mangrove forests into aquaculture farm. Owing to the rapid development of shrimp farming of the country, many mangrove forests were converted into shrimp farms that mainly focus on tiger prawn farming. Shrimp farm is the fastest cash return from aquaculture which is a big incentive for many people to engage in this activity and most of them have started with seeking a piece of land in mangrove forest area for farm establishment. The advantage of the mangrove forest areas is the seawater can be pumped into the farm easily.

(2) The conversion of mangrove forests for supporting tourism industry and urban expansion. Due to the tourism industry booming in the last four decades and the increasing of the population in the Andaman Sea coast many mangrove forest areas were used for the construction of hotels, piers, restaurants and households. In addition, a new government office or the expansion of the government offices, such as education institutes, research institutes, naval bases, are mainly used the mangrove forest areas for construction.

(3) Waste dumping into mangrove areas. Many communities that locate in or nearby the mangrove forest areas have dumped solid waste and polluted water directly into the mangrove forest areas. Koh Yao Yai is an example, the garbage from communities in the island is dumped directly into the mangrove forest areas just behind the district office.

(4) Restriction of water exchange with the sea. This results from construction of infrastructure (roads, piers, dams, etc.) in the mangrove forest areas. With the poor water exchange the mangrove trees may have a lower growth rate.

(5) Illegal mangrove cutting. Although cutting any mangrove trees in the public area is prohibited by law but there are some poachers continue cutting mangrove trees for charcoal making and house construction. Some fishers use mangrove trees for the construction of fishing gears and cages for coastal aquaculture.

##### Causes

- (1) Lack of awareness on mangrove forest conservation.
- (2) Lack of knowledge and understanding on mangrove forest and its ecosystem.
- (3) The previous development policy is focused on economic growth rather than environmental conservation.
- (4) Outdated laws and regulations, especially the loophole that allows degraded forests to be converted for other uses.
- (5) Unplanned and unregulated expansion of coastal cities and towns.
- (6) Lack of efficient law enforcement.
- (7) Lack of collaborations among government agencies concerned.

#### ***Seagrass beds***

##### Threats

The treats to seagrass in the Andaman Sea are more or less the same as in the Gulf of Thailand. They may be ranked as follows:

(1) Fisheries. Bottom scraping fishing gear that operate near the shore, such as small trawls, push nets and beach seines, can extensively damage seagrass communities. The collection of sea cucumbers in seagrass beds also create a damage to seagrass communities.

(2) Natural disaster. Inappropriate substrate, strong waves and currents, and oscillating monsoons limit growth and the survival of seagrass. In the Andaman Sea, seagrasses are usually found in clam protected area such as Phangnga Bay and Chaomai Beach, or near river mouths with clayey sand substrate, or off remote islands which are little affected by humans.

(3) Land reclamation. Although this cause is strongly put forward as the major cause of seagrass destruction in Thailand, there are only a few areas where land reclamation and land development are quoted as the causes of destruction. However, it is highly possible that many more beds have been destroyed without this being record.

(4) General deterioration of seawater quality. Suspended particles in the water are particularly damaging because of their smothering and light shading effect. Many activities on land and in the sea can increase the concentration of solids in the water and stunt the growth of nearby seagrass.

### Causes

- (1) Coastal development without taking seagrass beds into consideration.
- (2) Lack of awareness.
- (3) Lack of efficient law enforcement.
- (4) Unregulated shrimp farming.
- (5) Tin mining

### ***Coral Reefs***

#### Threats

The threats of coral reefs in the Andaman Sea may ranked as follows.

(1) Effects of coastal development. The growth of coastal cities and towns along the Andaman Sea coasts generates a range of threats to nearby coral reefs. Many households, government offices, hotels, restaurants and entertainment parlors are installed along the coasts and created a severe impact to the coral reefs. Algal blooms resulting from excess nutrients that come from sewage releases and other sources block sunlight, reducing coral growth. Shoreline construction and modification disturbs sediments, which smother corals. Unregulated tourism has destroyed the coral reefs.

(2) Overfishing and destructive fishing practices. Overfishing results in shifts in fish size, abundance, and species composition within reef communities. Evidence suggests that removal of key herbivore and predator species may ultimately affect large-scale ecosystem changes. Unfortunately, a comprehensive research on this issue is very limited in the Andaman Sea. Trawls, push net, dynamite fishing, rock lobster fishing, fishing with cyanide and other poisonous chemicals directly damage corals. In addition, the fishing nets that fishers throw into the sea cover the coral reefs and result to the death of corals.

(3) Tourism. Off islands that attract many tourists, the coral reefs are destroyed by the activities of tourists and boat anchoring by tour operators. The destroyed corals were branch corals (*Hymophora rigida*, *Acropora spp.*)

(4) Storms. The large area of coral reefs in the southern part of many islands were destroyed in 1986 by a heavy southwest monsoon. The heaviest damage occurred off the Adang-Ravee islands.

(5) Starfish invasion. From 1984 to 1986 the coral reefs around Adang-Ravee Islands were invaded by starfish.

(8) Coral bleaching. In 1991 and 1995, the sea temperature was abnormal high (31<sup>o</sup> C) for a long period during the dry season. 15-20 per cent of coral reefs were destroyed by coral bleaching.

