PART III MASTER PLAN AND SHORT TERM DEVELOPMENT PLAN FOR FISHERY COMPLEX

5. MASTER PLAN FOR FISHERY COMPLEX

5.1. Present Fisheries Sector and Its Future Projection in Project Site

5.1.1. Socio-economic Conditions in the Phuket and Phang-nga Provinces

Phuket has made steady and substantial economic progress during the period of 1990 to 1994. The nominal GRP in 1994 was Bt. 20.1 billion with an average annual growth rate of 7.7%, and a per capita GRP of Bt. 108,652. With respect to the industrial structure, the main industry is tourism and the service industry has 24.6% share of the Gross Provincial Products (GPP). The agriculture sector is second and contributed 17.3% of GPP in 1994, followed by the transport and communication sector (15.3%), commercial (13.6%), banking and insurance (9.1%), manufacturing (6.4%), construction (6.1%) and others. Of the agriculture sector, the fishery sector comprises 69.9%, thereby contributing to the aggregate production of goods and services in the province by 12.1%.

In general, economic activities in Phang-nga province depends on the agricultural sector, especially rubber production, and tremendous development potential of tourism and other industries remains untapped. Numerical data associated with economic activities of the Phuket and Phang-nga provinces is given in Table 5.1.1 and 5.1.2.

The financial system of the local government in Thailand is based on cash accounting and balanced finance. The budget balance at the end of fiscal year (30 September) is carried forward as an opening balance for the following year. In 1995, 118.7 million baht were carried forward, accounting for 5.7 percent of the total provincial budget in Phuket. The 1995 provincial budget of Phuket and Phang-nga provinces were 2.0 billion baht and 1.27 billion baht, respectively and average annual increase rates during the past five years were 24.7% and 25.4% in nominal account. The fiscal budgets of Phuket and Phang-nga provinces are shown in Table 5.1.3.

MLSW estimates around 20,000 and 26,290 alien workers, mostly from Myanmar in Phuket and Phang-nga provinces. The numbers are almost 10% of total provincial population. Rubber plantation and fisheries absorb most of the work force both in Phuket and Phang-nga, accounting for 67-70 percent and 83 percent, respectively. Statistics on alien workers in the provinces are shown in Table 5.1.4.

5.1.2. Fisheries Sector

(1) Fisheries Sector in Phuket Province

1) Fish Landing Site in Phuket

There are three landing sites for commercial fisheries in Phuket Province. One is in Siri Island in Muang, Sapam in Muang, and the third is Sarasin in Thalang. Sarasin is a base for squid fishing boats, and fishing boats operate there from October to April of the following year. A small jetty was under construction by DOF as a small-scale fisheries development project in February 1996. In contrast, Sapam is controlled by fish agents as a coastal fish landing site.

There are two types of landing sites on Siri Island, the FMO Fishing Port and the private landing sites. The private landing jetties are owned and used only by resident fish agents or processing factories in Phuket. Meanwhile, fishing boats from outside areas such as the Gulf of Thailand, use the FMO landing site. In order to resolve the congestion at the FMO Fishing Port, construction is underway to expand the wharf and mooring space.

Japanese purse seiners which operate in the eastern area of the Indian Ocean, unload their catch at the Phuket Commercial Port located in the southern part of Phuket, due to the shallow waters of the FMO Fishing Port.

2) Fishing Ground and Fish Production

The major fishing grounds at Phuket extend off the coast of Phuket to Ranong (border of Myanmar) in Myanmar waters. Some fish agents dispatch their own boats to the Indian Ocean, Malaka Straits, etc. Fishing boats from the Gulf of Thailand operate in this area during the lean season in the Gulf of Thailand (November to February).

In addition, Taiwanese long line boats which operate in the Indian Ocean have begun landing tuna at the Phuket FMO Port since August 1995. Much of this tuna is exported mainly to Japan as fresh fish for "sashimi".

The landing volume at Phuket decreased from 81,379 tons in 1988 to 63,832 tons in 1993. This was caused by a decrease in trash fish from 49,490 tons to 19,760 tons. In contrast, the landing volume of commercial fish increased from 29,869 tons to 37,187 tons (see Fig. 5.1.1 and Table 5.1.5). The peak landing volume was in March in 1988 through 1990, in May in 1991, in June in 1992, and in April in 1993 (see Fig. 5.1.2 and Table 5.1.6).

3) Main Fishing Methods

Commercial fisheries employ trawls, purse seines, and long lines in Phuket.

a. Trawler

According to DOF, a fishing trip for a 18 to 25 meter boat is 16 to 19 days in the Andaman Sea and 32 to 38 days in Myanmar territorial waters (see Table 1.2.3).

Phuket is the base port for trawlers of more than 18 meters in length. A fishing trip for 20 to 24 meter trawlers operating off the shores of Sumatra or Thai territorial waters bordering the Malaka Straits, is 7 to 15 days and 1.5 to 4 months if fishing is carried out in Myanmar territorial waters or the Arafura Sea in Indonesia. Carrier or collection vessels are also used for long trips. A carrier vessel capable of transporting 40 to 50 tons of fresh fish has been known to collect the fish of eight 70 GT trawlers twice in one month during fishing operations carried out in Myanmar territorial waters.

b. Purse Seiner

Phuket is the base port for 18 to 25 meter purse seiners. The fishing grounds of purse seiners are mainly located in Thai territorial waters; and one fishing trip lasts one to two days. Normally, they depart around 5 p.m. and return at 8 a.m. of the following day or the second day. Some purse seiners operate in Myanmar territorial waters for more than two months per trip. They also use collection vessels to transport their catch from Myanmar to Phuket.

c. **Long Line Fishing**

Long line fishing trips in the Indian Ocean last 15 to 30 days per trip. Long line fishing is mainly carried out by Taiwanese FRP boats, 13 to 20 meters long with a capacity of 20 to 40 GT. However, large-scale Chinese fishing boats (30 to 35m in length, 6 to 8 meters wide, with a depth of 2.5 to 3.5 meters) have begun operating in Phuket from February 1996. These large boats arrive and depart from the port only during the high tide due to the shallow water depth of the port.

d. **Unloading**

The unloading time for a trawler is four to five hours and 90 minutes to two hours for a purse seiner at the FMO Fishing Port. The unloading time for trawlers is longer since their catch is composed of many fish species, and a longer period of time is required for sorting and selection.

In addition, tuna long line boats require two to three hours to pack and transport their fish to the airport from the time the catch is landed. As a result, the landing of a long line catch must be synchronized with flight schedules. This is a major difference between the landing of trawlers and purse seiners. Tuna long line fishing boats are managed by Taiwanese fishermen and fish agents. In order to avoid conflicts with Thai fishermen using the FMO Fishing Port, preparations for long line fishing boats are often done at midnight.

4) **Number of Fishermen and Fishing Boats**

In a comparison of 1985 and 1995 fishery census statistics, the number of fishery establishments increased slightly from 1,098 to 1,274 and coastal aquaculture rose from 16 to 178. In contrast, the number fishery employee households decreased sharply from 1,063 to 694 (see Table 5.1.8).

The capacity of fishing boats in Phuket is larger than boats in other provinces. Of the 431 boats registered in 1994, 162 fishing boats (38%) were more than 18 meters in length. Of this number, there were 104 otter board trawlers and 45 purse seiners (see Table 5.1.9).

The number of registered trawlers and purse seiners engaged in commercial fishing has decreased from the peak period of 1989 to 1990. Otter board trawlers dropped from 150 boats in 1989 and 1990 to 110 in 1994 and purse seiners decreased from 79 to 51 boats for the same period (see Fig. 5.1.3). The number of pair trawlers has remained at around 90. These fishing boats are owned by local fish agents and boat owners in Phuket, and they mainly utilise private landing sites. In contrast, fishing boats owned by fish agents and boats from other provinces use the FMO Fishing Port.

Phuket and Myanmar territorial waters are the major fishing grounds for boats based in Phuket. However, the number of boats has decreased in recent years due to closure of Myanmar territorial waters, damages incurred from the typhoon in Bangladesh, the transfer of fishing boats to Ranong following infrastructural improvements to the Ranong FMO Port, etc.

(2) Phuket FMO Fishing Port

1) Landing Volume

The annual landing volume at the FMO Fishing Port decreased from a peak of 39,343 tons in 1989 to 24,558 tons in 1994. This is mainly attributed to a decrease in the landing volume of trash fish. The landing volume of commercial fish fluctuated between 25,000 to 30,000 tons in 1988 to 1994. However, the annual landing of commercial fish also decreased to about 22,000 tons in 1995 (see Fig. 5.1.4 and Table 5.1.10). According to monthly landing records, a peak volume was seen in March and April from 1988 to 1995. But this trend has declined since 1993 (see Fig. 5.1.15 and Table 5.1.11).

In addition to trawlers and purse seiners, Taiwanese long line boats have also unloaded tuna at the FMO Fishing Port in Phuket since 1994. Nearly 500 tons of tuna was unloaded at this port from August to December in 1994 and 345 tons from January to April in 1995. The unloaded catch was mainly comprised of tuna (more than 80%) such as yellow fin, bigeye, and marlin.

(3) Number and Capacity of Fishing Boats

1) Number Fishing Boats According to Fishing Methods

The number of fishing boats utilising the Phuket FMO Port has been reduced in recent years. The interview survey was carried out to confirm the possibility of using the Phuket FMO Port. The interviewees were fish agents along the Gulf of Thailand, such as Samut Sakorn, Samut Prakran, Pattani, etc.

As the result, all of the fish agents, including fish agents who were associated with companies at the Phuket FMO Port, had negative opinions about using Phuket FMO Port. These fish agents were composed of two groups. One group operated in the Andaman Sea, and the other operated in the Indonesian territorial waters such as Arafula Sea. The reasons for not using Phuket FMO Port are as follows :

Group of Fish Agents	Reasons
Operating in the Andaman Sea	• Their bases are in Ranon or Satun which are the closet to their fishing grounds in joint ventures with Myanmer or Malaysia. • Landing volume from the fishing grounds near Phuket has been declining.
Operating in the Indonesia	• They have no experience operating in the Andaman Sea. The results of the fishing survey was very poor in the Andaman Sea. • They have connections with fish agents in Indonesia, but not in Myanmer or Malaysia.

In the other hand, as the results of the field survey for fish agents in Phuket FMO Port, 93 trawlers, 35 purse seiners, and 71 long line boats (53 Taiwanese and 18 Chinese boats) utilised the FMO Fishing Port in June 1996.

Fishing boats from other provinces which used the FMO Fishing Port were mainly boats having relations with fish agents on the FMO side. However, resident boats in Phuket also use the FMO Port when their landing site is congested. As mentioned earlier, the number of fishing boats operating in the area is not indicative of the number of fishing boats utilising the port, since trawlers operating in Myanmar waters transport their catch by collection vessels.

The largest number of fishing boats using the FMO Fishing Port in one day from January 1994 to May 1996 was 38 boats in 1994, 43 boats in 1995, and 48 boats in 1996. Most of these boats were purse seiners (see Fig. 1.2.6 and Table 1.2.7). The number of long line boats were not included in the peak season since Taiwanese long line boats migrate to Phuket only during the winter season. There were 72 Taiwanese boats utilising the FMO Fishing Port as their base in 1994 and 99 boats were registered in 1995. In addition, Chinese boats have begun to use the port as their base of operations since February 1996 after contracting with Taiwanese fish agents based in Phuket.

2) Capacity of Fishing Boats

The capacity of fishing boats that utilised the FMO Port from January 1994 to May 1996 were mainly 46 to 60 GT (see Fig. 5.1.9 and Table 5.1.12). Typical specifications of Thai fishing boats are shown in Table 5.1.13.

Nearly one half of the long line boats were Taiwanese boats in the 30 to 40 ton class, but six 70 ton class fishing boats were also registered. In contrast, Chinese long line boats were in the 170 ton class and larger than Taiwanese vessels.

5.1.3. Projected Landing Volume and Number of Boats

(1) Development Potential in the Indian Ocean

Present tuna resources has been reported in Indian Ocean by several organisations. As mentioned on Table 2.3.8, Skipjack was unlikely to be over-exploited, and fishing pressure for Yellowfin in western Indian Ocean was likely to range from moderate to above the sustainable level, even ITPT mentioned that more analyses were needed to clarify the situation of the stock. On the other hand, National Research Institute of Far Seas Fisheries, Japanese Fisheries Agency, reported that there was still some room for develop the Skipjack resources in the Indian Ocean. Suzuki also reported that condition of Yellowfin sub-stock was middle used or almost maximum sustainable yield, and Skipjack was middle used, possible to increase production by increase CPU in the Indian Ocean (Suzuki "The Resources Management of Tuna in the World" Suisan Shinko No 316, 1994).

Even all the reports have not clarify the Maximum Sustainable Yield (MSY) of stocks, it has reported that stock of Skipjack has room to develop, Yellowfin also has some room or almost reached MSY, and stock of Bigeye has been utilised MSY level.

The purse seine targets Skipjack and Yellowfin, and longline targets Yellowfin and Bigeye in the Project. Fishery resource should be developed less than MSY level for sustainable development. As a result of existing studies mentioned above, it was considered that there was the possibility to develop Skipjack stock and Yellowfin stock in the Indian Ocean.

(2) Development Potential in the Andaman Sea

DOF has reported that fisheries resource was over-exploited in the Andaman Sea. As mentioned on "2.3.3 Problems in the Fishery Sector", many Thai fishing boats have moved their fishing grounds to the outside of Thai waters such as Myanmer and Indonesia, due to decrease catch.

Since the "United Nations Convention on the Law of the Sea" has effected in 1994, ratified countries have been obligated to manage fisheries resources in the EEZ. The neighbouring countries of Thailand, such as Myanmer, Indonesia and Malaysia have already ratified "United Nations Convention on the Law of the Sea", while even Thailand has not ratified it yet. These ratified countries have obligation to establish Total Allowable Catch (TAC) based on the resources. Therefore, it is considered that there is quite low possibility to increase fish production in these countries.

The main fishing ground for existing Thai fishing boats is limited in less than 90 meter water depth, due to the performance of fishing boat. Because of this less than 90 meter water depth area has been over exploitation, target for fishery development should be resources in more than 90 meter water depth area, if fishery development will carry out in the Thai water. However, Hayase suggested there is a possibility to supply the demersal fish resources from the continental shelf that water depth is about 200 meter to fishing area (less than 90 meter water depth) in the Andaman Sea (Hayase Marine Fisheries in Thailand, JICA 1988). The fishery development on continental shelf with the unknown resource condition would be caused over exploitation of whole of the Andaman Sea.

The sustainable development of Thai territorial water is one of the target of the National Fisheries Development Plan, and it was estimated 280 thousand tons of fishery production from the Andaman Sea in the Plan. However, there was landed about 800 thousand tons from the Andaman Sea in 1993. The real production volume from the Thai territorial water was not clear, because of these 800 thousand tons included catch from the boats that operated in neighbouring countries. However, from the view point of resource condition and development policy, it is very hard to consider that production volume will increase in the Andaman Sea.

(3) Projection of Fisheries in Phuket

1) Introduction of Stock Management for Offshore Fishing

According to DOF reports, fishery resources have been overexploited in Thai territorial waters. As a result, CPUE (per hour) decreased both in the Gulf of Thailand and the Andaman Sea from 1981 to 1990 (see Table 5.1.14).

In addition, as mentioned earlier, the number of fishing boats utilising the FMO Fishing Port in Phuket has also decreased. In view of lowered CPUE and the removal of fishing boats to the major fishing port at Ranong, the possibility of raising the number of fishing boats utilising the FMO Fishing Port in Phuket is dim. According to an interview survey of the Phuket Fishermen's Association, fishermen were negative on new investments in fisheries under the present conditions.

Based on these circumstances, it can be said that fisheries in Phuket is in transition. Development in offshore fisheries in Phuket has ended and the next phase is the introduction of fisheries based on resource management. If present conditions persist, fishery resources will be overexploited and CPUE will continue to decrease.

2) Conversion of Present Fishing Methods to Tuna fishing in Open Sea

Objectives of Fishery Complex Project will be set forth to develop not only coastal fishing in the Andaman Sea but also tuna fishing in the Ocean Indian. To achieve the latter development, the Thai Tuna Ocean Fishery Cooperative based in Phuket has been established and investigating possibility of the tuna and skipjack purse seine fishing in the deep sea based in Phuket Fishing Port. On the other hand, tuna long-line fishing and skipjack pole-and-bait fishing are considered easier than that purse seine fishing with larger boats and good performance of the fishing is reported in foreign countries in Indian Ocean.

According to the statistical data of the FAO, total annual catch in the world was reached to 109.6 million tons in 1994 with increasing 7.3 millions tons from the catch in 1993. In the past, the pessimistic opinion from FAO on fishery resources prevailed with assumption of overexploitation of resources, however, some fishery scientists insist that there still remain exploitable fishing grounds in the world for small scale fishing except commercial fishing by larger boats Namely, it is said that existing fishing grounds are for financially feasible operation by larger vessels and that undeveloped fishing grounds are for fishing with good returns by small fishing boats due to low operation costs. The discussion is held considering potential fishing grounds inhabited by the pelagic migratory fish in the mid-depths. Therefore, it is considered that development of pelagic fishing by Thai boats be required in the waters offshore Phuket Island, the north and west waters of Sumatra Island and the vicinal waters of Andaman Islands. According to a leading Japanese fishing company which planned operation of a skipjack canning factory with a cold store in capacity 3,000 tons in Panda Ache, North of Sumatra, certain schools of skipjack are migrating in the above waters and resources might be available for supplying about 2 or 3 factories of skipjack canning factories.

The size of skipjack around the waters is little smaller than that migrating coastal waters in Japan in the warm current, however, remarkable local production of the skipjack by the numbers of pole-and-bait fishing boats is expected when this fishing method is mastered by Thai fishermen.

Regarding resources of yellowfin and big-eye tunas, Banda Sea is widely known as the one of abundant fishing grounds where the species migrate for spawning from the Indian Ocean through the straits of Timor Islands seasonally from September to April next year. Chinese and Taiwanese long line tuna boats based in Phuket Fishing Port are operated to catch the species as the above. When these schools of tunas are in situation of dissemination, the fishing tunas with larger fishing boats is not commercially practicable due to high operation costs. From 1996, however, smaller Taiwanese and Chinese long-line boats are operated in the said fishing grounds for the whole year under lower operation costs.

In the course of such operation by the foreign boats, the fishing method is becoming familiar with Thai fishermen, who are interested in long line fishing with intention to establish joint venture companies between Thai fish agents and foreign agents.

The fishermen's intention is demonstrated because the present methods of purse seine fishing and trawl fishing are getting into commercially worse operation which has been reducing operation efficiency of the existing fishing fleet.

It is considered that tuna long-line fishing will be operated by Thai fishermen to develop new fishing grounds, if the fishing technology is transferred to the Thai fishermen through the operation by the foreign boats. Therefore, the tuna fishing is expected to play an important role of prospective development of Thai fishing based on Phuket Fishing Port.

Fishing boats to be used for this method will be easily prepared with improving of the existing Thai fishing boats by fitting necessary equipment. In general, a typical Thai wooden boat has relatively wide space from stem to a wheelhouse located at stern side and the possibility of the improvement is expected to improve the Thai boats into the pole-and-bait fishing and long-line fishing boats. The following description is for information on baits for the fishing and improvement of boats for skipjack pole-and-bait fishing and tuna long-line fishing.

* Tuna Long-Line Boat.