(9) Sedimentation. In islands where there is a large mangrove forest area, the sediment is rather high that results in the slow growth of coral reef.

(10) Harvesting of coral fish and sharks. Owing to the high demand of marine ornamental fish in domestic and world markets. Many species of coral reefs as well as sea anemone are collected from the coral reefs. Sharks also are heavily exploited due to the skyrocketed price of their fins. The declining of coral fish and sharks results to the growth of coral reefs.

### Causes

The causes of these threats are:

- (1) Lack of enforcement owing to insufficient resources (budget, personnel, patrol boats, etc.) of local officials.
- (2) Lack of awareness of some local people and tourists.
- (3) Lack of knowledge on ecosystem of marine fauna and fishery resources.
- (4) Coastal construction that affect sediment transport.
- (5) Insufficient land area for development and expansion of coastal activities that lead to the landfill.
- (6) Domestic wastes from human settlement, fishing vessels and tour boats.
- (7) Uncontrolled and unmanaged quantity and quality of tourists.
- (8) Irresponsible divers and tour operators.
- (9) Conservation zoning system is not fully implemented.
- (10) Destructive fishing methods, including dynamite, trawls and push nets.

### ***Marine Fauna and Fishery Resources***

#### Threats

Marine fauna and fishery resources in the Andaman Sea are heavily exploited in the past three decades owing to the rapid increasing of demand on fish and fishery products. The total amount of fishing effort and the number of small-scale fishery households have increased year by year. The threats on these resources are ranked as follows.

(1) Overfishing. Capture fishery in the country is open access fishery thus it leads to the unlimited number of fishers. Overfishing derives from the increase in the number of small-scale fishers and in the improvement in fishing technology of commercial fishery. From the marine fishery censuses in 1985, 1995 and 2000, the figures have clearly shown that the number of small-scale fishery households in the Andaman Sea has the highest increase rate. The light luring fishing technique is employed by the commercial fishery and some high technology fishing equipments are installed on commercial fishing vessels. These have led to an increase in fishing efficiency and consequently to overfishing.

(2) Degradation of fish habitat. The destructive fishing practices, i.e., trawls, push nets, short neck clam dredge, dynamite fishing and chemical poisoning have an effect on all living resources habitats. In addition, in some coastal areas, increasing land base development pollutes coastal waters. The major pollutants affecting coastal habitats are sedimentation, increasing nutrient input from domestic discharge and industrial and mining runoff. Dumping garbage into the sea and infrastructure construction also result to the degradation of fish habitat.

### Causes

(1) Fishery resources are treated as common property and open access fishery has practiced.

(2) Out-dated fishery law.

(3) High demand on fishery resources for domestic consumption and export.

(4) The DOF is not the only agency implementing a fishery management program. There are other Departments concerned with the management program, for instance, Department of Police, Royal Forest Department and Department of Marine. In addition, the following latest restructuring of the Thai administration, a new Marine and Coastal Resources Department has been established. The new Department's mandate includes fishery resources management. Thus, it is very hard for the DOF to implement any measures efficiently.

(5) The collaboration by fishers is limited. Since fishery resources are treated as common property, they do not belong to anyone. Hence, the fishers are not willing to collaborate with the DOF in the fishery management program. They just want to catch as much as they can each day because they believe that if they follow the DOF fishery management program, they will be the losers.

(6) The law enforcement cost is very high. The construction and operational costs of patrol boats are considerable; the DOF has provided quite a big budget for them each year during the past two decades but it is still inadequate. Furthermore, it is doubtful whether the benefits from recovery of fishery resources can meet the cost of law enforcement.

(7) Low efficiency of enforcement. The limited number of staff and patrol boats compared with a coast line of 740 km allows a huge number of fishing vessels to operate various types of fishing gear.

(8) Lack of awareness on fishery resources conservation of fishers particularly commercial fishers.

## **4. Threats that have Transboundary Effects on the Health of the Coastal and Marine Environment and Its Living Resources**

Since the Andaman Sea is connected to several countries in this region as well as Indian Ocean. The threats to the Thai water areas in the Andaman Sea may create a transboundary effects on the health of the coastal and marine environment and its living resources. The followings are the ranking threats that create transboundary effects.

### 4.1 Threats to Coastal and Marine Environment

(1) Oil spill. The Andaman Sea is an transportation route of this region. There are many fishing vessels, tour boats, cargo vessels and yachts sail in this area. Thus an oil spill can be found in some area particularly piers, harbors and ports. At present, the oil spill is not a severe impact to the coastal and marine environment owing to the limited amount of oil spill. However, in the case of an accident of tankers or big vessels it will be a serious problem not only to the Thai waters but also a create transboundary effects to Malaysia, Myanmar and Indian Ocean.

(2) Water pollution. As mentioned in part 3, land-based activities have created solid waste and polluted water that discharged into the coastal area and may transfer to the neighboring countries and open sea. The transboundary effects may occur if the large amount of polluted water are discharged continuously.

(3) Marine tin mining. Although the tin mining in the sea is not active at present but it may start again one day. The tin mining concession is still available for approval and it may be approved if there is a strong political support. Marine tin mining will create a wide spread of transboundary effects on the health of coastal and marine environment.

### 4.2 Threats to Coastal and Marine Living Resources

(1) Overfishing. Thai fishing fleet has a high fishing efficiency and they exploited the fishery resources within and outside exclusive economic zone of the country. The overexploit on fishery resources of Thai fishers results to the degradation of many fish stocks in the Andaman Sea. Many pelagic species are migratory fish stock and they migrate from Thailand to neighboring countries and open sea. Overfishing in Thai waters may lead to the declining of fish stock in the neighboring country waters and open sea.

(2) Degradation of mangrove forest. The degradation of mangrove forest in Ranong and Satun Provinces may create transboundary effects on the declining of coastal and marine living resources especially fishery resources in Myanmar and Malaysia.

(3) Water pollution. The large amount of polluted water that discharge into the sea area result to the decreasing of recruitment and growth rate of the marine living resources and increase their natural mortality.

(4) Oil spill. Oil spill in Thai waters may be widely distributed to the neighboring country waters and will create an effect to coastal and marine living resources.

(5) Marine tin mining. Siltation from tin mining is a major cause on the declining of coastal and marine living resources. Silt can be transferred from Thai waters to neighboring country waters and open sea by wave and current.

## **5. National Action Plans for Coastal and Marine Environment and Its Living Resources Protection**

### 5.1 National Action Plans

Under the 9<sup>th</sup> National Economic and Social Development Plan, the coastal and marine environment protection was introduced as part of the strategy on environment and natural resources management. The plan has focused on sustainable utilization of natural resources and the environment through public participation. The objectives of the plan are:

- To establish a transparent and practicable management of resources and the environment with full participation by all stakeholders.
- To balance utilization and conservation of natural resources and establish appropriate control for supporting the basic economic system and quality of life.

#### *Goals of the natural resources and environment management strategy*

- To reform the natural resources and environment management system, with public participation, in order to manage and protect natural resources and monitor the environmental conditions and pollution point sources.
- To conserve and rehabilitate the coastal resources.
- To improve the sea water quality to meet the national standard.

In order to achieve the above goals, two directions of coastal resources conservation and rehabilitation are established as follows:

(1) To protect the conservation zone by keeping a balance between the ecosystem and utilization of resources through:

- Completing zoning to conserve mangrove areas.
- Establishing a mechanism and network for mangrove forest management in order to minimize conflicts between government and local people.
- Participation of local people in reforestation programs.

- Declaring the marine protected areas and fishery resources conservation areas. Establishing fishing zones and management measures for small-scale fishery.

(2) To rehabilitate the coastal resources through:

- Establishing a Sea Habilitation Plan that covers conservation, rehabilitation and utilization of coastal and marine resources, tourism and small-scale fishery.
- Supporting the regulations aimed at eliminating the use of destructive fishing gear, in particular trawls and push nets that destroy the coastal ecosystem.
- Declaring coastal zones along the coast line for land use purposes, and protection of coral reefs, seagrass and seaweeds.
- Restoring the beach areas damaged by erosions.
- Provide garbage and waste water treatment systems for communities and development activities along the coast.

*Thailand Policy and Prospective Plan for Enhancement and Conservation of National Environment Quality (1997-2016)*

This 20-year plan was established by the National Environment Commission to keep a balance between economic and social development, and conservation of the environment and natural resources. The two main targets regarding coastal resources are (1) to reserve not less than 160,000 ha as mangrove forest; and (2) to conserve and rehabilitate all coastal resources to maintain coastal ecosystem. The details of the plan are summarized as follows.

Coastal land development and coastal resources utilization

- The coastal land development policy should create minimum impacts on the coastal resources.
- The coastal resources utilization policy should be based on the principle of conservation and the potential of coastal resources.
- The policy on coastal and underwater land use zoning, and the establishment of regulations and measures for the utilization of those lands, should aim at protecting the environment and avoiding conflicts among users.

Conservation and rehabilitation of the coastal ecosystem

- Plan to conserve the coastal ecosystem for sustainable development.
- Plan to improve the efficiency of the mangrove forest management and ensure its continuity.
- Plan to rehabilitate the denuded mangrove forest areas.
- Plan to conserve the coastal areas and islands for sustainable development of tourism.

*Environmental Quality Management Plan (1999-2006)*

Under the framework of Thailand Policy and Perspective Plan for Enhancement and Conservation of National Environment Quality (1997-2016) there is a directive for formulation of environmental quality management plan. The environmental management plan

was aimed to materialize long-term policies and guidelines into practical action plans for 3-5 years' time as well as to provide relevant agencies of all ministries, departments and provinces, common guidelines for formulating harmonized work plans/projects and budgets.

The plan contains the following 3 frameworks:

- Urgently resolve problems on all aspects of natural resources and environmental quality degradation including restoration of natural environment, cultural environment, community environment, environmental education and public relation, and environmental technology.
- Improve organization involved in administration and managing natural resources and ensure more effective and unified coordination among relevant organization.
- Improve, revise and update laws, rule and regulations as well as change public attitude and value toward natural resources conservation and preservation of environmental quality.