A gate is opened on gun wall at starboard side for loading hooked tuna from the sea and a hydraulic line hauler is installed close to the gate. A large reel for main line ranging from 10 km to 15 km is installed in the stern of the boat. The above equipment, installation of a gate and fishing gear (buoys, main long-line, branch line, wire line and hooks (2,000 - 3,000) etc. will be required for long-line fishing operation and investment in the equipment is estimated at about 350,000 Baht except installation costs.

The baits to be used for long line fishing are saury, scad and squid etc. Milk fish (Chanos Chanos) cultured in the southern Thailand, which is good for resistance off from hooks and brightens in the water, is used as baits by Japanese tuna long-line boats. Therefore, milk fish is recommended as easily obtainable baits for tuna fishing in the Thailand.

* Pole and Bait Skipjack Fishing Boat.

A part of fish hold is arranged for storing live baits (Vivarium) and fish net of small mesh is prepared vertically between a bow mast and a bridge for protection of hooked skipjack to fly across a boat. Small passages along outside the gunwale is arranged for as fishing deck, and a water pipe line outside the gunwale and electric motor pumps are provided for spraying water to the sea. Total amount of sea water spray pipe, spray valves and spray pumps is estimated at about 100,000 Baht except installation costs.

Necessary baits to be used as small live baits (sardine, anchovy) for skipjack fishing are abundant in the sea surrounding Phuket Fishing Port. These species are popular as raw materials for fish sauce and dried fish. These species will be supplied easily to skipjack fishing boats by the local fishing boats.

(4) Projection of Fishing Boats in Phuket

1) Fishing Boats in Offshore Fisheries

According to DOF reports, fishery resources have been overexploited in Thai territorial waters. As a result, CPUE (per hour) decreased both in the Gulf of Thailand and the Andaman Sea from 1981 to 1990.

The major fishing grounds for boats based in Phuket are located around Phuket and in Myanmar territorial waters. However, the number of boats operating in this area has decreased from 900 in 1993 to 672 in 1995, due to the closure of Myanmar territorial waters, damages incurred by the typhoon in Bangladesh, the removal of fishing boats to Ranong following infrastructural improvements of Ranong FMO Port, etc. In contrast, the total number of purse seiners landing their fish increased from 3,506 in 1993 to 4,178 in 1995; and the total number of boats landing their fish catch at the FMO Fishing Port has increased. However, the fish landing volume at this port has stabilised in recent years, but it decreased in 1995 (see Fig. 5.1.10). There is a strong possibility that CPUE is decreasing in contrast to a rise in CPU and this fact appears to endorse the idea of overexploitation of resources in the Andaman Sea. As mentioned earlier, offshore fisheries in Phuket Province can no longer continue to increase its fish landing volume and sustainable development must be targeted through resource management.

In view of the existing circumstances, it is not likely that there will be an increased number of fishing boats from other provinces or new investments in fisheries which will increase the number of fishing boats in Phuket Province. According to the interview survey of the Fishermen's Association in Phuket, negative opinions were expressed by fishermen on the purchase of new fishing boats, excluding new replacements of depreciated boats. As a result, it was concluded that the number of trawlers and purse seiners at the FMO Fishing Port was currently at maximum and that any new boats in future would simply be the replacement of depreciated boats.

2) Number of Long Line Boats

Although the ITPT has not reached any conclusive decision on tuna resources in the Indian Ocean, the Far Seas Fisheries Research Institute in Japan has reported that an increased volume in bigeye catch cannot be anticipated with a corresponding rise in CPU. CPUE for yellowfin is shown in Table III for the long term for long line and purse seine boats, but there is still room to develop skipjack resources.

According to Fishery Statistics of the FAO Yearbook, the annual landing volume of tuna in the Indian Ocean has been about 17,000 tons for skipjack, 30,000 tons for yellowfin, and 10,000 tons for bigeye since 1989, despite annual fluctuations (see Table 5.1.15).

Although it is said that tuna resources in the eastern part of the Indian Ocean is less than the western area, it is believed that there is still room for purse seiners to develop skipjack resources, aside from the benefits. However, the future outlook for rapid development of long line fishing that targets bigeye and yellowfin is limited.

Despite these circumstances, Taiwanese long line boats have shifted their base port from Singapore to Penang in Malaysia to Phuket in pursuit of convenience and short cuts to fishing grounds in the Indian Ocean. Of these three ports, the FMO Fishing Port in Phuket is the nearest location to the fishing grounds and to Phuket international airport with direct flights to Japan, the consumer site. Therefore, long line boats that are based in other ports would be attracted to the FMO Fishing Port in Phuket, if it is developed and expanded.

In addition, recent studies have found that long line fishing operations in the Indian Ocean which were restricted to the winter season in the past, could be carried out in the summer as well. As a result, some long line fishing vessels (Chinese boats) have begun year long fishing operations since 1996. Taiwanese fish agents who operated 72 long line boats in 1994 and 99 boats in 1995, are planning to use the same number of Chinese boats in 1996. However, the Phuket FMO Fishing Port has been unable accommodate more than the current number of fishing vessels, due to congestion.

Based on these circumstances, it is estimated that approximately 200 long line boats, the same number as the present plan, will be based at Phuket by the short term target year of 2002.

Taiwanese long line boats have changed their base port northward from Singapore to Penang, in order to procure a base port in close proximity to fishing grounds. According to findings obtained from interviews with fish agents, about 100 small-scale Taiwanese long line boats are based in Penang, although there is no registered record of them. It is believed that in conjunction with improvements to the fishing port in Phuket, these long line boats based in Penang will also move their base port there, in order to be closer to their fishing grounds.

Many Thai fishermen are also interested in long line fishing, due to the success of tuna long line fishing boats. DOF is promoting the development of deep sea fisheries by purse seines and long lines in the Indian Ocean. Some Taiwanese fish agents have been positive about possible joint ventures with local Thai fishermen. According to one Taiwanese fish agent, there were more than ten inquires about joint ventures or technical transfers from Thai fishermen.

It is estimated that the number of long line boats will increase to about 300 in 2012 since there is a high possibility that Taiwanese boats will transfer their base port from Penang to Phuket following improvements to the FMO Fishing Port.

Presently, there are only foreign long line boats from Taiwan and China in Phuket. The objective of DOF is to develop long line fishing among Thai fishermen. Therefore, a development plan which includes demonstrations, technology transfer, etc., similar to the development plan for tuna purse seiners, is required.

3) Number of Tuna Purse Seines

Currently, TTOFIC is promoting tuna purse seine fisheries in the Indian Ocean; and it has drawn up a plan to purchase three purse seiners using the capital collected from 42 members. The amount of the joint contribution was 20 million bahts as of July 1996.

Rapid development of tuna purse seine fisheries in Thailand is difficult, due to the high initial investment cost (one new purse seiner is about 250 to 380 million bahts). However, if TTOFIC is able to purchase one purse seiner by 2002 and its operation is successful, the organisation will be able to purchase three additional boats by 2012.

Japanese purse seiners operating in the Indian Ocean have decreased in recent years. But due to the restriction on the number of Japanese fishing boats which operate in the Indian Ocean, with no foreseeable possibility of permission to increase the number of Japanese boats in other fishing grounds, the two Japanese purse seiners presently operating in the Indian Ocean are expected to continue their activities.

(5) Projection of Fish Landing Volume in Phuket

1) Landing Volume of Offshore Fisheries

The landing volume of offshore fisheries is not anticipated to increase rapidly since the industry has been adequately modernised and motorised and the fishery resources have been overexploited. The fish landing volume of trawlers and purse seiners at the FMO Port will be limited to the existing volume for the next ten years, despite the introduction of resource management based fisheries.

The monthly total landing volume and the monthly commercial fish landing volume at the FMO Port from 1988 to 1995 are shown on Table 5.1.16 and 5.1.17. The peak total landing volume was in March for five out of eight years, but that trend has changed since 1993.

The daily landing volume for the peak months of September 1994 and January 1995 is shown in Table 5.1.17 and 5.1.18. The top ten daily landing volume in September 1994 ranged from 107,489 kg to 314,528 kg and from 133,774 kg to 355,596 kg in January 1995. However, the maximum daily landing volume for each year has been recorded in other months as well (see Table 5.1.19).

2) Landing Volume of Tuna Long Line Fishing in the Indian Ocean

One Taiwanese fishing trip for a 40 GT class of tuna long line boat is about 11 to 17 days and one month per trip for a 70 GT boat, including the six days for the round trip to the fishing grounds and back. The catch is kept in an insulated fishhold with ice and water and the export ratio of a fish catch for a one month trip was 60 to 70 percent. The average catch per trip for a 40 GT boat was about 7 tons (5 to 10 tons, see Table 5.1.21) and 10 tons (5 to 18 tons) for a 70 GT boat. Generally, 40 GT boats will return to port after their catch has reached 10 tons, but in some cases, fishing has been known to be carried out for 30 days. However, in order to maintain the freshness of their catch, the recent trend is to limit fishing to 15 days, irrespective of the fish catch volume. The fish catch of long line fishing is fresh and it is shipped to the sashimi market in Japan. As a result, it is anticipated that the trend to limit fishing operations to 15 days will continue. Subsequently, the average catch per trip is estimated at 7 tons, with some variations due to the different capacity of each boat. Nearly 60 percent of this catch will be exported to the Japanese market.

Long line fishing boats require three days of rest and preparation. Therefore, a total of 18 days is needed for a 15 day fishing operation. In addition, approximately one month per year is needed for boat maintenance. Therefore, the number of fishing trips per year is 19.

Number of fishing trips/year = (365 days - 30 days) / 18 days = 18.6 = 19

Therefore, the annual landing volume of one boat is estimated at 133 tons, of which 79.8 tons are exported.

Approximately 200 fishing boats are expected to be in operation in 2002; and the annual fish landing volume of tuna long line boats at Phuket is estimated at 25,200 tons, of which 15,120 tons will be exported.

3) Landing Volume of Tuna Purse Seiners in the Indian Ocean

In 1995 the DOF carried out five trial tuna purse seine operations in the Indian Ocean using their own research vessel. The results of these trial operations were below that of Japanese boats operating in the same waters (see 5.1.22). Factors such as the limited number of operations, an inadequate number of payau, etc. were some of causes underlying the poor results.

The average catch of one trial operation was 133 tons. But in a real fishing operation lasting 45 days (7 days for the round trip to the fishing grounds and back, and 38 days of fishing) 480 tons of catch per trip is estimated for 38 fishing operations.

If the annual number of trips made by purse seiners is six, the annual fish landing volume per boat is estimated at 2,880 tons.

The current fishing landing volume of Japanese purse seiners for one operation averages 550 tons. The average length of one fishing trip is one month and five days are required for preparation and fish landing. In addition, one month is required for boat maintenance annually. Based on these factors, it is estimated that an annual 4,950 tons of fish are landed in nine operations per year by one tuna purse seiner.

4) Projection of Total Fish Landing Volume in 2002 and 2012

Based on the projections described above, the landing volume and the number of fishing boats are as follows.

	2002			2012		
	Annual landing / boat	No. of Boat	Total landing	Annual landing / boat	No. of Boat	Total landing
Off-shore fishing	1,348 ton	46	62,000 ton	1,348 ton	46	62,000 ton
Tuna Longline	133 ton	200	26,600 ton	133 ton	300	39,900 ton
Tuna Purse seine						
Thailand	2,880 ton	1	2,880 ton	2,880 ton	3	8,640 ton
Japan	4,950 ton	2	9,900 ton	4,950 ton	2	9,900 ton
Total			101,380 ton			120,440 ton

As the result, the estimated landing volume on Phuket FMO Fishing Port is 101,380 ton in 2002, and 118,340 ton in 2012.

5.1.4. Fish Marketing and Processing

(1) Present Situation of Fish Marketing and Processing in the Project Site

1) Fish Agent

There are eighteen fish agents in Phuket and ten of them are engaged in business at the FMO Fishing Port. The remaining agents operate outside of the FMO Fishing Port. Fish agents organize their fishing boats into one group with other boats owned by other owners. They are also closely connected with other boat owners through credit ties and monopolize the fish transactions.

2) Fish Transaction System

All fish unloaded in Phuket are transacted through fish agents. Transactions at private jetties are all carried out through direct consignments. Transactions at the FMO market are conducted through direct consignments and auctions. However, the number of transactions carried out through direct consignments is higher than transactions made through auctions (refer to Table 1.4.1). Shrimp and squid are sold through auctions. Fish agents participate in auctions along with buyers such as middlemen, retailers and processors. If a fish agent wins in an auction, he pays the fish agent of a seller, who in turn pays the fisherman after deducting a 3 percent commission and miscellaneous expenses (ice, fuel, advance payment).

3) Fish Marketing Volume and Destination of Fish

According to FMO in Phuket, 24,000 tons of fresh fish were unloaded at the FMO port in 1994. Of this volume, 16 percent were consumed locally and the remainder was transported out of the province. Major destinations outside the province were the FMO and processors in Samut Sakhon and Bangkok. Their share was 27 percent and 26 percent, respectively. The remaining 19 percent was transported to Hat Yai/Songkhla and 12 percent was sent to Phang-nga, Krabi and Trang. Some fresh fish are exported to Malaysia and Singapore through Hat Yai.

In addition to this fresh fish, frozen skip jack/tuna which was unloaded at the commercial port was transported over land to processing factories in Songkhla. This volume was 14,000 tons in 1995.

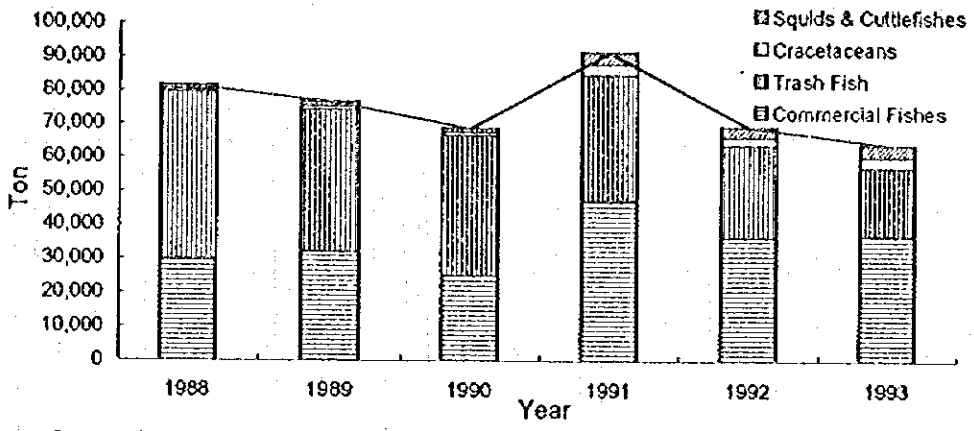
In addition, fresh tuna which was unloaded at Phuket commercial port, was transported by air from Phuket International Airport to Japan through fish agents.

4) Fish Transport System

Fish in Phuket are transported by air and motor vehicles. Fresh tuna is transported by air from Phuket International Air Port to the Japanese market. Most of the fish agents individually own insulated/refrigerated trucks. There are several transporters in Phuket, but their scales are limited (refer to Table 1.4.1).

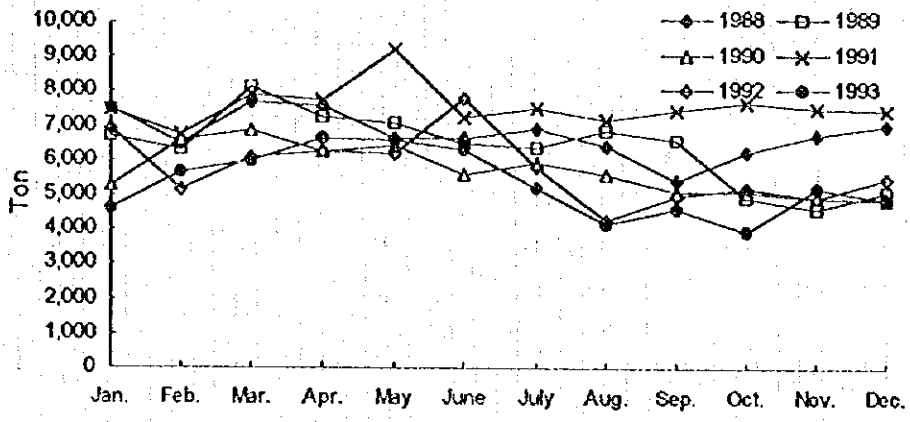
According to the Truck Register Office in Phuket, fish agents owned a total number of 145 trucks. Fish agents occasionally hire trucks from other fish agents and they help each other when their trucks are not sufficient to transport the fish.

Figure 5.1.1 Landing Volume of Marine Fish in Phuket Province (1988-1993)



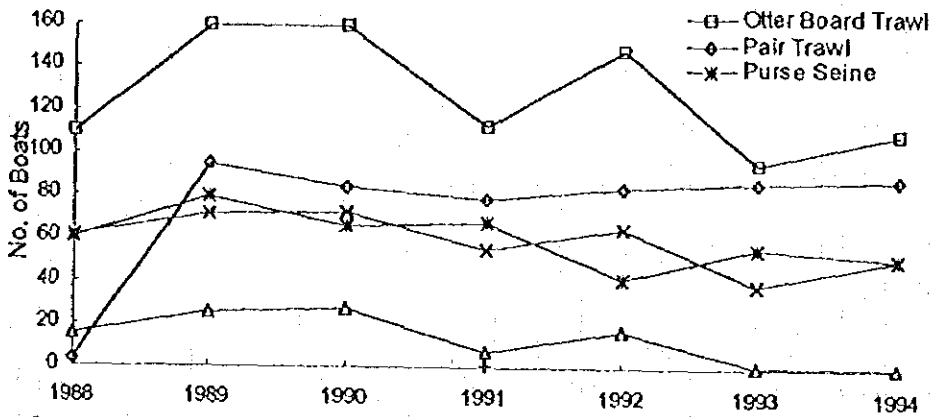
Source : The Landing Place Survey 1988-93, DOF

Figure 5.1.2 Monthly Landing Volume in Phuket Province (1988-1993)



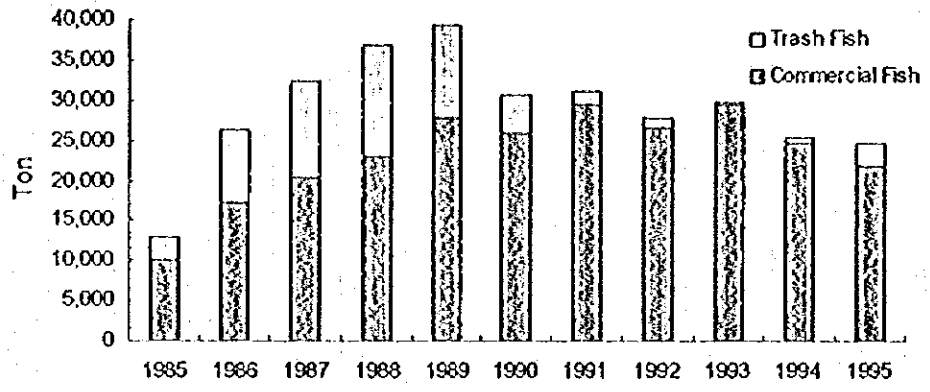
Source : The Landing Place Survey 1988-93, DOF

Figure 5.1.3 Number of Registered Fishing Boats in Phuket (1988-1994)