The first section of the plan, which is set for a period of 8 years (1999-2006), comprises of 2 phases as follows:

#### The first phase (1999-2001)

The first phase is the implementation of work plans and projects proposed in the management plan under limitation of existing laws, rule, regulations and purviews of institutions/organizations. The implementation should be in accordance with the guidelines stated in Thailand Policy and Perspective Plan for Enhancement and Conservation of National Environment Quality, with an emphasis on formulation of priority measures/projects for rehabilitating deteriorated natural resources and environment in 6 areas: land and land use, water resources, forest, water pollution, air and noise pollution and pollution from solid waste. Simultaneously, the formulation, revision and enactment of laws, regulation and procedures to facilitate conservation and enhancement of natural resources and environmental quality for the next phase have been carried out.

#### The second phase (2002-2006)

The second phase is a continuation of work plans/project under regulations, laws and procedure, which are expected to be improved, revised and enacted during this phase.

#### Objectives of the plan

- To preserve and rehabilitates deteriorated mangrove forests.
- To enhance efficiency in managing coastal resources.
- To ensure appropriate and sustainable use of coastal resources.
- To strengthen local participation and awareness on conservation of coastal resources.

#### Work Plan

- Improvement of legislation, administration and fundamental facilities to support natural resources and environment development.
  - Monitoring and evaluation for sustainable management of coastal resources
- Revolving natural resources and environmental problems.
  - Mangrove forest management for sustainable development

- Coastal resources management for sustainable development
- Environmental management in coastal areas

*Environmental quality management framework (2002-2006)*

This framework was devised with a view to the concerned agencies to implementing measures to improve the quality of environment. The objectives of the framework are:

1. To improve the efficiency of natural resources and environment management and pay more attention to capacity building of the local people and to the participation of all stakeholders.
2. To conserve and rehabilitate natural resources and the environment for the beneficial uses only.

The strategies of the framework include;

- Declare zones for land use control along the coast line on the basis of existing laws and regulations. An announcement should be drawn up in the collaboration with the local people.
- Strictly control mangrove forest utilization by government offices and rehabilitate the denuded mangrove forests.
- Assess problems that may arise during rehabilitation of coastal resources and draw up plans for solving them.
- Declare a marine protected area (MPA) for coral reefs, seagrass and seaweed for sustainable utilization.
- Conserve or rehabilitation the depleted fishery resources of the country through the control of number of fishing boats, fishing gears, fishing season and fishing practices.
- Provide the budget and facilities for law enforcement to provinces and fishing communities and establish joint fishery patrol units.
- Support the small-scale fishery through a zoning system and support the fishing communities in their efforts to conserve and protect coastal fishery resources.
- Establish monitoring, control and surveillance systems in the coastal areas with the support of remote sensing and the geographic information system.
- Strictly control construction by the private or public sectors in the coastal areas that may create environmental impacts.
- Monitor and control all economic activities that may create impacts on the environment and natural resources (both living and non-living). Such activities shall be in accordance with all the existing laws and regulations.

*Action plan for environmental quality management at Provincial level*

This action plan is an example of decentralization. It is a short-term plan that will be formulated by the province itself and approved by the National Environment Commission. The provincial action plan consists of four components as follows.

- (1) Encourage awareness
- (2) Precaution and protection
- (3) Recovery and rehabilitation
- (4) Research

The details of each component will be formulated by the province in close collaboration with the people of the province. The budget may be supported by the Environmental Fund Office.

*Action plan on conserving and rehabilitating marine resources and the environment (1999-2003)*

This action plan was formulated by the former Ministry of Science, Technology and Environment. The objectives of the plan are:

- (1) To enhance the conservation and rehabilitation of coastal and marine resources and the environment systematically.
- (2) To promote sustainable use of marine and coastal resources.
- (3) To coordinate with ASEAN member countries on coastal and marine environment protection and problem solving.

The main activities of the action plan are:

- (1) Research
  - Studies for the purpose of drawing up a direction and measures for protecting and minimizing environmental impacts from development in coastal areas.
  - Coordinate with ASEAN countries in conducting research on DNA and tagging to ascertain habitat and spawning grounds of marine turtles.
  - Studies leading to the formulation of a master plan on beach erosion protection.
- (2) Management
  - Promote sustainable coastal aquaculture.
  - Reforest the denuded or abandoned mangrove forests.
  - Set buoys for anchoring in coral reefs.
  - Establish a national management plan and action plan for seagrass.
  - Establish measures for the conservation of turtles in the upper Gulf of Thailand and Andaman Sea.
  - Establish mineral industry zoning and mapping along the coast.
  - Establish a strategy and action plan for integrated utilization of the sea.
- (3) Legislation
  - To expedite the issuing of regulations for ornamental fish exporting.
  - To coordinate with ASEAN countries in drafting laws and regulations on transboundary pollution that impacts on coastal and marine ecosystems.
- (4) Monitoring
  - To monitor the deterioration of the environmental quality caused by harbor construction or marine mining activities, petroleum industry, coastal aquaculture, coastal industrial estate and wastes that discharge from ships.
  - To monitor water and sediment quality and the toxic accumulation in coastal aquatic living resources.
  - To monitor the red tide phenomena and develop precaution system.

## 5.2 International Cooperation on Management of Coastal and Marine Resources and Environment

The international cooperation on management of coastal and marine resources and environment that relating to the Andaman Sea coast are as follows:

### *APEC Marine Resources Conservation Working Group (APEC MRC WG)*

APEC Marine Resources Conservation Working Group was established under the Asia-Pacific Economic Cooperation (APEC) to review and endorse work plans and projects of the Working Group as well as determine Thailand's roles and responsibilities in administrating and managing coastal resources of the country and cooperating with other APEC member countries. The Working Group also responsible for recommending measures and policies to the APEC Senior Official Meeting (SOM) before further submission to the APEC ministerial and leader meeting, consecutively. The Office of Environmental Policy and Planning is Working Group's contact point for Thailand.

### *ASEAN-Australia Economic Cooperation Program (AAECP) (Phase III): Coastal Zone Environment and Resources Management Project (CZERMP)*

The OEPP has been conducting Coastal Zone Environment And Resources Management Project, a cooperation program between ASEAN and Australia. The main objective of the program was to promote sustainable development of coastal areas through establishment of the National Environment and Resource Information Centre in each ASEAN member countries. Phangnga Bay was selected as the study site under the program due to the existing of considerable diversity of marine resources, especially mangrove forests, as well as various kinds of development in adjacent areas which are likely to effect mangrove forests, beaches, coral reefs and other marine ecosystem of the bay. The program was completed in April 1998.

### *ASEAN-EU Cooperation Program Phase II: Interdisciplinary Methodologies for the Sustainable Use and Management of Coastal Resource Systems*

Cooperation program between EU and ASEAN member countries for developing and applying integrated coastal management program which divides areas and information for analysis in sectors and assesses status of natural resources and environment, activities, important issues and existing laws and regulations to be used for analysis and deliberation of appropriate management measures under existing policy framework. Phangnga Bay was one of the selected areas for the program. The program was completed in July 1999.

### *Implementation under the ASEAN Working Group on Coastal and Marine Environment (AWGCME)*

The ASEAN Working Group on Coastal and Marine Environment is responsible for management of coastal resources and protection of coastal and marine environment in ASEAN region through implantation of the ASEAN Strategic Plan of Action on Environment. OEPP is the agency responsible for Thailand's coastal and marine resources management by acting as a sub-focal point in exchanging of the database and information and

preparing Thailand's Guideline for Management and Conservation Plans for Coastal and Marine Resources.

*Implementation under the ASEAN Sub-committee on Marine Science and Technology (SCMSAT)*

OEPP is Thailand's representative in the ASEAN Sub-committee on Marine Science and Technology under the ASEAN Committee on Science and Technology. OEPP has cooperated with the Sub-committee from the Philippines in developing a project proposal on "Development of National and Regional Coastal Resources and Environmental Profile for ASEAN Region". The output of the project is to be used as baseline information for formulation of Regional Framework on Integrated Management to provide guideline for management of coastal and marine resources and environment among the ASEAN member countries.

### 5.3 Propose specific priority actions to address those threats and their causes

The coastal and marine resources in the Andaman Sea are utilized by various economic activities and result to the declining of those resources. The impact to coastal and marine environment also is in a considerable situation. Therefore, in order to reduce or eliminate the threats and their causes, the propose specific priority actions may be as follows.

- *Information improvement.* For efficient management, complete, reliable and up-to-date information is required. At present, the information for managing the coastal environment and resources in the Andaman Sea is fragmentary. For example, the biology of economically important species has not fully studied, and the fishery production from Thai waters is unknown. Therefore, comprehensive scientific and socio-economic research projects should be drawn up. In addition, remote sensing data and the geographic information system should be used.
- *Strengthening the participation of stakeholders.* The local people in the Andaman Sea have a strong desire to participate in coastal environment and resources conservation and management which would be a great advantage in solving the problems. However, at present the opportunities of their participating are limited under the existing laws and regulations and their own low level of capabilities. Therefore, in order to strengthen the participation of the stakeholders, appropriate laws and regulations should be issued. For capacity building of the stakeholders, training and information transfer projects should be developed, as well as institutional arrangements. In addition, the natural resources co-management and community-based fishery management system development project should be strengthened.
- *Joint research.* For the benefit of every country in this region, joint research on the biology of transboundary fishery resources and other common resources should be carried out.
- *Zoning.* For the sustainable use of the coastal resources, the coastal areas should be zoned according to economic activities. The zoning should be based on scientific evidence, socio-economic conditions and way of life of the local people. Once a zone is established the boundary should be clearly defined for conservation and management purposes.
- *Establishment of an information network.* An information network linking the provinces is essential for environmental protection and resources management. Therefore, the provinces in the Andaman Sea should have a well-developed information network for exchange of information.

- *Environmental monitoring.* An environmental monitoring team should be established for continuous monitoring. An annual report on the situation of the environment should be provided for the public understanding.
- *Training for young scientists.* In order to improve the capability of young scientists and increase their number, training courses or on the job training on conservation and management of the coastal environment and resources should be provided.

5.4 Actions which could be undertaken on a regional collaborative basis and their benefits.

The actions that should be under taken on a regional collaborative basis are as follows.

(1) *Management of transboundary fish stock.* Some economically important pelagic fish stock are transboundary stock. Although Thailand is the main user of these stock but their comprehensive biological information is fragmentation. The comprehensive study requires collaboration from neighboring countries, i.e., Myanmar and Malaysia. The information from the study can be used for conservation and management of these stocks. A shared stock management can be established with a collaboration among countries concerned.

The benefits from this action are:

#### National

- Fishery production for local consumption and export.
- Sustainable utilization of fish stocks.
- Maximum sustainable yield can be achieved.
- Sustainable development of Thai marine capture fishery.
- Avoid conflicts among fishers.