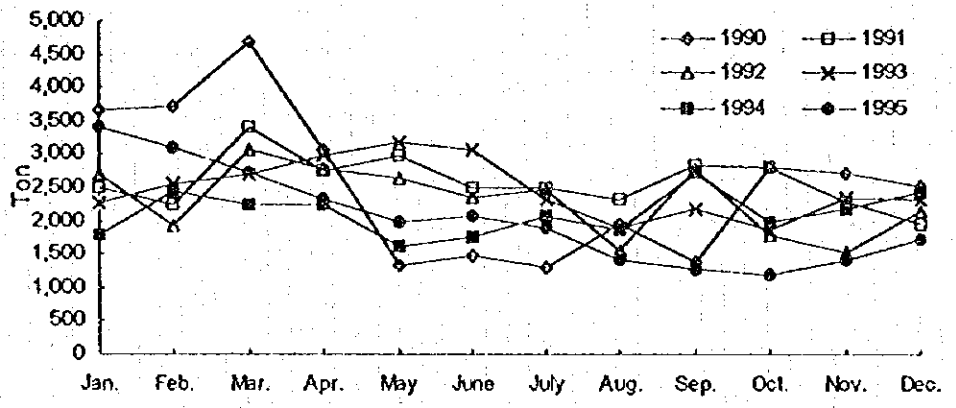
Source : The Landing Place Survey 1988-94, DOF

Figure 5.1.4 Landing Volume on Phuket FMO Fishing Port (1985-1995)



Source : Fisheries Record 1985-95, FMO

Figure 5.1.5 Monthly Landing Volume on FMO Fishing Port (1990-1995)



Source : Fisheries Record 1990-94, FMO

Figure 5.1.6 Number of Landing Boats on FMO Fishing Port

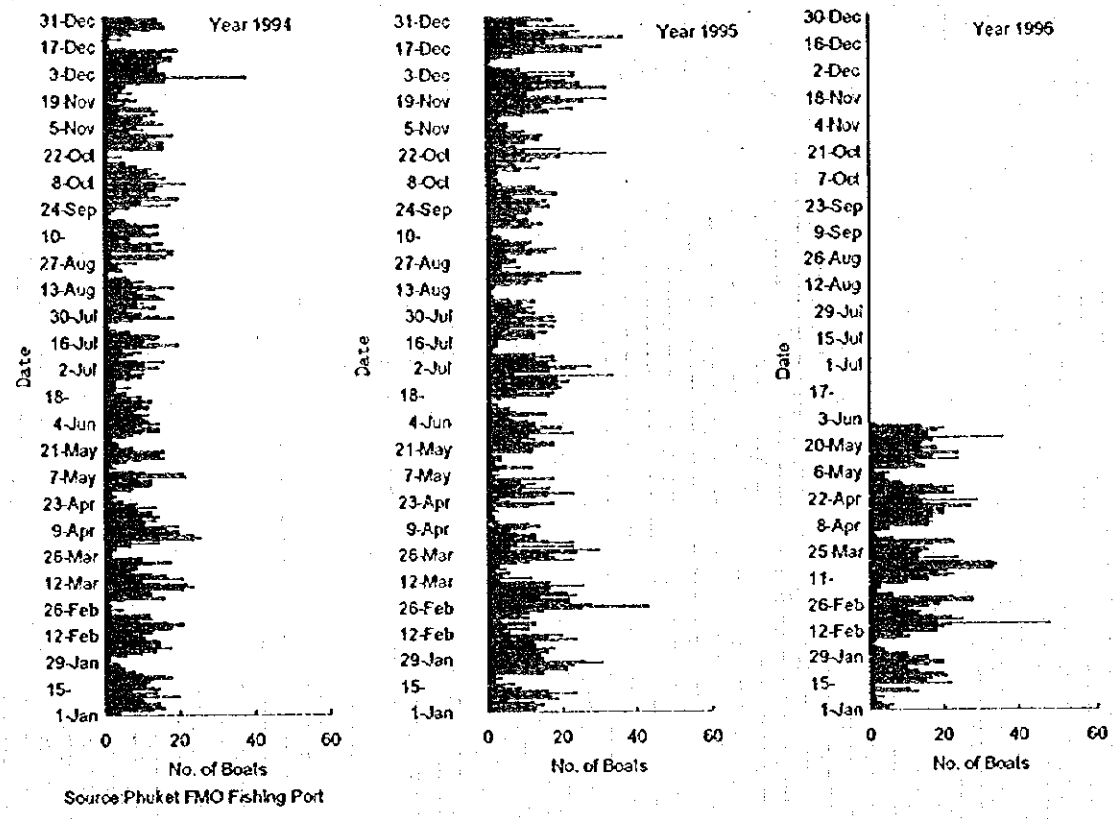


Figure 5.1.7 Number of Landing Trawler on FMO Fishing Port

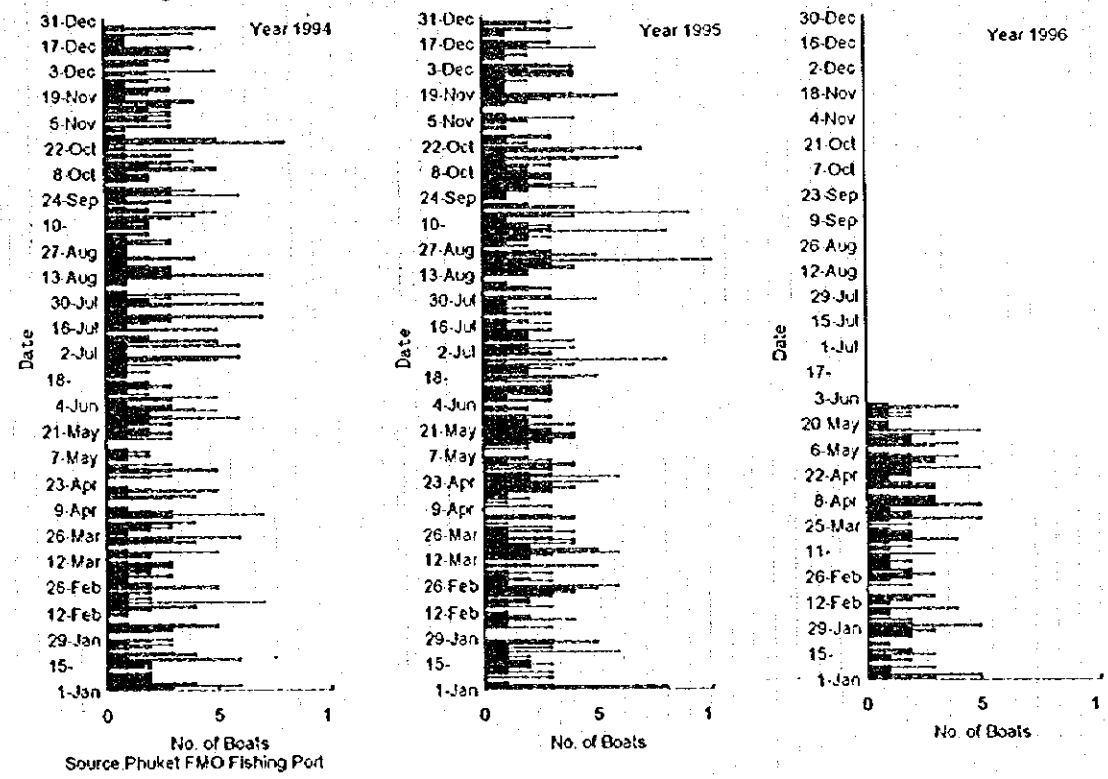
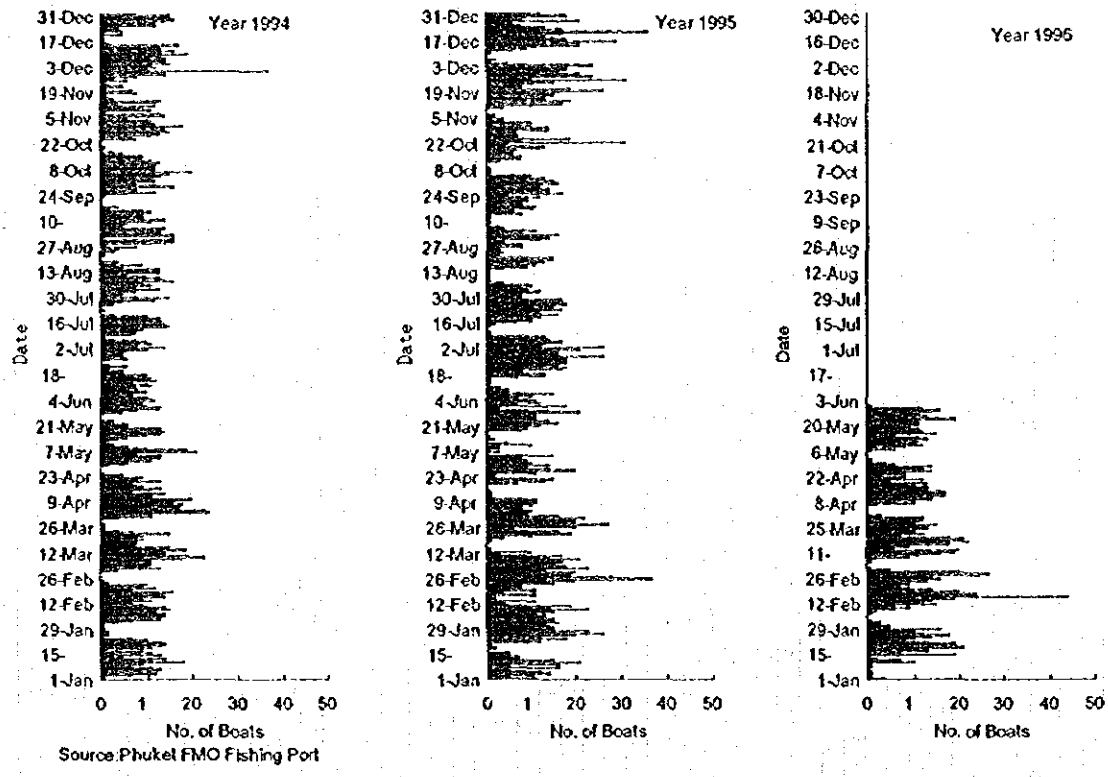
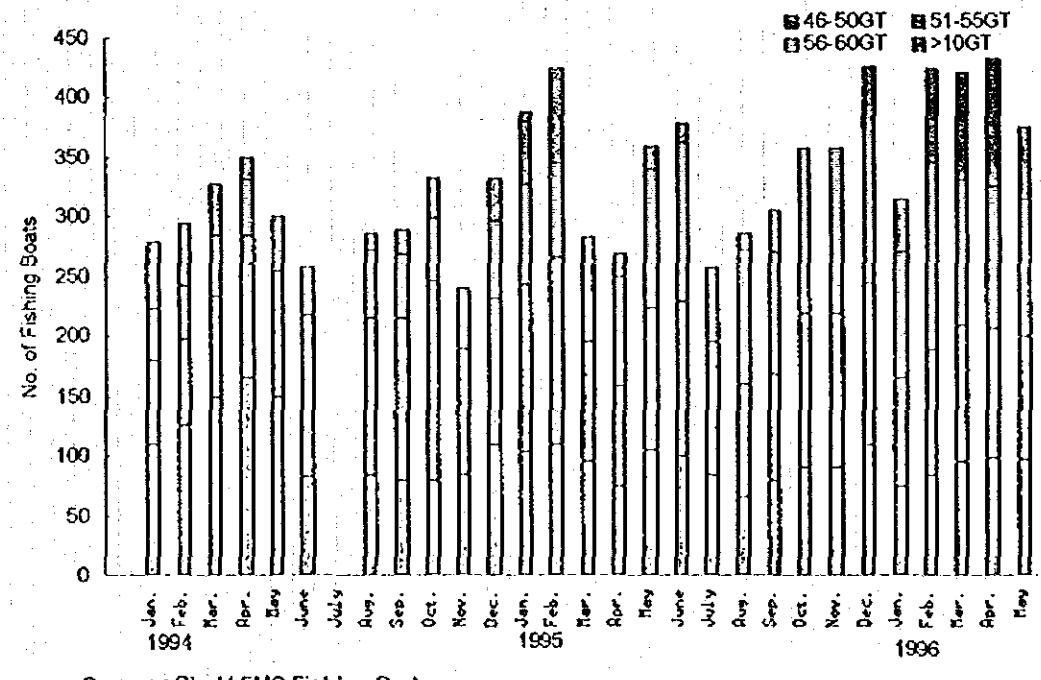


Figure 5.1.8 Number of Landing Purse Seiner on FMO Fishing Port



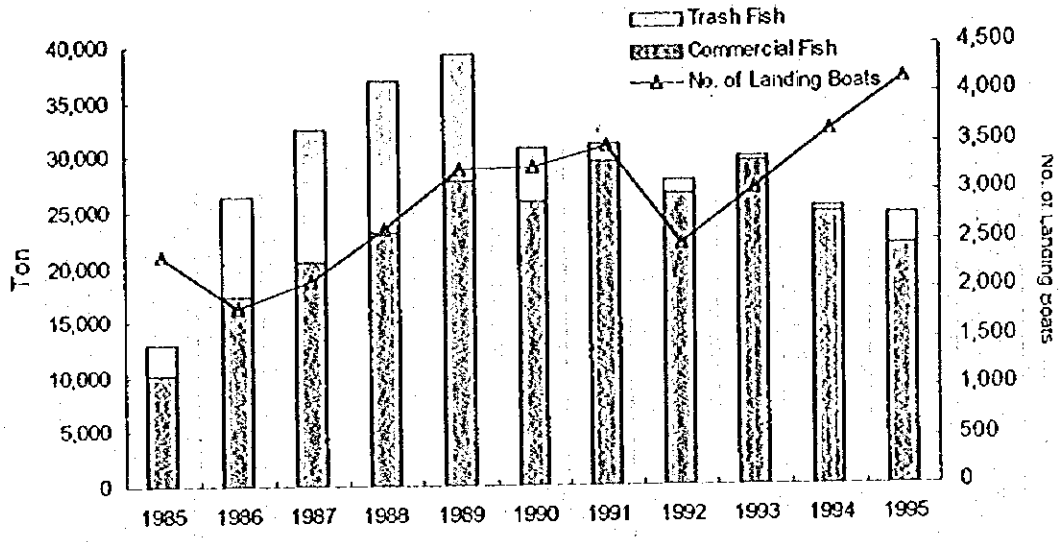
Source:Phukel FMO Fishing Port

Figure 5.1.9 Number of Landing Boats on FMO Fishing Port by Capacity (1994-1996)



Source : Phukt FMO Fishing Port

Figure 5.1.10 Number of Fishing Boats Landed and Landing Volume on FMO Fishing Port



Source : Fisheries Record 1985-95, FMO

Table 5.1.1 Gross Provincial Product at Current Price by Sector, Phuket (GPP, B billion), 1990-1994

	1990	1991	1992	1993	1994	Annual Growth	Share (1994)
Agriculture	1.7	2.6	2.9	3.1	3.5	15.5%	17.4%
Crops	0.3	0.3	0.4	0.4	0.5	10.8%	2.5%
Livestock	0.1	0.1	0.1	0.1	0.1	4.6%	0.5%
Fisheries	1.1	1.9	2.1	2.1	2.4	16.9%	11.9%
Forestry	-	0.00	0.01	0.01	0.001	-	0.0%
Agricultural Services	0.0003	0.0003	0.0002	0.0002	0.0002	-7.8%	0.0%
Simple Agri-Processing	0.2	0.2	0.2	0.2	0.3	8.4%	1.5%
Mining and Quarrying	0.1	0.0	0.1	0.0	0.01	-33.5%	0.1%
Manufacturing	1.2	0.9	1.1	1.2	1.3	1.6%	6.5%
Construction	1.8	2.1	2.2	2.2	1.2	-7.8%	6.0%
Electricity/Water Supply	0.3	0.4	0.5	0.6	0.7	18.5%	3.5%
Transportation/Communic'n	2.2	2.4	2.2	3.5	3.1	7.1%	15.4%
Whole Sale/Retail Sale	1.7	2.0	2.1	2.3	2.7	9.7%	13.4%
Banking/Insurance/Real Ests	1.0	1.1	1.2	1.3	1.8	12.5%	8.9%
Ownership of Dwellings	0.2	0.2	0.3	0.3	0.4	14.9%	2.0%
Public Administr'n/Defense	0.2	0.3	0.3	0.4	0.5	20.1%	2.5%
Services	4.2	4.9	4.4	4.4	4.9	3.1%	24.4%
Aggregate GDP	14.6	16.9	17.3	19.3	20.1	0.6	

Sources: NESDB, Phuket Provincial Statistic Office, June 1996

Table 5.1.2 Gross Provincial Product at Current Price by Sector, Phang-nga (GPP, B billion), 1990-1994

	1990	1991	1992	1993	1994	Annual Growth	Share (1994)
Agriculture	4.2	4.3	5.2	4.8	6.2	8.1%	51.9%
Crops	1.6	1.7	2.2	2.0	3.0	13.4%	25.1%
Livestock	0.1	0.1	0.1	0.1	0.1	0.0%	0.8%
Fisheries	0.7	0.7	1.1	1.2	1.2	11.4%	10.0%
Forestry	1.6	1.60	1.60	1.30	1.60	0.0%	13.4%
Agricultural Services	0.003	0.002	0.002	0.002	0.002	-7.8%	0.0%
Simple Agri-Processing	0.2	0.2	0.2	0.2	0.3	8.4%	2.5%
Mining and Quarrying	0.2	0.1	0.2	0.1	0.05	-24.2%	0.4%
Manufacturing	0.3	0.3	0.3	0.3	0.3	0.0%	2.5%
Construction	0.2	0.2	0.2	0.3	0.4	14.9%	3.3%
Electricity/Water Supply	0.06	0.07	0.09	0.09	0.20	27.2%	1.7%
Transportation/Communic'n	0.2	0.2	0.3	0.3	0.3	8.4%	2.5%
Whole Sale/Retail Sale	0.9	1.0	1.0	1.2	1.3	7.6%	10.9%
Banking/Insurance/Real Ests	0.2	0.2	0.3	0.2	0.5	20.1%	4.2%
Ownership of Dwellings	0.2	0.3	0.3	0.3	0.3	8.4%	2.5%
Public Administr'n/Defense	0.3	0.4	0.4	0.5	0.5	10.8%	4.2%
Services	1.3	1.6	1.6	1.7	1.9	7.9%	15.9%
Aggregate GDP	8.1	8.7	9.9	9.8	12.0	8.2%	

Sources: Phang-nga Provincial Statistic Office, June 1996

Table 5.1.3 Government Budget for Phuket and Phang-uga (1991-1995)

(unit:Bmillion)

	1991	1992	1993	1994	1995
Phuket					
Total	828.2	1,118.2	1,415.9	1,614.6	2,005.4
ofwhichCarryover	80.5	99.5	129.3	157.2	118.7
Phang-nga					
Total	515.9	73.8	915.3	1,121.5	1,276.5
ofwhichCarryover	75.1	634.5	80.1	214.6	113.4

Source:FinanceDivisions,Phuket and Phang-nga provincial governments

Table 5.1.4 Burmese Laborers by Type of Job in Phuket and Phang-uga 1996

Job Description	Phuket*	Phang-nga
Rubber Plantation	6,000-7,000	12,000
Fisheries	6,000-7,000	9,750
Prawn Aquaculture		1,700
Building Maintenance	4,000-5,000	1,000
Charcoal Manufacturing		800
Shipping		380
Land Transportation		180
Palm Oil Factory		150
Ice Manufacturing		90
Construction		80
Market Helpers		50
Minerals		40
Garage		30
Wholesale		20
Housekeeper		20
Others	1,000-2,000	
Total	18,000-20,000	26,290

Note : * Estimation by Phuket Office, MLSW
Sources: Ministry of Labor and Social Welfare,Employment service Offices, Phuket and Phang-nga