#### Regional

- Sustainable of fish stocks.
- Maintain biodiversity of marine living resources.
- Increase supply of fish to the region.
- Avoid fishery conflicts with neighboring countries.

#### International

- Provide fish to the world market.
- Maintain biodiversity of marine living resources.

(2) *Marine environmental monitoring.* An environmental monitoring team should be established in each country with close collaboration among them. A standard method should be adopted for comparison purpose. A pollution warning system is also required.

The benefits from this action are:

#### National

- Minimize the degradation of environmental quality.
- Avoid severe impacts from pollution.
- Better environmental protection program can be established.
- Marine living resources can be recovered.
- Tourism development.
- Better quality of life.

## Regional

- Maintain better environmental quality of the region.
- Maintain biodiversity of marine living resources.
- Available of marine living resources.
- Better quality of life.

## International

- Maintain global marine environmental quality.
- Available of marine living resources.

(3) *Establishment of sub-regional committee on environmental protection and resources management committee establishment.* Since Thailand, Malaysia, and Myanmar have connected ecosystem and there are some transboundary fish stocks all three countries have common interests. Thus a sub-regional committee is require for the environmental protection and management of transboundary stocks.

The benefits of this action are:

## National

- Sustainable utilization of marine living resources.
- Maintain environmental quality.
- Avoid conflicts with neighboring countries.
- Maintain biodiversity of marine living resources.

## Regional

- Maintain environmental quality.
- Maintain biodiversity of marine living resources.
- Close collaboration among neighboring countries.
- Available of marine living resources.

## International

- Maintain healthy environment of the sea and ocean.
- Maintain biodiversity of marine living resources.

(4) *Establishment of an information network.* An information network linking the three countries is essential for environmental protection and resources management. Therefore, the countries in this region should have a well-developed information network for exchange of information. In addition, this network should be linked to the environment warning system so that countries can avoid hazards from pollutants through the “flash information” services.

The benefits of this action are:

## National

- Available of up-to-date information.
- Avoid hazards from pollutants.

## Regional

- Available of up-to-date information.
- Avoid hazards from pollutants.

## International

- Available of up-to-date information.

- Avoid hazards from pollutants.

## 6. Information gap

Ideally, the conservation of coastal and marine environment and its living resources requires three sets of data and information, i.e., biology, economic and social. In the beginning stage, the conservation and management is mainly based on biological information. Any regulations and measures are established according to the available scientific evidences. However, in order to get a good success on conservation and management under the economic and social complexity, it is essential to use economic and social information for planning and its implementation.

The coastal and marine conservation and its living resources management in the Andaman Sea also require biology, economic and social information. However, owing to some constraints, there are some information gaps as follows.

### Biological Information

- Biology of important economically fish stocks and their biomass.
- Biology of transboundary fish stocks.
- Marine capture fishery production within Thai waters statistic.
- Total amount of fishing effort.

### Economic Information

- Valuation of mangrove, seagrass beds and coral reefs.
- Distribution of benefit from tourism industry.
- Economic lost of environment and aquatic resources that derive from destructive fishing practices.
- Law enforcement costs.

### Social Information

- Social movements on environment and resources conservation.
- Roles of social actors on environment and resources conservation.

## 7. Information to Enable Social and Economic Assessment of these Priorities, Including Identification and Analysis of Relevant Traditional Ownership and Customary Use Rights to Coastal and Marine Resources, and Their Evolution as a Result of Development

-NOT APPLICABLE-

## 8. Summarize the Results of the National Workshop.

The two days national workshop is conducted from 29 to 30 October 2003 at KU Home, Kasetsart University Campus, Bangkok. The participants are representative of government agency such as Department of Fisheries, Department of Marine and Coastal Resources, Tourism Authority of Thailand, etc. Non-Government Organization, small-scale fishery and university.

The format of the Workshop is designed by the National Coordinator and National Consultant. In the morning of first day the invited speakers presented the following topics to the Workshop for information and comments.

- BOBLME Programme
- Thailand Country Report
- Marine and Coastal Environment of the Andaman Sea
- Marine and Coastal Resources of the Andaman Sea
- Management of Marine and Coastal Resources of the Andaman Sea
- Law and Regulation Related to Environment and Resources Management

The participants are divided into two groups for brainstorming. The first group discussed on “Management for Sustainable Use of Fishery Resources” and the second group on “Marine and Coastal Environment and Resources Management”.

The recommendations of the first group are:

- All of the stakeholders should participate in management process and an appropriate training programme should be provided for them.
- Laws and regulations that apply for the management and conservation of environment and resources should be revised.
- Limit entry and zoning measures should be implemented for marine capture fishery.
- Fish habitat improvement programme should be encouraged.
- Data base for fishery sector should be established both national and regional levels.
- Post harvest practice should be strengthened.
- Joint research among countries in this region should be strengthened.

The recommendations of the second group are:

- Zoning system should be applied to all of resources.
- Participation of all stakeholders should be strengthened.
- Appropriate training programme for managing environment and resources should be provided for stakeholders.
- Comprehensive research for environment and resources conservation and management should be done continuously.
- Joint research on environment and resources among the countries in this region should be established.
- Training programme or on the job training for young scientists should be established.

## **9. Contacted Stakeholders and Stakeholders Who Could Not Be Consulted.**

### 9.1 Contacted stakeholders

Mr. Somsak Chullasorn  
 Mr. Jate Pimoljinda  
 Mr. Rangsak Chayakul  
 Department of Fisheries  
 Ministry of Agriculture and Cooperatives

Mr. Praveen Limpsaichol  
 Department of Marine and Coastal Resources  
 Ministry of Natural Resources and Environment

Dr. Pornsook Chongprasith

Department of Pollution Control  
Ministry of Natural Resources and Environment

Mr. Tanoo Nabnian  
Thailand Wildlife and Flora Protection Foundation (Southern Branch)  
24/28 Udomsuk Village, Sakdidej Road, Vichit District  
Muang District, Phuket 8300

Dr. Suvalak Satumanatpan  
Faculty of Environment and Resource Studies  
Mahidol University, Nakorn Pathom 73170

Mr. Pisit Charnsanoh  
Yard Fon Foundation  
16/8 Rakchant Road, Muang District  
Trang 92000

Dr. Heiko Seilert  
CHARM Project  
Department of Fisheries, Ministry of Agriculture and Cooperatives  
Bangkok 10903

Chairman  
Phuket Fishery Association  
21 Taladyai, Muang District  
Phuket 83000

Representatives  
Small-Scale Fishers Groups of Phangnga  
20/3 M 1, Koh Yao District, Phangnga 82160

## 9.2 Stakeholders Who Could Not be Consulted

Chairpersons or Representatives of the following groups.

Small-Scale Fishers Group of Satun Province  
87 M 15, Langoo, Langoo District, Satun 91110

Small-Scale Fishers Group of Trang Province  
202/19 Hnongyuan Road, Muang District, Trang 92000

Small-Scale Fishers Group of Ranong Province  
84 M 3 Suksamran District, Ranong 85120

Small-Scale Fishers Group of Krabi Province  
1/1 M 3 Nuaklong District, Krabi 81130

Small-Scale Fishers Group of Phuket Province  
93/6 M 2 Talang District, Phuket 83110

The Assembly of Southern Small-Scale Fishers  
36/1 Muang District, Trang 92000

Southern Coastal Resources Management Project  
57/215 Muang District, Songkhla 90100

Andaman Natural Resources Rehabilitation Collaboration Project  
32/3 Muang District, Phangnga 82000  
Fishery Association of Trang Province  
Provincial Fishery Office, 5<sup>th</sup> Floor Governor Office, Trang 92000

Fishery Association of Krabi Province  
140 M 7, Muang District, Krabi 81000

Fishery Association of Satun Province  
176/4-5, Muang District, Satun 91000

Fishery Association of Ranong Province  
170/26 M 1, Muang District, Ranong 85000

Fishery Association of Phangnga Province  
39 Takuapa District, Phangnga 82110

## References and Sources of Information

### Reference quoted in text

- ASEAN. 1986. Statistical yearbook on food, agriculture and forestry 1970-1985. ASEAN Agriculture Development Planning Center, Bangkok.
- Bhatia, U. And S. Chullasorn. 1980. Coastal fisheries on the west coast of Thailand. Paper presented at the Consultation on the Stock Assessment in Small-Scale Fisheries. 16-21 June, 1980. Chittagong, Bangladesh.
- Bhatiyasevi, U. 1997. The assessment of marine resources and marine fisheries management along the Andaman Sea Coast of Thailand. Tech. Paper No. 2/1997. Marine Fisheries Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. (in Thai).
- BOBP. 1987. Investigation on the mackerel and scad resources of the Malacca Straits. BOBP/REP/39. Bay of Bengal Programme.
- Bunruang, P. 1985. The community structure, abundance and distribution of zooplankton at the east coast of Phuket Island, southern Thailand, Andaman Sea. *Phuket mar. Biol. Cent. Res. Bull.* 39:1-13.
- Chansaeng, H., P. Boonyanate, S. Poovachiranon, N. Phongsuwan and S. Bussarawit. 1988. Project 2: Living resources in coastal areas with emphasis on mangroves and coral reef ecosystem: Subproject on inventory and monitoring of coral reefs, seagrass and soft bottom communities in the Andaman Sea. ASEAN-Australia Cooperative Program on Marine Science. Phuket Marine Biological Center, Phuket Province, Thailand. Chansaeng and Poovachiranon. 1994. The distribution and species composition of seagrass beds along the Andaman Sea Coast of Thailand. *Phuket mar. Biol. Cent. Res. Bull.* 59:43-52.
- Chatananthawej, B. and S. Bussarawith. 1987. Quantitative survey of the macrobenthic fauna along the west coast of Thailand in the Andaman Sea. *Phuket mar. boil. Cent. Res. Bull.* 47:1-23.
- DOF. 2001. Fisheries Statistics of Thailand 1998. Fisheries Economics Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. No. 6/2001. (in Thai).
- Isaranhura, A. P. 1971. Assessment of stocks of demersal fishes in the west coast of Thailand and Malaysia. FAO/UNDP Indian Ocean Fishery Commission. IOFC/DEV/71/20.
- Janekarn, V. and J. Hylleberg. 1987. The primary production along the Andaman Sea Coast of Thailand. *Phuket mar. boil. Cent. Res. Bull.* 47:1-23.
- Juntarashote, K. 2002. Coastal fishery management of Thailand. In The report of the APO Seminar on Coastal Fisheries Management, 2 to 7 December 2000. Sri Lanka. P 171-178.
- Limpsaichol, P., S. Khokkiattiwong and N. Phongsuwan. 1987. Subsurface current patterns of the Southern Andaman Sea, Trang to Satun Provinces of Thailand. Proceedings of the Seminar on Fisheries. Department of Fisheries. Bangkok. (in Thai).
- Marr, J.C., G. Campleman and W.R. Murdoch. 1976. An analysis of the present and recommendation for future fishery development and management policies, programmes and institutional arrangements for the Kingdom of Thailand. SCS/76/WP/45. Manila, Philippines.
- Nootmorn, P., R. Chayakun, and S. Chullasorn. 2003. The Andaman Sea Marine Ecosystem in Thailand. Department of Fisheries. Bangkok.
- NSO. 2001. The 2000 intercensal survey of marine fishery. National Statistical Office, Office of the Prime Minister. Bangkok.
- Office of Environmental Policy and Planning (OEPP). 2003a. OEPP 2003 Project: Thailand's National Coastal Resources and Environmental Profile. OEPP. Ministry of Science, Technology and Environment. Bangkok. (in Thai)
- , 2003b. OEPP 2003 Project: Progress Report of Situations of the Coastal Resources and Environment of Thailand. OEPP. Ministry of Natural Resources and Environment. (in Thai)