Table 5.1.5 Landing Volume of Marine Fish in Phuket Province (1988-1993)

Unit: ton

	1988	1989	1990	1991	1992	1993
Commercial Fishes	29,869	31,996	25,036	47,296	36,364	37,187
Trash Fish	49,490	42,035	41,447	37,132	27,252	19,760
Cracetaceans	915	1,130	1,012	3,392	2,408	3,338
Squids & Cuttlefishes	1,105	1,354	1,046	3,424	3,097	3,547
Total	81,379	76,515	68,541	91,244	69,121	63,832

Source : The Landing Place Survey 1988-93, DOF

Table 5.1.6 Monthly Landing Volume in Phuket Province (1988-1993)

Unit : ton

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1988	7,536	6,470	7,703	7,567	6,642	6,637	6,940	6,404	5,432	6,275	6,752	7,021	81,379
1989	6,708	6,305	8,141	7,245	7,096	6,505	6,392	6,845	6,619	4,931	4,627	5,101	76,515
1990	5,251	6,581	6,691	6,268	6,407	5,596	5,951	5,584	5,115	5,087	4,931	4,897	68,559
1991	7,484	6,759	7,932	7,756	9,231	7,229	7,526	7,191	7,451	7,667	7,527	7,491	91,244
1992	6,902	5,152	6,078	6,255	6,205	7,803	5,802	4,262	5,002	5,205	4,967	5,488	69,121
1993	4,594	5,654	5,979	6,633	6,617	6,296	5,230	4,199	4,589	3,941	5,230	4,870	63,832

Source : The Landing Place Survey 1988-93, DOF

Table 5.1.7 Fishing Days of Trawler by Capacity

Unit : days

	< 14m	14-18m	18-25m	> 25m
Andaman Sea	3.0 -5.2	11.1 - 15.2	16.0 - 18.5	
Myanmer waters I			37.5	31.7

Source : The Marine Fisheries Statistics 1993 Base on the Sample Survey, DOF,1993

Table 5.1.8 Number of Fisherman's Household in Phuket

Unit : Households

	1985	1995
Marine Caputure Fishery Only	1,060	1,066
Coastal Aquaculture Only	16	178
Both Caputure & Aquaculture	22	30
Fishery Employee House-hold	1,063	694
Total	2,161	1,968

Source : Fisheries Statistics of Thailand 1984-93

Table 5.1.9 Number of Registered Fishing Boats in Phuket (1994)

Unit : boats

	< 14 m	14 - 18 m	18 - 25 m	> 25 m	Total
Otter board trawl	1	51	56	2	110
Pair trawl		54	34		88
Beam trawl	12	13	15		40
Purse seine	1	10	39	1	51
Anchovy purse seine	5	4	5		14
King mackerel drift gill net	9	2			11
Other gill net	2	1	2		5
Makcerel gill net			1		1
Crab gill net	2				2
Sardinellas gill net	26				26
Mullet gill net	10				10
Push net	25				25
Shrimp gill net	4				4
Other net	6				6
Long line		1	3	1	5
Squid cast net	14	16	3		33
Total	117	152	158	4	431

Source:Thai Fishing Vessels Statistics, DOF, 1994

Table 5.1.10 Landing Volume of Marine Fish in the Phuket FMO Fishing Port (1985-1995)

Unit : ton

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Commercial Fish	10,076	17,327	20,424	23,004	27,737	25,906	29,498	26,510	29,453	24,772	21,792
Trash Fish	2,894	9,036	11,993	13,814	11,606	4,751	1,650	1,225	358	578	2,766
Total	12,970	26,363	32,417	36,818	39,343	30,657	31,148	27,735	29,811	25,350	24,558

Source : Fisheries Record 1985 - 94, FMO

Table 5.1.11 Number of Fishing Boats Landed on FMO Fishing Port (1/3)

Unit : Boats

	1994												1995												1996				
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1	0	6	1	15	12	13	11	6	19	12	12	12	11	16	22	16	13	9	24	10	12	19	9	24	4	4	6	2	5
2	4	10	5	7	13	10	15	14	17	11	7	17	13	11	14	13	9	13	28	12	19	15	10	11	5	3	6	2	2
3	13	14	16	24	13	15	9	14	13	14	11	11	13	18	24	13	9	11	16	9	10	11	5	24	6	2	2	1	4
4	16	10	11	26	13	12	11	9	11	12	3	15	15	13	21	13	18	7	15	10	11	13	6	9	3	0	0	3	0
5	8	18	13	24	9	11	16	11	16	16	9	15	12	13	16	8	2	6	19	13	12	3	1	4	2	1	3	5	5
6	15	15	12	16	22	10	9	9	4	22	16	13	5	12	16	6	3	11	13	6	6	4	6	2	2	2	2	4	1
7	11	12	12	20	21	12	4	16	7	14	14	15	19	19	17	10	1	16	18	1	2	2	1	0	4	7	9	16	10
8	9	15	21	17	11	10	6	15	8	10	4	16	5	24	26	11	3	8	13	2	4	3	3	1	2	11	10	7	15
9	10	14	24	17	8	8	8	14	13	17	11	19	17	16	16	14	3	6	2	1	3	1	2	1	1	9	16	17	14
10	20	11	22	20	1	9	10	11	15	13	12	13	24	20	17	11	12	6	1	1	1	2	4	3	13	6	16	16	13
11	11	10	15	10	3	12	5	9	9	15	14	19	16	6	3	3	5	1	2	1	2	3	10	7	11	18	21	17	12
12	14	7	10	11	2	12	9	14	11	12	4	16	6	4	12	1	2	3	2	2	2	3	17	10	3	13	23	17	24
13	7	13	21	14	4	10	14	19	11	9	15	8	9	11	3	2	2	1	3	2	12	9	16	13	1	20	18	20	17
14	15	13	14	10	6	13	20	13	15	13	13	20	4	5	4	2	4	1	2	6	9	14	23	26	22	22	21	19	16
15	13	18	17	15	10	13	15	8	9	9	7	6	7	2	6	1	2	4	3	11	15	8	15	13	8	48	33	20	24
16	11	14	13	13	16	7	11	11	7	6	6	2	2	13	2	1	4	8	8	15	10	7	15	31	15	18	29	17	14
17	7	21	7	10	15	10	14	7	6	6	1	2	1	4	5	3	1	17	13	14	11	2	20	21	17	25	34	27	11
18	12	17	8	13	14	6	15	6	2	1	9	1	4	3	1	2	12	18	12	16	7	12	26	16	21	22	33	21	18
19	13	9	9	9	16	6	13	1	1	1	7	1	1	11	3	11	12	8	13	16	8	16	32	13	17	17	25	14	10
20	18	13	9	14	6	3	5	1	0	5	3	5	2	9	8	13	3	19	16	25	11	20	20	18	20	13	13	29	14
21	16	10	13	8	8	2	7	0	2	1	4	2	15	11	11	18	14	20	12	6	9	7	2	37	13	14	24	15	11
22	10	12	18	9	2	7	3	5	3	1	8	8	13	10	23	6	18	19	6	4	12	32	11	7	8	12	13	13	17
23	8	2	8	5	4	3	2	2	1	0	5	7	21	15	18	3	18	18	18	9	6	10	13	22	10	10	12	15	36
24	2	1	10	1	3	1	1	4	7	16	2	4	13	25	16	13	9	22	16	4	17	20	15	25	16	16	14	23	10
25	5	5	1	2	2	3	1	4	18	8	6	13	23	43	7	16	13	15	10	6	7	8	32	16	20	19	16	17	16
26	1	1	2	3	2	7	4	9	10	16	4	17	31	28	24	23	11	19	19	8	14	5	12	8	20	15	15	21	12
27	4	2	2	0	6	10	8	2	10	14	10	15	26	6	30	16	5	34	15	8	16	10	25	24	13	28	11	23	18
28	3	1	2	2	8	6	19	15	20	16	17	16	15	22	6	9	23	7	18	6	13	5	21	11	16	28	17	17	20
29	1		3	7	10	11	15	17	15	12	13	1	15		23	17	14	17	8	5	7	14	21	9	8	23	23	9	14
30	1		2	8	15	7	10	19	9	14	38	15	14		8	10	4	16	13	12	19	14	15	18	10		22	8	2
31	1		7		15		8	2		19		8	13		23		20		11	16		15		12	5		6		0
Total	279	294	328	350	290	259	298	287	289	335	285	332	385	390	425	285	269	360	369	257	287	307	408	436	316	426	493	435	385
Max	20	21	24	26	22	15	20	19	20	22	38	20	31	43	30	23	23	34	28	25	19	32	32	37	22	48	34	29	36

Source:Phuket FMO Fishing Port

Table 5.1.11 Number of Purse Seiner Landed on FMO Fishing Port (2/3)

Unit : Boats

	1994												1995												1996				
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1		4		11	11	9	10	5	16	12	12	10	11	16	20	16	9	7	21	10	11	15	8	18	4	3	5		1
2	1	7	4	7	10	7	14	8	16	11	4	12	5	11	13	9	5	12	26	12	16	13	10	9	1	1	1		
3	7	13	13	24	13	12	8	13	13	13	11	11	10	15	23	9	8	11	12	9	8	10	4	24					
4	12	5	10	23	13	11	11	8	9	10	3	15	14	12	18	10	15	7	13	8	11	10	4	5	1				
5	6	14	11	17	8	10	10	11	14	15	6	14	12	13	15	8		3	17	10	4	1	1	1	1				
6	13	14	10	13	21	7	8	9	4	20	14	11	5	11	16	6	3	10	13	4	3	1	2	2		1	1	2	1
7	11	12	11	18	19	7	3	16	5	12	13	14	16	15	17	10	1	15	14			1				2	2	10	6
8	7	15	18	16	10	10	1	14	6	9	1	13	5	23	21	11	3	5	13	1	1	1			1	6	9	7	8
9	9	14	23	16	6	6	7	13	11	12	11	19	16	14	14	11	3	5		1	1				1	9	11	14	12
10	18	10	19	20		8	8	10	14	8	9	13	21	19	17	11	10	3	1	1			4	1	10	6	16	14	10
11	11	9	14	10	3	11	4	6	7	13	12	16	15	5	3	2	5			1	1		10	6	7	15	19	17	11
12	14	7	10	11	2	10	9	13	9	11	4	13	6	4	10	1					1	3	17	9	2	12	20	17	13
13	5	11	19	14	4	7	14	12	8	6	12	6	7	11	1		2	1		1	8	8	15	11		14	6	17	11
14	13	9	14	7	6	12	15	13	11	9	13	17	1	2	1	1	1	1	1	4	6	8	19	21	19	19	9	13	6
15	11	14	15	11	10	11	14	5	9	9	3	2	5	1				1	2	9	6	1	13	11	7	44	18	9	15
16	9	13	8	13	13	6	11	9	2	5	2	1		11				7	7	11	10	6	11	29	13	18	16	13	12
17	1	14	6	9	14	10	13	4	4	3	1	1		4				13	10	10	11		15	18	12	24	22	10	9
18	11	16	8	8	12	5	13	4			8	1	2	1	1		8	13	10	13	3	7	16	15	21	20	21	13	11
19	13	7	9	7	13	5	10			1	7		1	11	1	7	9	8	12	15	8	12	26	13	14	14	18	5	9
20	14	12	8	13	4	2	3			1	1	5	1	6	4	13		17	16	15	9	13	19	17	19	9	7	12	11
21	13	9	9	8	6						1	1	9	8	10	15	12	18	12	3	9	5		36	13	7	12	8	11
22	10	10	15	9	1	6		1			5	5	12	6	19	1	16	16	3	3	12	31	8	2	8	9	10	3	7
23	7	2	7	5	3	2	1		1		2	3	18	15	15	2	14	16	17	4	5	8	10	17	10	9	5	8	19
24		1	4	1				3	6	8	1	4	12	20	16	11	8	18	15	2	17	19	15	13	14	13	13	14	9
25	2		1					4	12	7	6	12	20	37	6	10	11	15	8	3	6	7	31	8	18	16	13	5	13
26			1			6	3	8	8	11	3	12	26	28	20	20	11	18	18	8	14	2	10	6	12	14	15	12	11
27	2		1			5	5	1	7	13	8	14	23	5	27	14	2	26	14	8	14	7	24	21	10	25	10	14	14
28					5	5	12	14	16	15	14	16	15	19	5	9	21	7	17	4	12	5	21	8	16	27	11	6	16
29	1			2	8	5	15	16	12	12	13	1	15		20	14	14	16	7	4	2	14	16	9	5	20	12	4	12
30	1			6	13	6	8	16	8	14	37	15	14		8	10	3	13	8	12	16	14	15	18	5		12	1	1
31	1		4		10		5			18		8	13		22		18		8	14		10		12	3		3		
Total	223	242	272	299	238	201	235	236	228	278	237	285	330	343	363	231	212	302	315	200	225	232	344	360	247	357	317	248	259
Max	18	16	23	24	21	12	15	16	16	20	37	19	26	37	27	20	21	26	26	15	17	31	31	36	21	44	22	17	19

Source:Phuket FMO Fishing Port

Table 5.1.11 Number of Trawler Landed on FMO Fishing Port (3/3)

Unit : Boats

	1994												1995												1996				
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1		2	1	4	1	4	1	1	3			2			2		4	2	3		1	4	1	4				2	4
2	3	3	1		3	3	1	6	1		3	5	8		1	4	4	1	2		3	2		2	3	2	1	1	2
3	6	1	3			3	1	1		1			3	3	1	4	1		4		2		1		5	1	1	1	1
4	4	5	1	3		1		1	2	2			1	1	3	3	3		2	2		3	2	4	1			3	
5	2	4	2	7	1	1	6		2	1	3	1			1		2	3	2	3	8	2		3	1	1	2	5	
6	2	1	2	3	1	3	1			2	2	2		1				1		2	3	3	4		1	1	1		
7			1	2	2	5	1		2	2	1	1	3	4				1	4	1	2	1	1		3		1	3	3
8	2		3	1	1		5	1	2	1	3	3		1	5			3		1	3	2	1	1	1	4	1		4
9	1		1	1	2	2	1	1	2	5			1	2	2	3		1	2		2	1		1			3	3	1
10	2	1	3		1	1	2	1	1	5	3		3	1			2	3			1	2		2				1	2
11		1	1			1	1	3	2	2	2	3	1	1		1		1	2		1	3		1	2	1	1		
12						2		1	2	1		3			2		2	3	2	2	1			1	1	1	1		2
13	2	2	2			3		7	3	3	3	2	2		2	2			3	1	4	1	1	2	1	2	2		3
14	2	4		3		1	5		4	4		3	3	3	3	1	3		1	2	3	5	2	5	3	1		3	
15	2	4	2	4		2	1	3			4	4	2	1	6	1	2	3	1	2	9	6		2		3	1	1	5
16	2	1	5		3	1		2	5	1	4	1	2	2	2	1	4	1	1	4		1	3	1	2		2	3	2
17	6	7	1	1	1		1	3	2	3		1	1		5	3	1	4	3	4		1	5	3	2		4	2	1
18	1	1		5	2	1	2	2	2	1	1		2	2		2	4	5	2	3	4	4	6	1			2		1
19		2		2	3	1	3	1	1			1			2	4	3		1	1		3	4		1		2	1	1
20	4	1	1	1	2	1	2	1		4	2		1	3	4		3	2		10	2	7	1		1		2	1	1
21	3	1	4		2	2	7		2	1	3	1	6	3	1	3	2	2		3		2	1	1		2	2	2	
22		2	3		1	1	3	4	3	1	3	3	1	4	4	5	2	3	3	1			1	1			1	1	1
23	1		1		1	1	1	2			3	4	3		3	1	4	2	1	5	1	2	1	1		1	1	2	2
24	2		6		3	1	1	1	1	8	1		1	5		2	1	4	1	2		1		3	2	1		1	1
25	3	5		2	2	3	1		6	1		1	3	6	1	6	2		2	3	1	1	1	4	2	2	2	5	2
26	1	1	1	3	2	1	1	1	2	5	1	5	5		4	3		1	1			3	2			1		2	1
27	2	2	1		6	5	3	1	3	1	2	1	3	1	3	2	3	8	1		2	3	1	2	3	3	1		2
28	3	1	2	2	3	1	7	1	4	1	3			3	1		2		1	2	1			3			5	3	4
29			3	5	2	6		1	3						3	3		1	1	1	5		4		2	2	1	1	1
30			2	2	2	1	2	3	1		1						1	3	5		3				5		2	3	1
31			3		5		3	2		1					1		2		3	2		1			2		2		
Total	56	52	56	51	52	58	63	51	61	57	48	47	55	47	62	54	57	58	54	57	62	64	43	48	44	29	44	50	48
Max	6	7	6	7	6	6	7	7	6	8	4	5	8	6	6	6	4	8	5	10	9	7	6	5	5	4	5	5	5

Source:Phuket FMO Fishing Port

Table 5.1.12 Total Number of Fishing Boats Unloaded at FMO Port (1/3)

Unit : Boats

	1994												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
< 10 GT	55	52	43	20				15	20	34		35	274
46 - 50 GT	110	125	149	165	150	83		84	79	80	85	110	1,220
51 - 55 GT	69	72	85	120	105	135		130	135	166	105	122	1,244
56 - 60 GT	44	45	50	45	45	40		58	55	53	50	65	550
81 - 90 GT													0
> 100 GT	1		1			1							3
Unknown							298			2	45		345
Total	279	294	328	350	300	259	298	287	289	335	285	332	3,636

Sources : Phuket FMO Fishing Port

Table 5.1.12 Total Number of Fishing Boats Unloaded at FMO Port (2/3)

Unit : Boats

	1995												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
<10 GT	60	80	88	20	20	15	62	15	35			30	425
46 - 50 GT	103	110	95	75	105	100	85	65	79	90	90	110	1,107
51 - 55 GT	140	155	100	84	120	129	110	95	90	130	130	135	1,418
56 - 60 GT	85	80		90	115	134		112	102	138	138	150	1,144
81 - 90 GT	2		2										4
> 100 GT								1				1	
Unknown										50		11	61
Total	390	425	285	269	360	378	257	287	307	408	358	436	4,160

Sources : Phuket FMO Fishing Port

Table 5.1.12 Total Number of Fishing Boats Unloaded at FMO Port (3/3)

Unit : Boats

	1996												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
< 10 GT	45	77	91	107	61								381
46 - 50 GT	75	85	95	98	97								450
51 - 55 GT	90	105	115	108	103								521
56 - 60 GT	105	157	120	120	115								617
81 - 90 GT													0
>100 GT	1	2	2	2	2								9
Unknown			70										70
Total	316	426	493	435	378	0	0	0	0	0	0	0	2,048

Sources : Phuket FMO Fishing Port

Table 5.1.13 Capacity of Typical Fishing Boats in Thailand

	Traditional Fishing Boat				Modern Fishing Boat			
LOA (m)	B (m)	D (m)	draft (m)	GT	B (m)	D (m)	draft (m)	GT
18.00	4.85	2.05	1.74	37.67	5.25	2.35	2.00	45.60
19.00	5.10	2.15	1.83	43.90	5.50	2.50	2.12	53.31
20.00	5.30	2.30	1.95	50.73	5.75	2.60	2.21	61.15
21.00	5.55	2.40	2.04	58.30	6.00	2.75	2.34	70.47
22.00	5.80	2.50	2.12	66.57	6.20	2.85	2.42	78.97
23.00	6.00	2.62	2.28	75.03	6.45	3.00	2.55	89.98
24.00	6.00	2.62	2.28	75.03	6.70	3.10	2.63	100.99
25.00	6.40	2.85	2.42	93.85	6.90	3.20	2.72	111.73

Source : DOF

Table 5.1.14 CPUE (kg/hour) by Fishing Grounds

Unit : kg/hour

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Otter Board Trawl										
Gulf of Thailand	64.08	60.92	56.89	54.76	50.61	49.39	56.38	53.35	56.90	53.65
Andaman Sea	72.82	70.02	73.66	75.22	82.53	65.31	67.11	58.47	69.92	49.59
Purse Seine										
Gulf of Thailand	448.25	268.10	288.31	299.94	418.88	327.47	353.18	330.01	372.92	240.48
Andaman Sea	208.38	455.55	734.01	493.51	490.82	418.84	577.78	483.77	617.48	461.43

Sources : DOF

Table 5.1.15 Landing Volume of Tunas in the Indian Ocean

Unit : 1000mt

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Western part of the Indian Ocean										
Skipjack tuna	92	125	137	156	191	219	204	194	253	249
Yellowfin tuna	85	89	107	115	166	136	163	162	243	285
Bigeye tuna	23	31	35	37	40	33	33	32	30	36
Sub-total	200	245	279	308	398	388	400	388	526	569
Eastern part of the Indian Ocean										
Skipjack tuna	11	12	12	13	14	19	15	17	18	17
Yellowfin tuna	11	12	12	14	13	31	29	26	31	30
Bigeye tuna	13	12	12	12	14	10	11	10	7	9
Sub-total	36	35	35	39	41	60	56	53	55	56

Source:FMO Yearbook 1993

Table 5.1.16 Monthly Landing Volume on FMO Fishing Port (1988-1995)

Unit : kg

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1988	4,013	2,500	4,602	4,151	3,505	2,709	2,148	2,268	1,688	2,662	2,421	4,152	36,818
1989	3,204	3,473	4,296	4,303	3,223	3,253	2,425	2,422	3,033	2,611	3,408	3,693	39,343
1990	3,653	3,731	4,688	3,081	1,321	1,475	1,294	1,972	1,379	2,824	2,720	2,519	30,657
1991	2,512	2,245	3,415	2,761	2,970	2,490	2,489	2,336	2,849	2,811	2,307	1,964	31,148
1992	2,698	1,941	3,056	2,780	2,634	2,353	2,462	1,566	2,783	1,782	1,534	2,146	27,735
1993	2,272	2,557	2,701	2,992	3,196	3,069	2,338	1,900	2,193	1,881	2,368	2,344	29,810
1994	1,784	2,429	2,256	2,248	1,606	1,756	2,061	1,862	2,721	1,985	2,197	2,445	25,350
1995	3,407	3,105	2,718	2,330	1,995	2,071	1,904	1,422	1,276	1,179	1,411	1,740	24,558

Source : Fisheries Record 1988-1995, FMO

Table 5.1.17 Monthly Landing Volume of Consumable Fish on FMO Fishing Port (1988-1995)

Unit : kg

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1988	2,475	1,438	3,052	2,407	1,986	1,856	1,473	1,444	1,128	1,417	1,636	2,694	23,004
1989	2,360	2,095	2,369	2,895	2,044	2,092	1,703	1,676	2,372	2,268	2,686	3,178	27,737
1990	2,754	2,908	3,607	2,242	775	1,207	1,120	1,939	1,359	2,781	2,710	2,504	25,906
1991	2,509	2,180	3,227	2,438	2,722	2,257	2,341	2,285	2,795	2,569	2,229	1,947	29,498
1992	2,622	1,792	2,502	2,442	2,628	2,352	2,452	1,530	2,777	1,778	1,503	2,000	26,377
1993	2,207	2,518	2,659	2,939	3,121	3,039	2,151	1,898	2,175	1,870	2,366	2,323	29,265
1994	1,780	2,371	2,218	2,101	1,563	1,743	2,045	1,856	2,718	1,956	2,169	2,252	24,772
1995	2,964	2,639	2,104	2,039	1,872	1,831	1,678	1,401	1,233	1,139	1,250	1,642	21,792

Source : Fisheries Record 1988-1995, FMO

Table 5.1.18 Daily Landing Volume on FMO Fishing Port on September, the Peak Month in 1994

Unit : kg

	Date	Scad	Other Food Fish	Shrimp	Squid	Indian mackerel	Trash fish	Total
1	9/29/94	9,642	268,507	15,301	15,795	2,570	2,713	314,528
2	9/14/94	110,652	104,827	49,044	15,290	11,840		291,653
3	9/1/94	99,330	115,546	40,450	8,130	8,169		271,625
4	9/25/94	14,551	165,150	35,031	13,717	109		228,558
5	9/28/94	24,292	146,548	16,960	24,580	4,722	217	217,319
6	9/2/94	100,914	63,232	448	2,507	3,842		170,943
7	9/22/94		91,812	25,050	14,109			130,971
8	9/10/94	62,192	46,792	6,682		2,236		117,902
9	9/11/94	13,341	60,290	30,865	4,721	3,230		112,447
10	9/5/94	45,052	42,944	13,300	1,790	4,403		107,489
11	9/27/94	7,317	87,783	9,289				104,389
12	9/4/94	22,504	38,240	26,630	3,210	12,990	120	103,694
13	9/9/94	16,919	68,303	7,360	5,012	893		98,487
14	9/13/94	11,008	59,957	9,210	1,886	2,653		84,714
15	9/21/94		40,920	12,160	6,600			59,680
16	9/7/94	20,725	15,708	120	3,900	1,230		41,683
17	9/16/94	4,707	29,231	4,300	2,908			41,146
18	9/3/94	20,549	13,050			3,900		37,499
19	9/8/94	10,160	22,500					32,660
20	9/17/94	4,221	21,174	1,443	3,713	673		31,224
21	9/30/94	21,078	2,000			4,043		27,121
22	9/15/94	22,460			300			22,760
23	9/26/94	5,590	13,725		500			19,815
24	9/24/94	2,528	6,100	210	3,200			12,038
25	9/12/94	7,958	2,994	210		545		11,707
26	9/19/94		8,500	210	2,100			10,810
27	9/6/94	4,800	1,920			1,100		7,820
28	9/18/94	980	5,820		200			7,000
29	9/23/94		500					500
30	9/20/94							0
		663,470	1,544,073	304,273	134,168	69,148	3,050	2,718,182

Source:Phuket FMO Fishing Port

Table 5.1.19 Daily Landing Volume on FMO Fishing Port on January, the Peak Month in 1995

Unit : kg

	Date	Scad	Other Food Fish	Shrimp	Squid	Swiming crab	Indian mackerel	Trash fish	Total
1	1/7/95	71,085	174,664	14,701	25,076			70,070	355,596
2	1/21/95	27,374	221,325	22,622					271,321
3	1/4/95	162,898	27,115	910	4,100	180	11,170	12,662	219,035
4	1/26/95	109,412	84,327	5,712	5,920		8,037	4,874	218,282
5	1/10/95	58,897	43,020	6,510	15,480		4,700	79,425	208,032
6	1/23/95	118,847	9,500	560	4,300			66,283	199,490
7	1/11/95	141,277	31,063	855	8,740	100	7,590		189,625
8	1/25/95	97,111	36,023		7,250	2,700		6,520	149,604
9	1/2/95	25,476	72,800	22,760	8,000	1,000		3,851	133,887
10	1/27/95	100,855	18,615	704	13,100	500			133,774
11	1/3/95	76,942	27,894	2,087	12,877		788	11,249	131,837
12	1/31/95	25,277	1,570				1,700	95,506	124,053
13	1/5/95	97,608	10,875				7,740	1,279	117,502
14	1/9/95	24,776	25,000	40,000	5,200			10,037	105,013
15	1/8/95	97,085							97,085
16	1/22/95	13,078	23,483		7,265		1,001	42,217	87,044
17	1/15/95	32,903	41,374	2,597	4,140	120	1,680		82,814
18	1/24/95	34,112	12,823		6,850			24,397	78,182
19	1/18/95		55,627	3,350	3,710				62,687
20	1/14/95		47,500	10,000	2,500				60,000
21	1/6/95	59,116							59,116
22	1/29/95	56,153							56,153
23	1/1/95	42,674	9,281				622	670	53,247
24	1/17/95		41,221	2,130	3,190				46,541
25	1/28/95	44,436							44,436
26	1/30/95	31,692			6,000			2,008	39,700
27	1/13/95	8,889	20,311		7,485				36,685
28	1/12/95	7,913	1,820		130		1,480	11,528	22,871
29	1/16/95		8,000	350	2,000				10,350
30	1/20/95	975	5,500	140	2,500				9,115
31	1/19/95		3,000						3,000
Total		1,566,861	1,053,731	135,988	155,813	4,600	46,508	442,576	3,406,077

Sources : Phuket FMO Fishing Port

Table 5.1.20 Daily Maximum Landing Volume on FMO Fishing Port

Unit : kg

	1994		1995		1996	
1	June 1	360,013	Feb 25	376,852	May 17	298,198
2	Mar 2	346,243	Jan 7	355,596	Feb 15	234,775
3	Feb 3	333,409	June 27	339,991	Apr 24	219,763
4	Sep 4	314,528	Feb 20	289,947	Mar 20	173,998
5	July 5	300,835	Mar 27	271,706	Apr 23	170,527
6	Sep 6	291,653	Jan 21	271,321	Feb 27	170,142
7	Sep 1	271,625	Feb 7	243,257	Jan 14	159,620
8	Aug 2	260,037	Feb 28	237,531	Apr 25	158,642
9	Apr 3	244,893	Mar 1	232,736	Feb 17	145,764
10	July 4	230,536	Apr 2	228,153	Apr 26	139,844

Note:Period of record in 1996 is from Jan. to May only
Source:Phuket FMO Fishing Port

Table 5.1.21 Landing Volume/Trip by Taiwanese Longline Boat (February to March, 1996)

Operation No.	1	2	3	4	5	6	7	8	9	10	AVG
Operation days	8	8	5	5	8	8	5	12	5	12	7.6
Total catch (kg)	5,800	4,400	9,898	10,000	5,900	6,000	9,799	5,522	9,900	5,423	7,268
Yellowfin	3,900	4,200	8,110	8,000	4,100	4,000	7,800	4,400	7,900	4,300	5,671
Marlin fish	1,800	100	900	1,000	900	900	1,400	351	900	652	890
Swordfish	100	140	888	1,000	900	1,100	599	771	1,100	471	707

Source : AFDEC

Table 5.1.22 Result of Experimental Tuna Purse Seine Operation in the Indian Ocean

	Survey by DOF						Survey by Japan		
Operation day	22	31	26	32	26	31	45	42	16
No. of operation	10	5	8	9	7	8	20	31	14
Total catch (ton)	94.3	73.0	76.4	194.7	98.8	51.5	497.0	988.0	593.0
Maximun catch/operation	38.6	32.0	31.2	51.5	26.7	18.0	-	-	-
Average catch/operation	9.4	14.6	9.5	21.6	14.1	6.4	24.9	31.9	42.4

Source:DOF and JAMARC

Table 5.1.23 Present Status of Fish Agents in Phuket (1/2)

Number of Fish Agent	1	2	3
Location	Outside FMO	Outside FMO	Within FMO
No. of Fishing Boats Owned	20 T	6 Small Boats*	7 T
No. of other Boats Belonged to His Group	20 T	150 Small Boats*	5 T
Destination of Fish Sold			
Local % (Buyer)	50% (Middleman)	40% (Middleman)	10% (Middleman)
S. Sakhon		20% (FMO)	40%
Bangkok	10% (FMO)	-	10% (FMO)
S. Prakhan		-	-
Songkhla	30% (*Processor's Agent*)	*Middleman*	20% (*Processor*)
Hat-Yai		40%	
Others	10% (FMO) in Ranong *Processor in Trang.*	Export to Malaysia *Singapore* Taiwan	20% (Middleman) *Malaysia*
Vehicles			
Capacity	10 Ton Insulated	10 Ton Insulated	10 Ton Insulated
No. of Vehicle	4 Units	15 Units	3 Units
Intention to move to Fishery Complex	Can't say yes or no Depend on condition	No. His Boats are small. He will send people to buy at Fishery Complex	-
Opinion for new Fishery Complex	Necessary	Good Project	Good Project
Auction System	His transaction is direct negotiation. Sometimes participates auction	Sometimes he Participates auction	Good for Competition

Remarks: (1)*; Fishing gear of small boats are Gillnet and Pushnet
(2)T; Traveler, P; purse Seine
Source: JICA Study Team

Table 5.1.23 Present Status of Fish Agents in Phuket (2/2)

Number of fish Agent	4	5	6	7
Location	Within FMO	Within FMO	Within FMO	Within FMO
No. of Fishing Boats owned	0	5 P	3 T	2 T
No. of other Boats belonged in his Group	15 T	10 P	20 T	10 T
Destination of Fish Sold				
Local % (Buyer)	FMO	30% (Middleman)	30% (FMO)	10% FMO
S. Sakhon	FMO	--	40% (Middleman)	40% FMO
Bangkok		40% (Processor)	--	40% FMO
S. Prakhan	FMO	--	--	--
Songkhla	--	--	15% (Processor)	(15% FMO)
Hat-Yai	Middleman	--	15% (Processor)	
Others	--	30% (Malaysia)	--	35% Processor in Kantang, N. Shithamarat
Vehicles	--			--
Capacity		10 Ton Ref x 2 units	10 Ton Ref x 3 units	
No. of Vehicles		10 Ton Insul.x24units		
Intention to move to Fishery Complex	--	--	--	--
Opinion for new Fishery Complex	--	Good Project	Good Project	Good Project
Auction System	40% auction 60% sell directly	If big volume of fish, sell through auction	Good system, all fish should be sold through auction	Good System 20% Auction, 30% sell directly

Remarks: (1)*; Fishing gear of small boats are Gillnet and Pushnet
(2)T; Traveler, P; purse Seine

Source: JICA Study Team

5.2. NATURAL CONDITIONS AT PROJECT SITE

This chapter discusses the summary of natural conditions in the proposed project site at Phuket.

5.2.1. Meteorology

Southern Thailand is situated in the torrid zone and affected by the tropical monsoon. During May and September, south-west (SW) monsoon blows with hot and humid air which brings plenty rainfall in the whole land of Thailand. In the north-east (NE) monsoon season from November to February, cold winds blow from the China continent to northern Thailand. Climate in Southern Thailand is characterised with the two monsoon seasons.

Meteorological conditions at Phuket are described below on the basis of the data for the period 1965-1990 prepared by the Meteorological Department.

(1) Temperature

Table 5.2.1 shows monthly fluctuation of temperature in a year. The characteristics of temperature in Phuket are summarised as follows;

* Mean temperature is 28.1 Celsius,

* Mean maximum temperature is 31.8 Celsius,

* Mean minimum temperature is 24.1 Celsius, and

* A range of temperature fluctuation is small.

(2) Relative Humidity

Table 5.2.2 shows monthly fluctuation of relative humidity in a year. The characteristics of relative humidity at Phuket are summarised as follows;

* Mean relative humidity is 75 %,

* Mean maximum relative humidity is constantly from 85 % to 93 %,

* Mean minimum relative humidity is constantly from 52% to 95 % in the NE monsoon season, but also it shows from 66 % to 68% in the SW monsoon season, and .

A range of relative humidity fluctuation is small.

(3) Rainfall

Rainfall records are tabulated in Table 5.2.3 and rainfall distribution in Thailand is shown in Figure 5.3.1. At Phuket, mean rainfall records have been little in the NE monsoon season as less than 60 mm in a month during December and March. However, mean rainfall records in the SW monsoon season have maintained that monthly rainfall was in the range from 200 mm to 400 mm and daily maximum rainfall varied from 100 mm to 200 mm. Additionally, 369 mm was recorded as daily maximum rainfall at Trang.

(4) Wind

Figure 5.2.2 shows wind roses from wind data during the period 1981-1990 at Phuket. These figures highlight that the significant wind blows in the direction of west in the SW monsoon season and NE or E in the NW monsoon season. Table III-3.1.4. shows monthly fluctuation of the velocity and the direction of wind. Mean wind speed has been recorded moderate like 1.9 m/sec at the stations and 20 m/sec was recorded as maximum wind speed.

(5) Typhoon (Tropical Storm)

While air pressure in the Pacific Ocean is high, tropical depressions generated in the Pacific Ocean, with developing, move westward to the northern and middle Thailand in August and September. When they enter in the southern Thailand during October and December, occurrence of typhoons affecting to Thailand in the period 1951-1995 are tabulated in the following table. It is maintained that their frequency is low as 4 typhoons per year as average.

Frequency of Typhoons Entering Thailand during 1951 - 1995

Month:	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Number:	1	6	6	11	19	36	47	24	6	156
%:	0.6	3.8	3.8	7.1	12.2	23.1	30.11	15.4	3.8	100

5.2.2. Marine Conditions

(1) Tides

Hydrographic Department of Royal Thai Navy keeps recording of tides in Andaman Sea at several stations. The tidal variation from the data during 1975 and 1993 at Ko Tapao Noi shows following tidal characteristics.

Highest High Water (HHW)	1.72 m
Mean High Water Spring (MHWS)	0.91 m
Mean High Water Neap (MHWN)	0.14 m
Mean Sea Level (MSL)	0.00 m
Mean Low Water Neap (MLWN)	-0.70 m
Mean Low Water Spring (MLWS)	-1.53 m
Lowest Low Water (LLW)	-2.29 m

The above data mean that the area on the Andaman Sea coast has high tidal range up to 2.44 m during a spring tide. And also the measurement of actual tide executed for 15days in the site survey could proof above data. The following data shows four major tidal constituents which indicates predominance of semidiurnal constituents.

Harmonic Constant

Constituent	K1	O1	M2	S2
Amplitude(cm)	14.0	6.6	80.3	40.3
Phase difference(deg.)	322.5	294.5	291.9	322.9

(2) Tidal currents

Continuous measurement for 16 days was carried out neat the approach channel about 2km south from Phuket Fishing Port. Figure 5.2.3 shows current fluctuation during the measurement period. The maximum velocity for the period is 30 cm/sec and current velocity is generally low. Figure 5.2.4 illustrates current ellipse obtained with analysis of the current record. Tidal currents circulate anti-clockwise and predominant current direction is north northwest at spring tides and south southwest.

(3) Wave

Wave measurement for 5 months during June 1998 and December 1996 with installation of a wave gauge as illustrated in Figure 5.2.5, in order to cover a few information of waves in Andaman Sea, which is required for technical investigation. Table 5.2.5 shows mean values of significant wave height ($H_{1/3}$), wave period (T1/3), maximum wave height(Hmax), and maximum wave period(Tmax). Table 5.2.6 shows maximum values of each wave characteristics. Mean values of $H_{1/3}$ vary from 0.14 m to 0.26 m, while mean values of T1/3 change between 8.12 seconds and 13.85 seconds. The maximum wave height of $H_{1/3}$ and Hmax are 1.32 m and 1.98 m respectively during the measurement periodis 1.32 m. Table 5.2.7 shows correlation between wave height and period , and indicates that about 80 % of waves offshore the site are of less than 0.3 m with predominant wave period between 7 and 10 seconds. Figure 5.2.6 illustrates the correlation.

Waves offshore the project site were hindcast with wind records for obtaining wave characteristics for a long period. Based on the hindcasting, occurrence frequency of the waves was calculated and extreme analysis was carried out to determine wave height with a return period. Wave hindcasting was conducted for a group of south western waves and a group of north eastern waves. The former wave group was hindcast at the location illustrated in Figure 5.2.7 for 5 years during June1985 and May 1990 with applying the Global Spectral Ocean Wave Model(GSOWM) by the US Navy. The extreme analysis is shown in Figure 5.2.8.