- Phasuk, B. 1987. Marine fishery of Thailand. *In* Proceedings of Seminar on Future of Thai Fisheries, 46 June 1987. The Secretariat, Southeast Asian Fisheries Development Center, Bangkok. P 324-404.
- Poovachiranon S., S. Nateekanjanalarp and S. Sudara. Seagrass beds in Thailand. *In* Proceedings Third ASEAN-Australia Symposium on Living Coastal Resources Volume 1. Chulalongkorn University, Bangkok. 16-20 May 1994.
- PCD. 2003. Assessment of marine environment. Pollution Control Division. CD ROM. Bangkok.
- Sanghaisuk, P., N. Krairapanond, C. Silpsoothorn and S. Rongrit. 2002. The implementation of the Office of Environmental Policy and Planning on management of coastal and marine resources. Office of Environmental Policy and Planning, Bangkok.
- Sutthakorn, P. And L. Saranakomkul. 1986. Biological aspects of chub mackerels (*Rastrelliger spp.*) and round scad (*Decapterus spp.*) in the west coast of Thailand. Technical report. Andaman Sea Fisheries Development Centre.
- United Nations Environment Programme. 2003. National Report of Thailand on the Formulation of a Transboundary Diagnostic Analysis and Preliminary Framework of a Strategic Action Programme for the South China Sea. (Manuscript).
- Wium-Andersen. S. 1977. Primary production in water around Surin Islands off the west coast of Thailand. *Phuket mar. boil. Cent. Res. Bull.* 16:1-4

Materials consulted during the preparation of this national report but they were not specifically cited

- Anonymous. 1997. Status of fisheries in the Bay of Bengal. Paper presented in the Tenth Session of Indian Ocean Fishery Commission: Committee for the development and management of fisheries in the Bay of Bengal. 24-25 September 1997. New Delhi, India.
- Bay of Bengal Programme. 1986. Atlas of deep water demersal fishery resources in the Bay of Bengal. Food and Agriculture Organization of the United Nations. BOBP/WP 53. Colombo.
- , 1996. Towards Sustainability: Needs and concerns of aquatic resources and fisheries in the Bay of Bengal Region and project ideas to facilitate their sustainable management. BOBP REP/71. Bay of Bengal Programme. Madras.
- , 1998. Emerging trends and prospects in fisheries management. Bay of Bengal Programme. Madras.
- , 1999. Report of the 21<sup>st</sup> Meeting of the Advisory Committee: Integrated coastal fisheries management. 12-13 February 1997, Bangkok, Thailand. BOBP REP/75.
- , 1999. Report of the 24<sup>th</sup> Meeting of the Advisory Committee: Integrated coastal fisheries management. 13-16 October 1999. Phuket, Thailand. BOBP REP/83.
- , 2000. Learning of the Third Phase of the Bay of Bengal Programme for Coastal Fisheries Management, 1994-1999. BOBP/REP/85. Chennai.
- CHARM. 2002. Technical Proposal of the Coastal Habitats and Resources Management. EuropeAid/11145/C/SV/TH. International Marine Dredging Consultants N.V. and Agriconsulting S.p.A.- Italy.
- Department of Fisheries. 1998. Pilot project for marine ecosystem protection and eco-sustainable development in the Adang archipelago Tarutao Marine National Park – Andaman. Department of Fisheries. Bangkok.
- Nootmon, P. unknown. The Phangnga Bay and adjacent areas, Thailand. (Manuscript).
- Saraya, A. 1997. Thematic report on situation analysis of Thai marine fisheries and the DOF policy for the rehabilitation and management of the sector. Department of Fisheries. Bangkok.
- Satumanatpan, S. 2002. Review on National Legislation for seagrass conservation, Thailand. Faculty of Environment and Resources Studies, Mahidol University. Bangkok.