The latter wave group was hindcast at the location illustrated in Figure 5.2.9 for 10 years during January 1984 and November 1995 with applying the Wilson's formula as below:

$$\frac{gH_{1/3}^2}{U^2} = 0.30\left\{1 - \frac{1}{\left(1+0.004(gF/U^2)^{1/2}\right)^2}\right\} \quad , \quad \frac{gT_{1/3}}{2\pi U} = 1.37\left\{1 - \frac{1}{\left(1+0.008(gF/U^2)^{1/3}\right)^5}\right\}$$

where, $H_{1/3}, T_{1/3}, U, F$ indicates significant wave height, its equivalent period, wind velocity, fetch, respectively. Each effective fetch is calculated with the following equation.

$$F = \frac{\sum F_i \cos^2(\theta_i - \Theta)\Delta\theta_i}{\sum \cos(\theta_i - \Theta)\Delta\theta_i}$$

The tables show a summary of hindcasting as occurrence frequency and extreme significant wave heights.

Percent Occurrence of Significant Wave Height (GSOWM)

Direction / Height (m)	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W
< 0.5	1.5	1.2	6.1	0.9	0.7	0.7	1.5		0.6	1.3	0.3
0.5 - 1.0		*	0.1	*	*	0.2	0.3	3.3	2.8	6.4	1.8
1.0 - 1.5						0.1		0.7	2.7	10.9	1.6
1.5 - 2.0								0.1	1.3	9.4	0.9
2.0 - 2.5								0.1	0.7	4.4	0.3
2.5 - 3.0								0.2	0.2	1.1	0.1
3.0 - 3.5										0.3	*
3.5 - 4.0											*

* indicates frequency less than 0.05 %

Offshore Wave Height for Return Period

	10-year return period	30-year return period
Waves from SW monsoon	3.8 m	4.0 m
Waves from NE monsoon	0.9 m	0.8 m

(4) Sampling and Analysis of Seabed Material

Analysis of seabed material by sampling at several locations was conducted to obtain data for estimation of littoral drift from current measurement and physical analysis of the material around the project site. Forty five samples from the seabed were taken and each sample was analysed as follows:

- Nine samples were recovered for laboratory tests. Items of laboratory test are Sieve Analysis, Specific Gravity and Water Content.
- Forty five samples were taken for observation of seabed condition. These samples were analysed with X-ray in Japan for mineral components of the seabed material.

Fig. III-3.2.3, Fig. III-3.2.4 and Fig. III-3.2.5 indicate locations of sandy seabed, movement direction of seabed material and results of grain size analysis of seabed samples respectively.

These samples of seabed neighbouring the navigation channel is considered to be disturbed by dredged spoil which was discharged by a dredger. Nevertheless, the results of X ray analysis indicates that movement direction of seabed material is mainly from south to north except area neighbouring No.23 and two islands.

(5) Turbidity Measurement

Continuous investigation of suspended solid (SS) with the equipment for turbidity measurement were executed to obtain input data for calculation of SS through measurement of vertical distribution of relative turbidity generated by the tidal currents during high and low tides. Two sets of equipment for turbidity measurement were installed at four locations near the channel for the fishing port Data of turbidity recorded in the memory packs were collected after measurement. The relation in the time process between SS distribution and velocity was measured. These results are indicated on Fig. III-3.2.6 and III-3.2.7.

5.2.3. Earthquakes

(1) Outline of Earthquakes in Thailand

Nine major active fault systems are identified in Thailand. It shows that destructive faults are located in the regions of the south and north west of Thailand.

The epicentres of tremors felt in Thailand are concentrated in regions of active faults in the northern Thailand. It also be concerned that the epicentres are not identified in the southern Thailand.

Based on the study on the previous measurement and further engineering research, the Thai Government prepared intensity zone maps corresponding to Modified Mercalli (MM) scale as follows:

* Zone 0 : Zero seismicity
* Zone 1 : V - VI (MM)
* Zone 2 : VI - VII (MM)

The province of Phuket in southern Thailand is categorised in Zone 1.

(2) Seismic Coefficient

The maximum seismic coefficient in Phuket is categorized into Zone 1. From the seismicity VI, the modified Mericalli scale gives its acceleration of 44.0 gal in the seismicity categories. The horizontal seismic coefficient is calculated as below:

$Kh = dh / g$

where:

Kh : lateral seismic coefficient g : gravitational acceleration (980 m / sec2)

dh : maximum horizontal acceleration (44.0 gal)

$Kh = 44.0 / 980 = 0.05$

Therefore, horizontal seismic coefficient (Kh) in this project is determined to be 0.05.

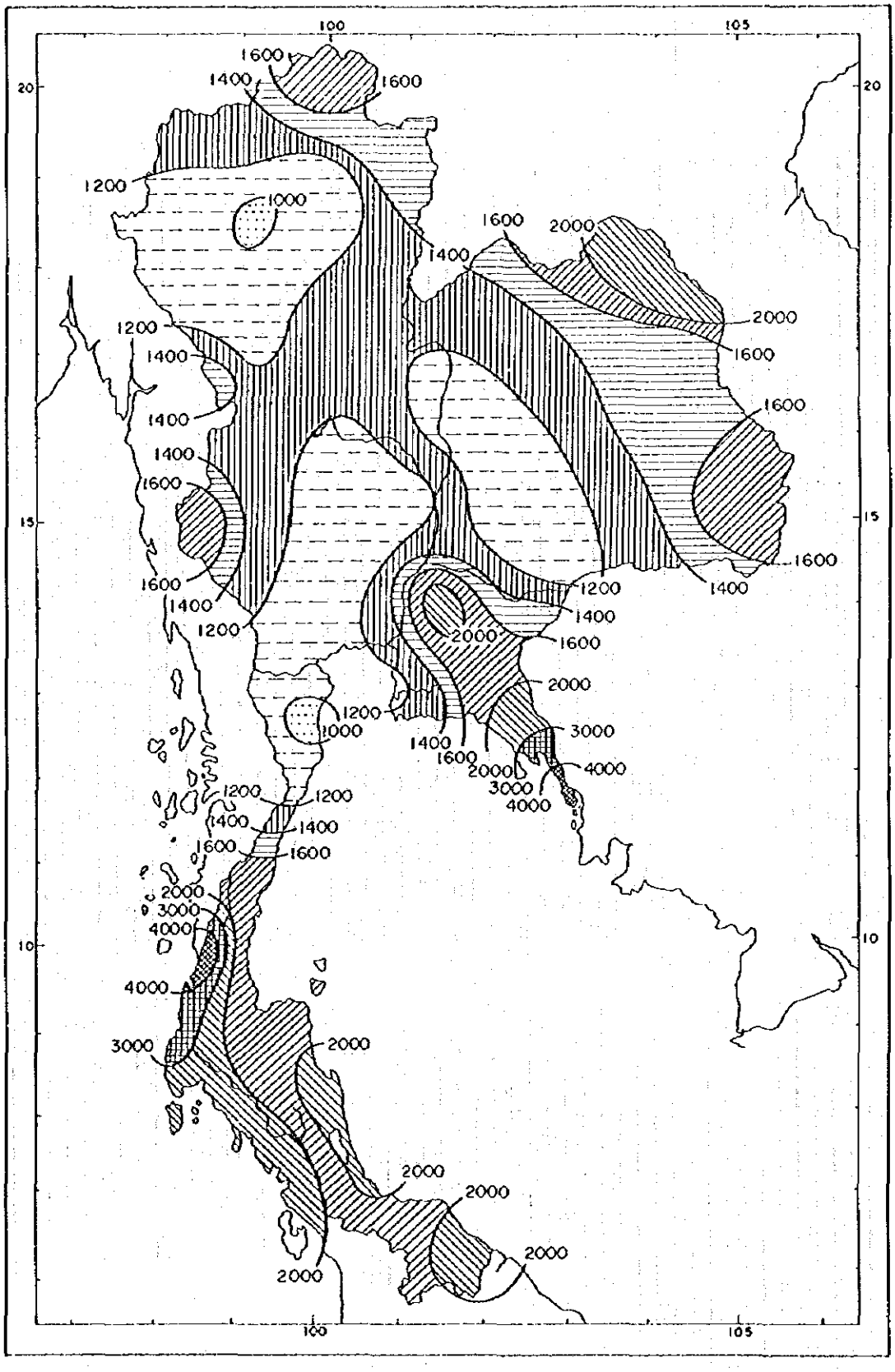


Figure 5.2.1 Annual Rainfall for 30-year Period (1961-1990)

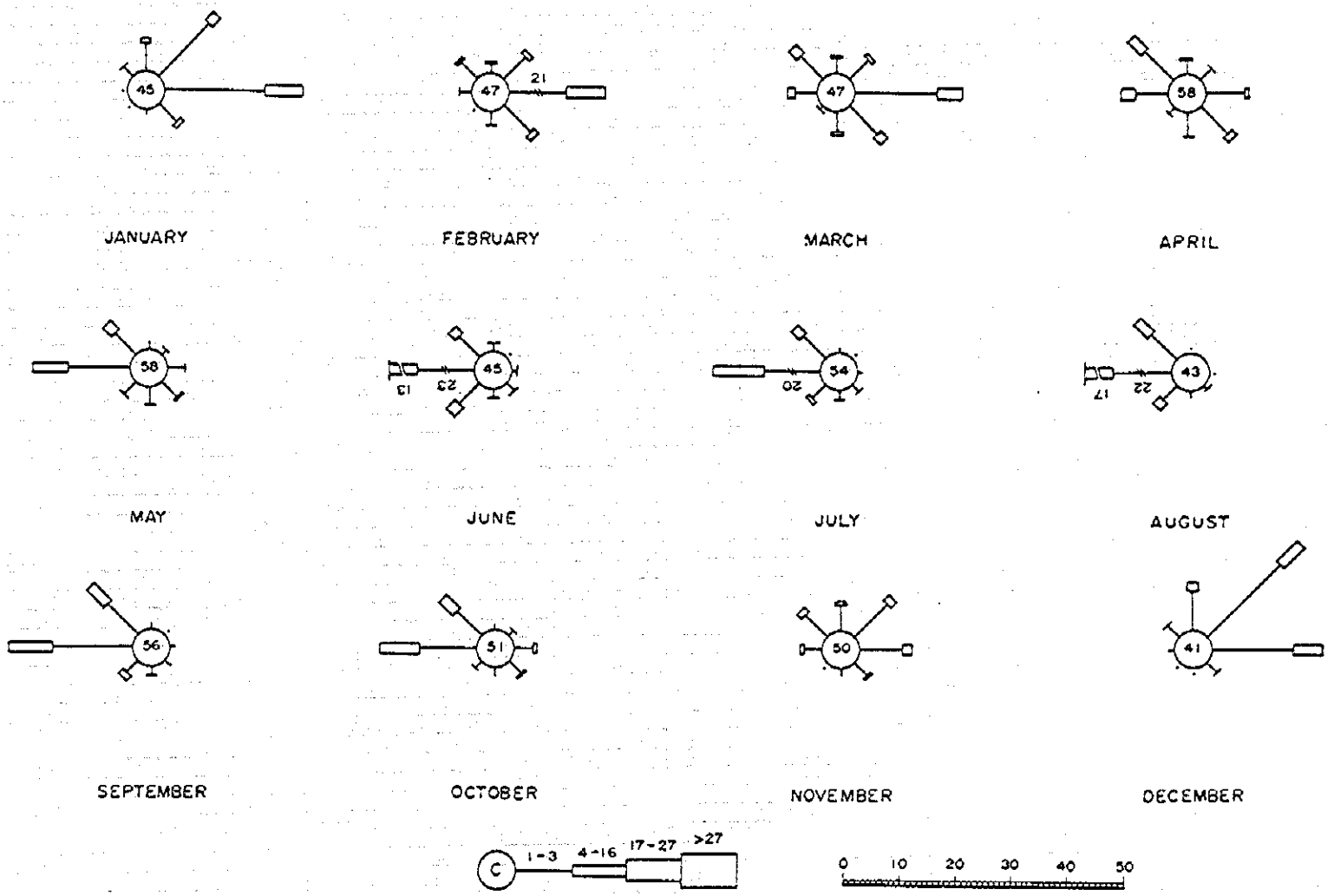


Figure 5.2.2 Wind Rose at Phuket

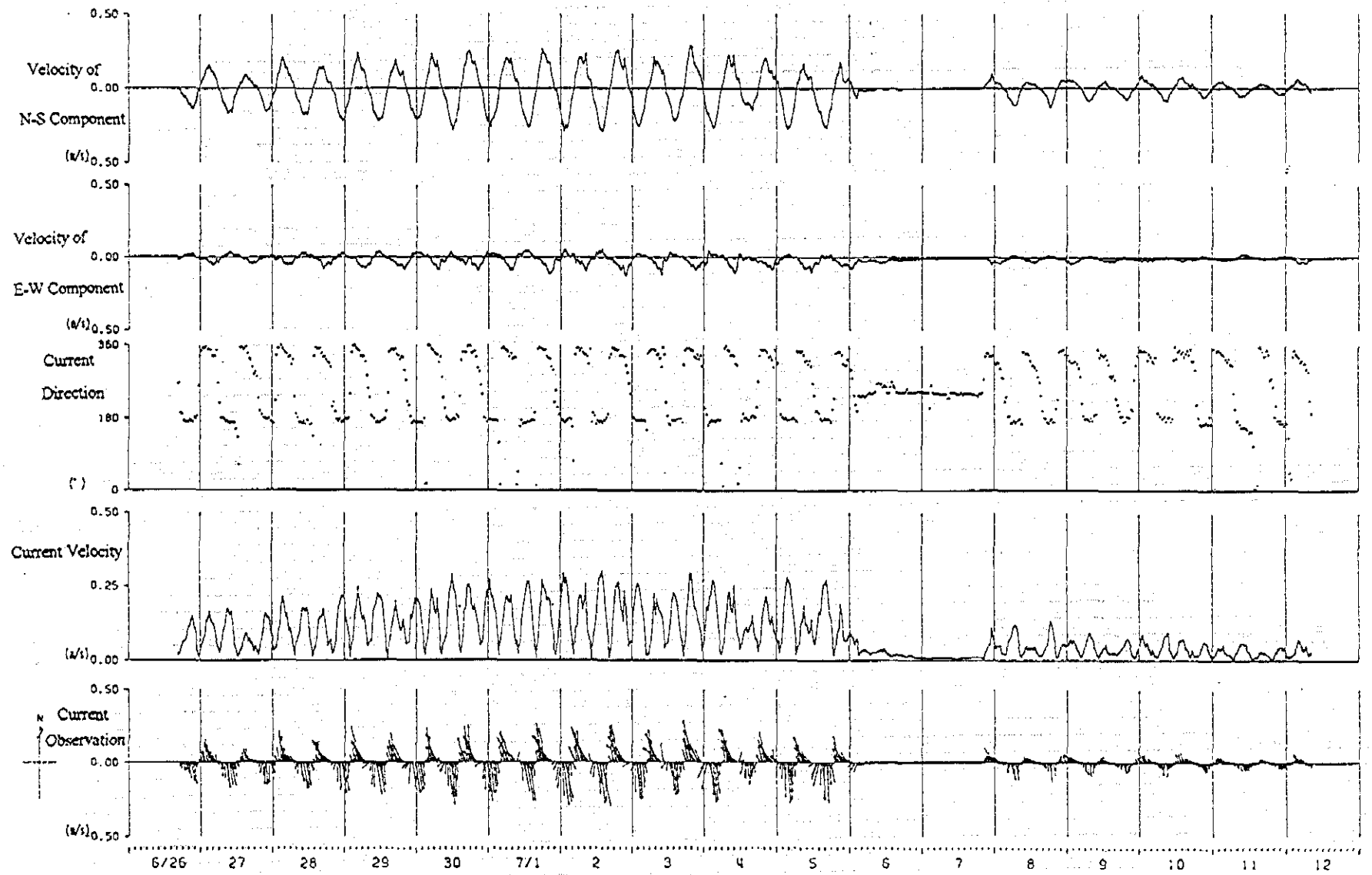


Figure 5.2.3 Chronological Graph of Flow Velocity's Fluctuation

observation Time : June 1996

Observation Period : 27 June, 1996～12 July 1996

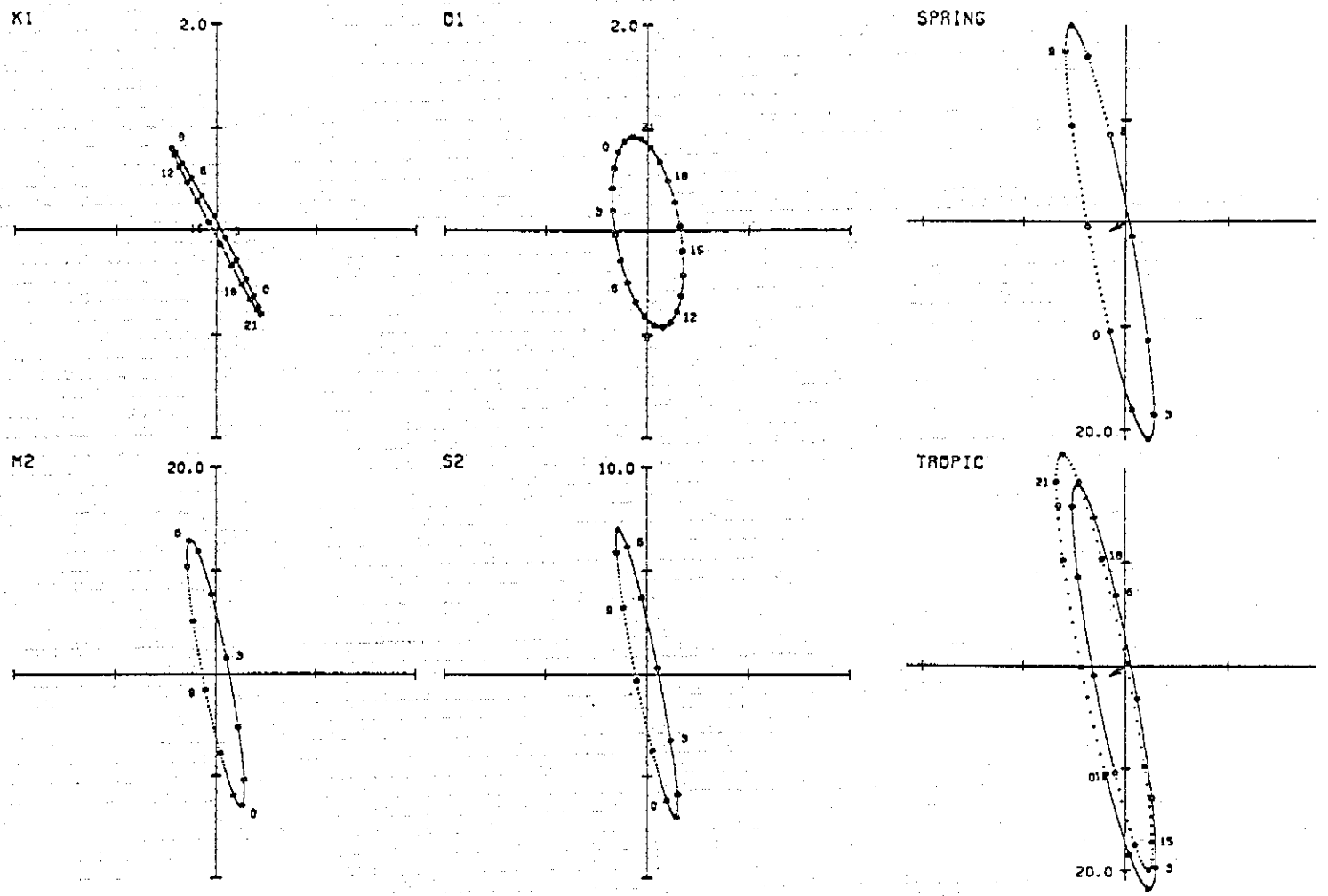


Figure 5.2.4 Current Ellipse

ANDAMAN SEA ST. 8 +0.6 M

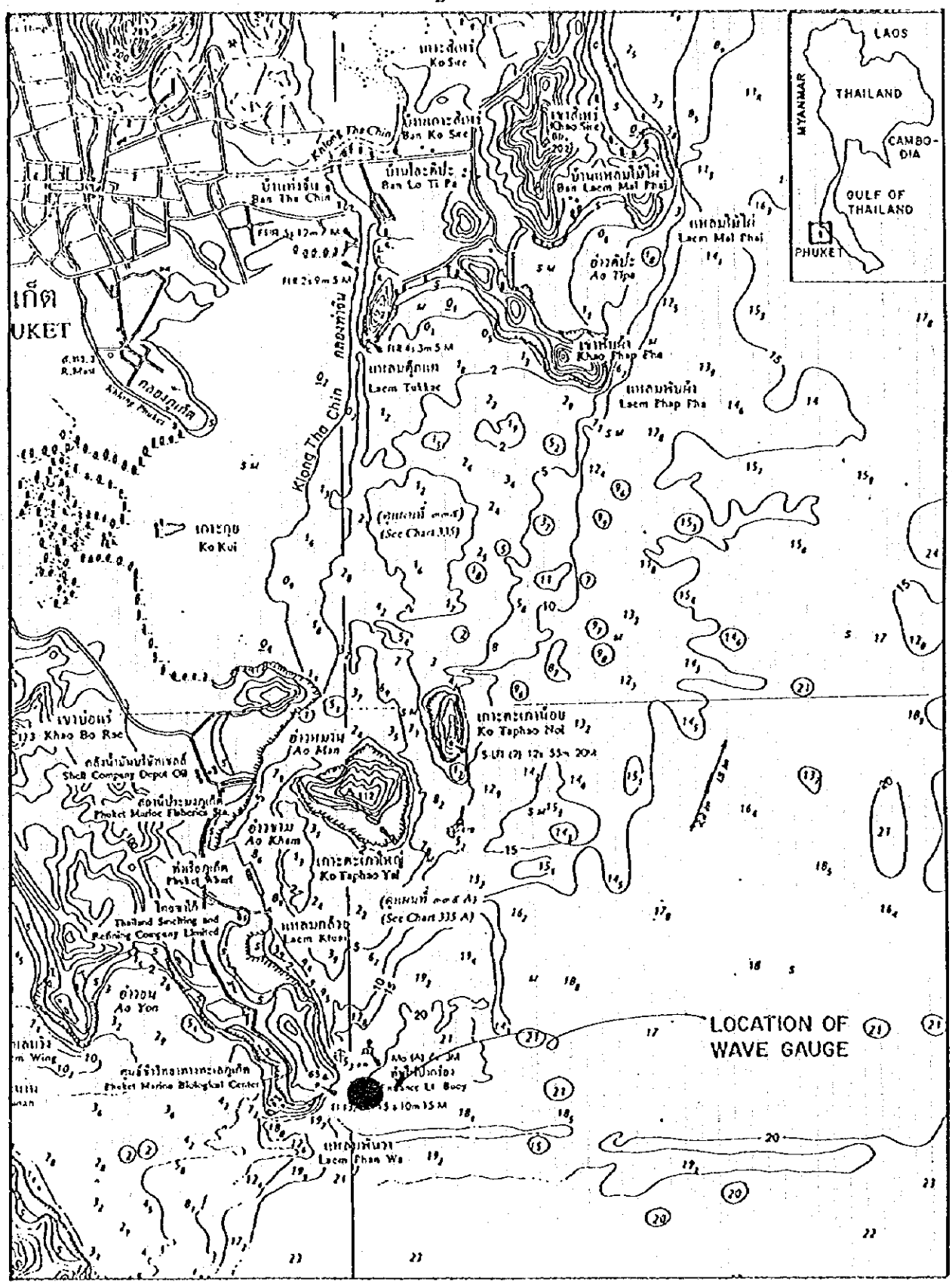


Figure 5.2.5 Location of Wave Measurement at Phuket

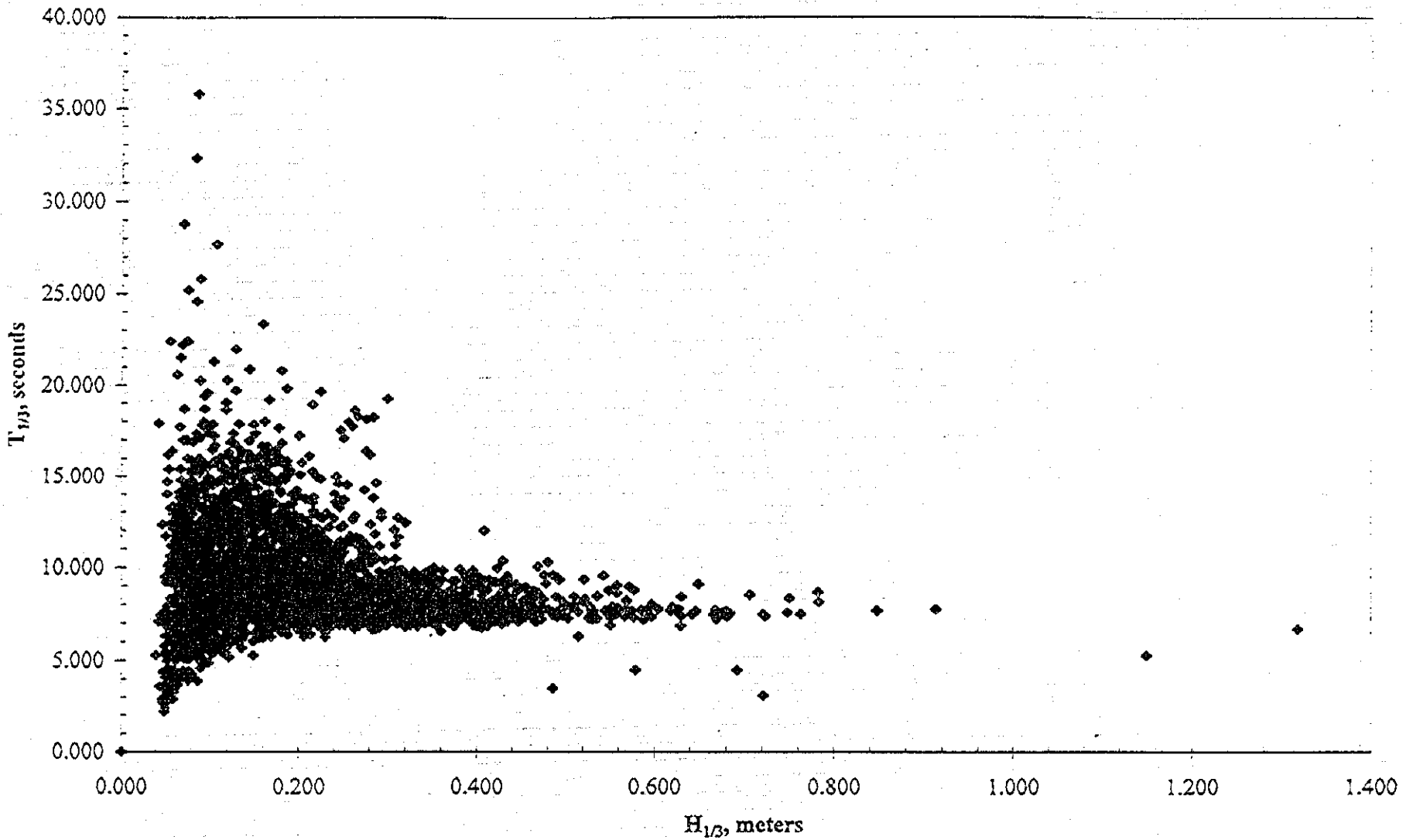


Figure 5.2.6 Plot of $H_{1/3}$ and $T_{1/3}$ from June-December 1996

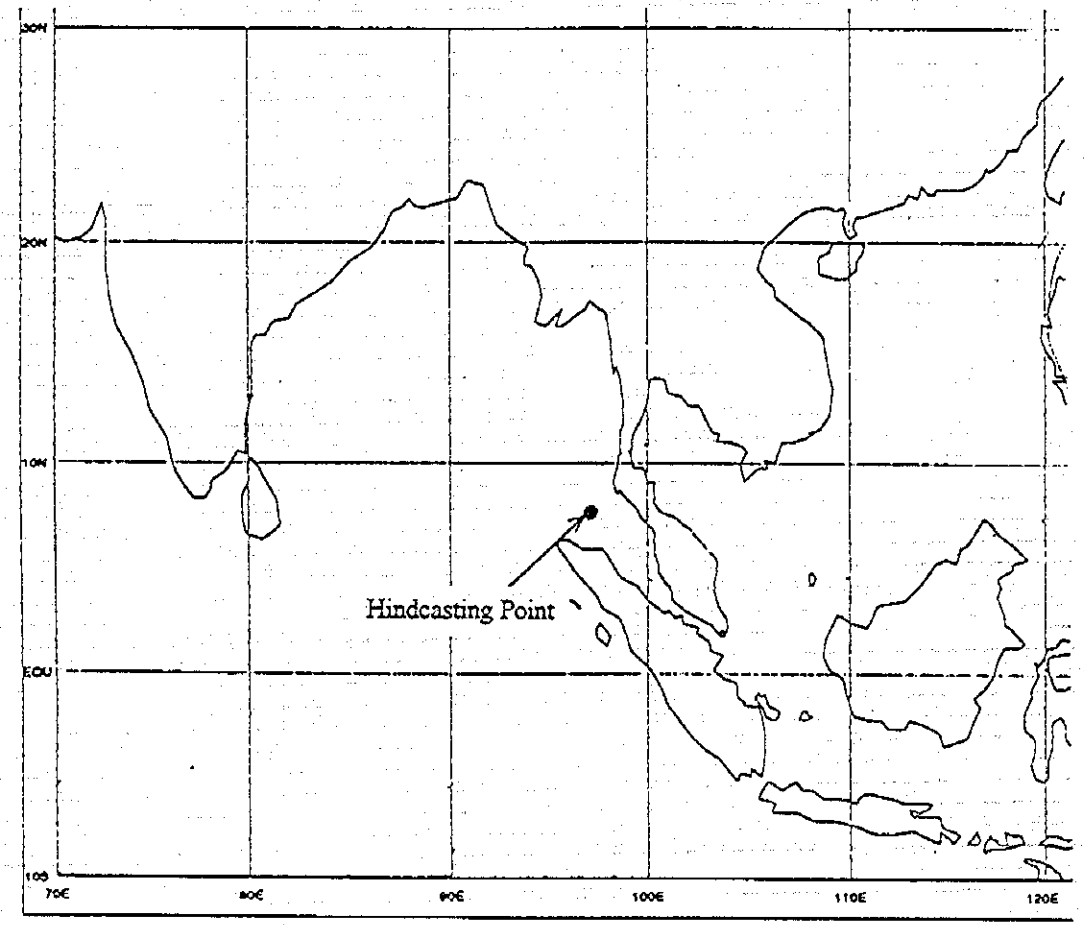


Figure 5.2.7 Location for Hindcast

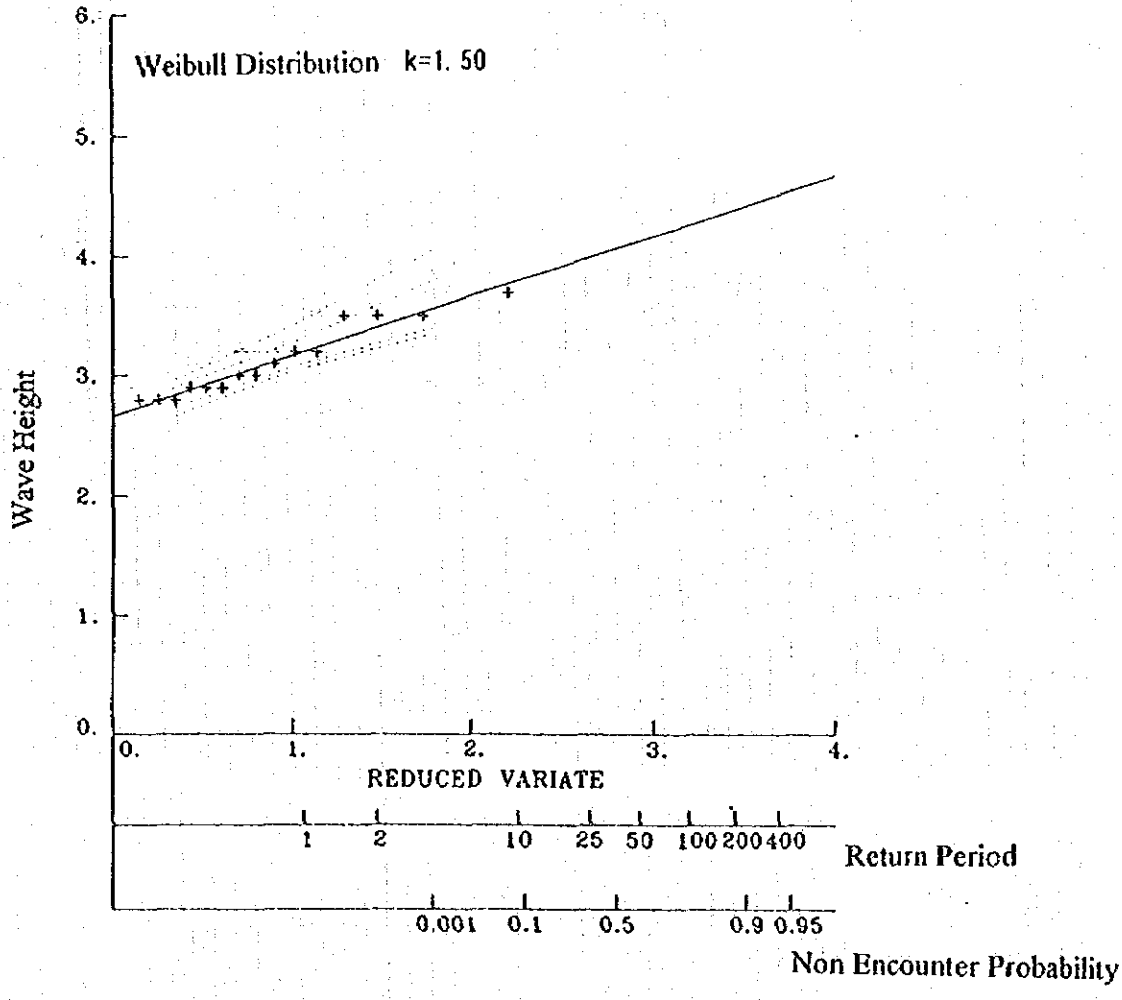


Figure 5.2.8 Extreme Analysis (1/2)

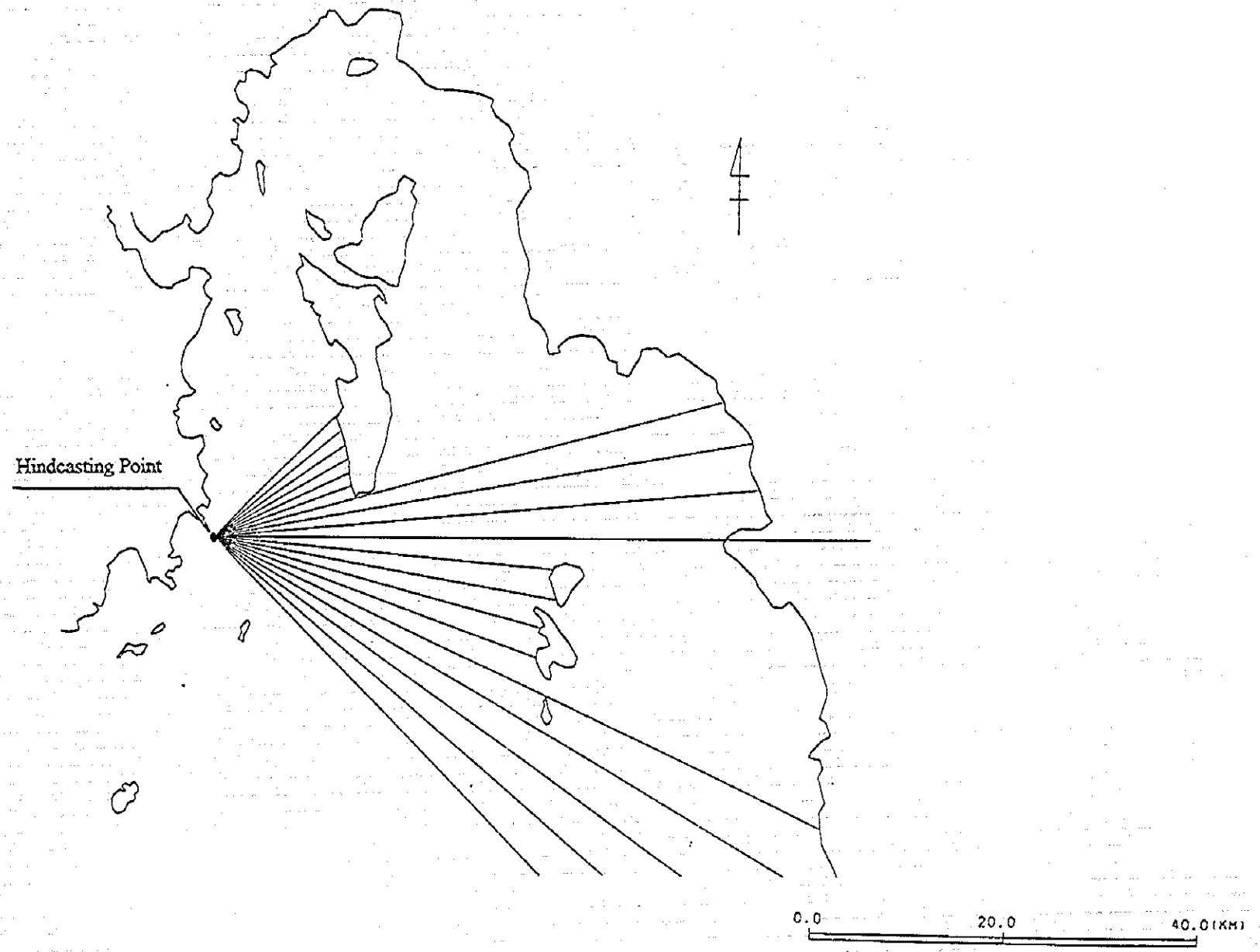


Figure 5.2.9 Location for Hindcast

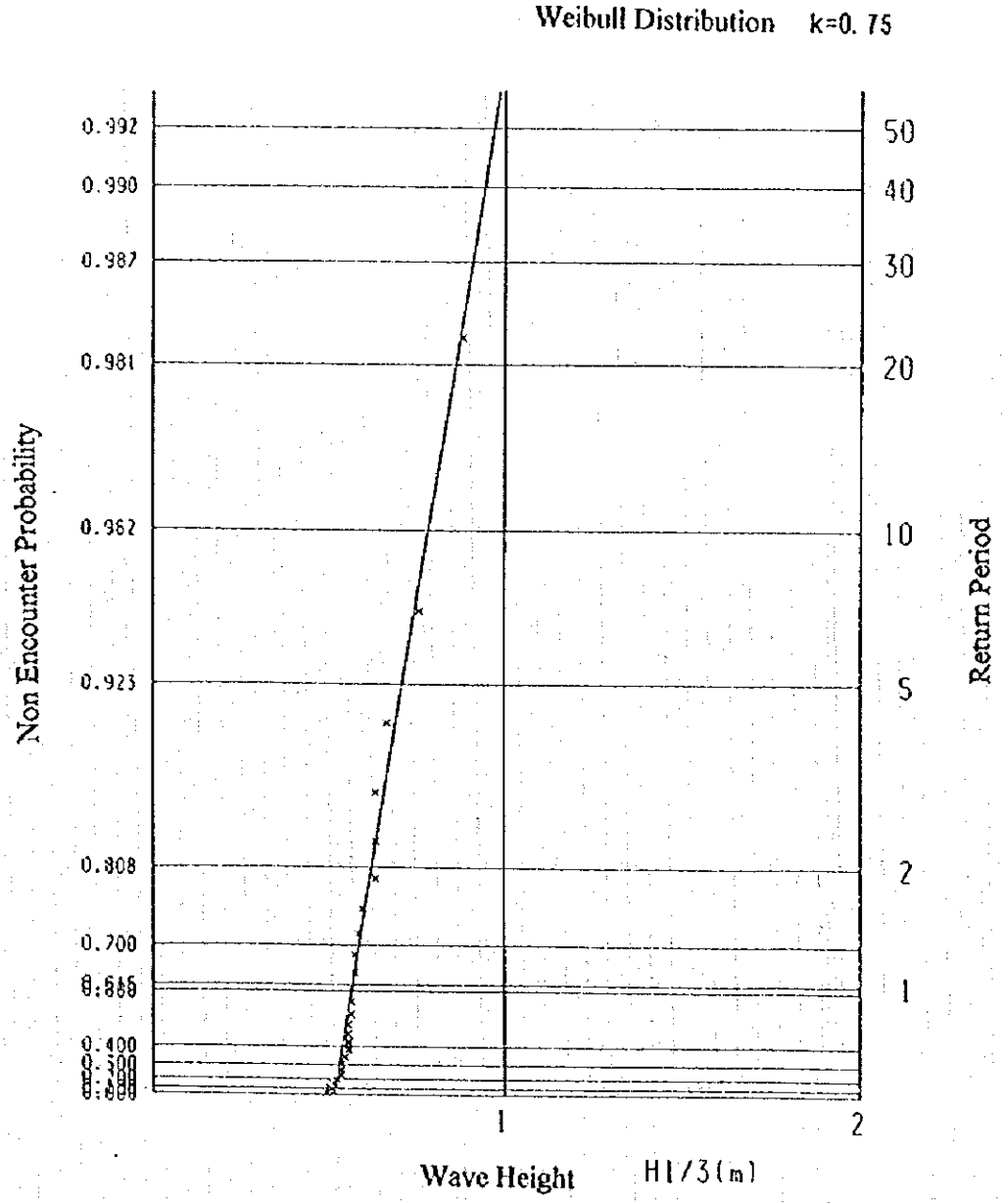


Figure 5.2.10 Extreme Analysis (2/2)

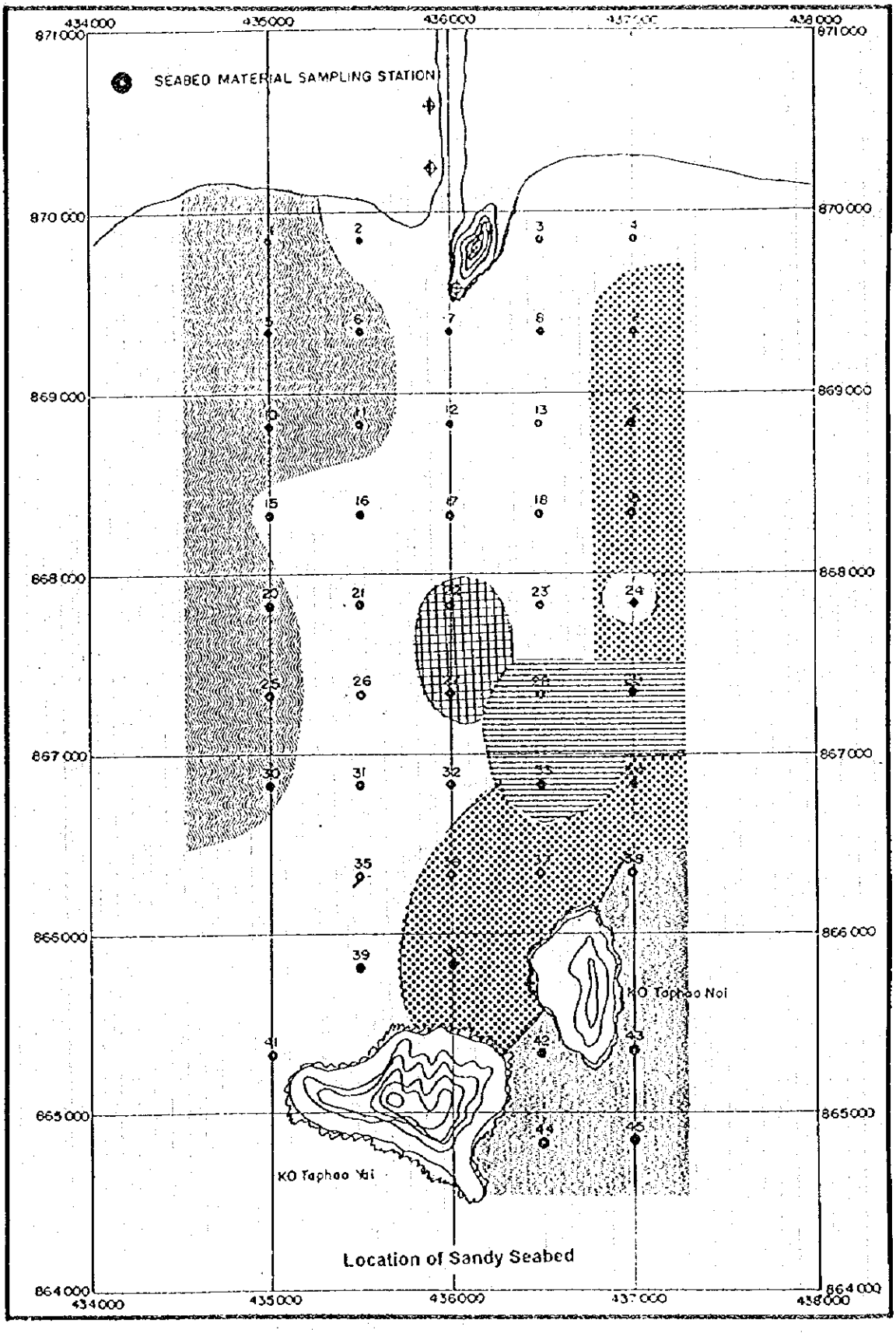


Figure 5.2.11 Location of Sandy Seabed

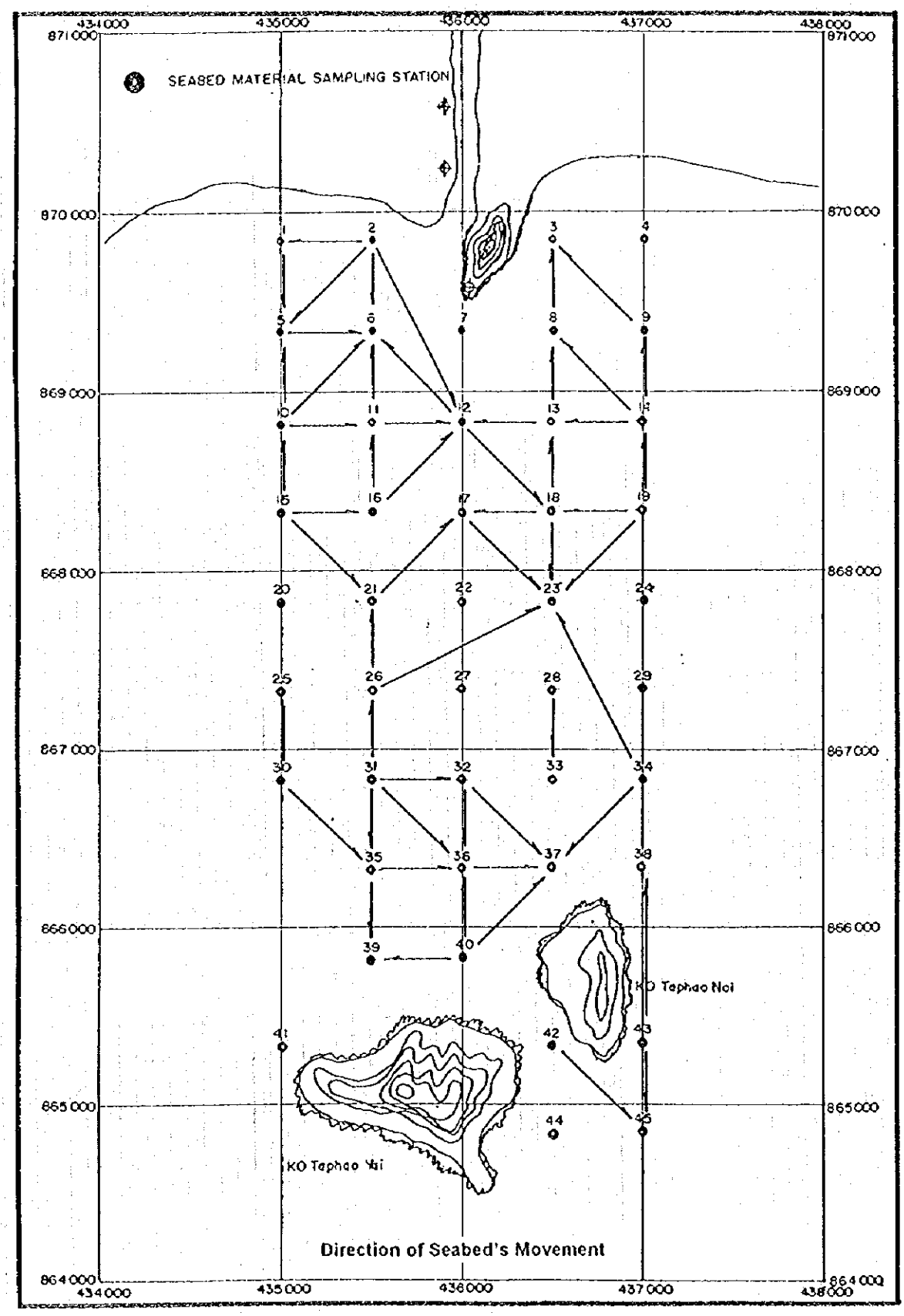
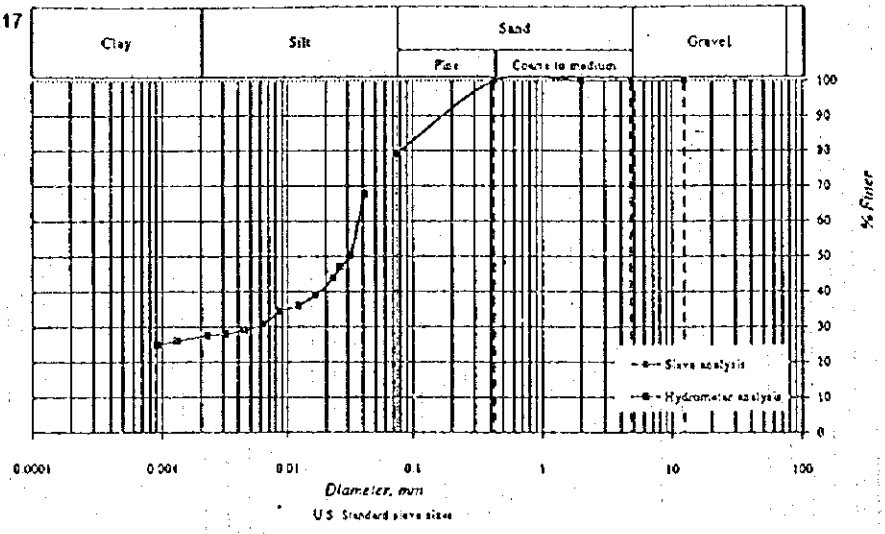


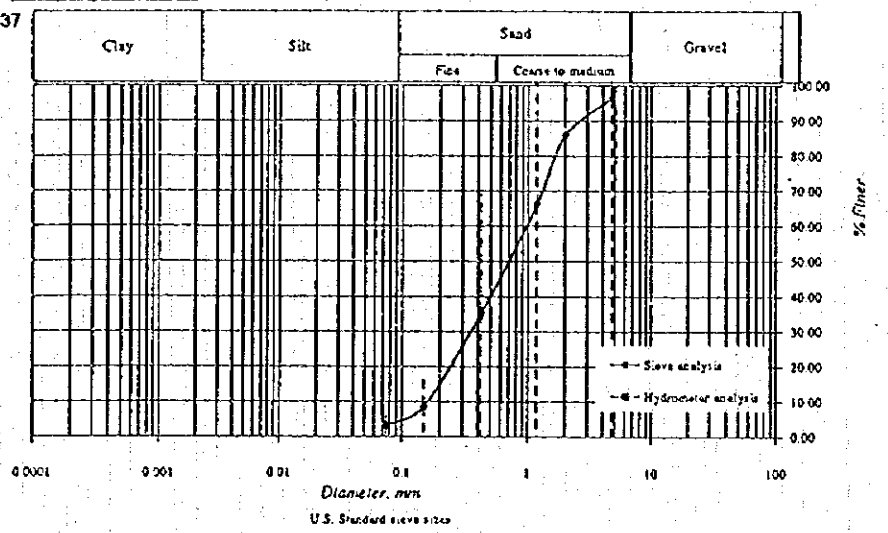
Figure 5.2.12 Direction of Seabed's Movement

Sample No.17



GRAIN SIZE DISTRIBUTION

Sample No.37



Location Map

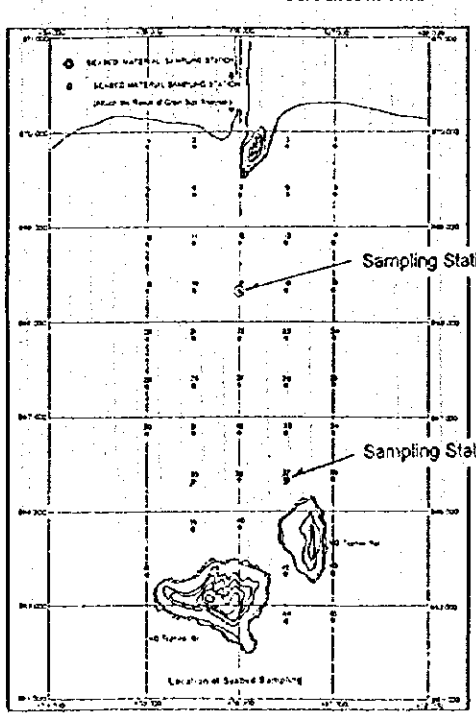


Figure 5.2.13
Grain Size Analysis of Seabed Sample

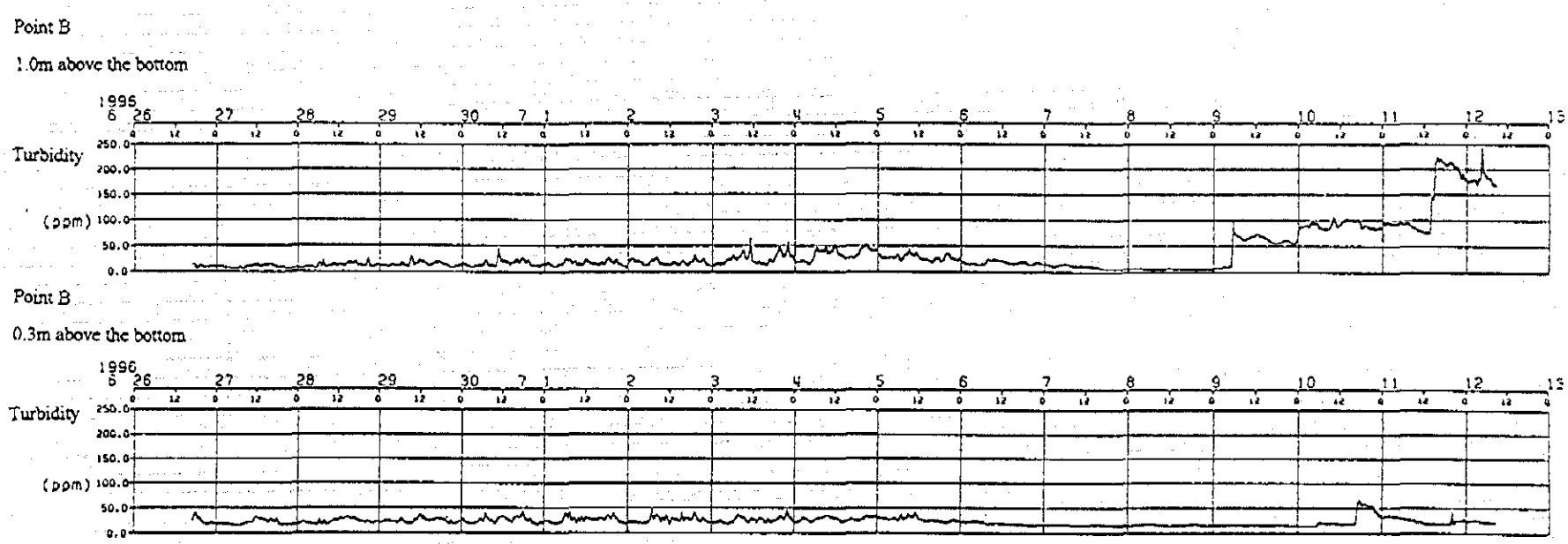


Figure 5.2.14 Chronological Graph of Suspended Solid's Distribution

Table 5.2.1 Monthly Fluctuation of Temperature (Celsius)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Trang													
Mean	26.5	27.5	28.4	28.6	27.6	27.0	26.9	26.9	26.5	26.4	26.1	26.2	27.1
Mean max.	31.9	34.0	35.2	35.2	33.0	32.1	31.6	31.5	31.2	31.4	30.8	30.7	32.4
Mean min.	21.2	21.2	22.0	23.1	23.5	23.3	23.0	23.1	23.0	22.9	22.7	22.3	22.6
Ko Lanta													
Mean	27.6	28.3	29.0	29.2	28.5	28.6	28.0	28.2	27.5	27.3	27.2	27.0	28.0
Mean max.	32.5	33.6	34.2	33.7	31.9	31.5	31.0	30.9	30.4	30.7	30.8	31.1	31.9
Mean min.	23.8	23.9	24.8	25.1	25.1	25.6	25.0	25.4	24.7	24.4	24.0	23.5	24.6
Phuket													
Mean	27.9	28.7	29.3	29.5	28.4	28.3	27.8	27.9	27.3	27.4	27.5	27.6	28.1
Mean max.	31.8	32.9	33.5	33.4	32.0	31.6	31.2	31.2	30.7	30.9	31.0	31.2	31.8
Mean min.	23.3	23.7	24.3	24.8	24.5	24.5	24.2	24.4	23.9	23.8	23.8	23.7	24.1

Table 5.2.2 Monthly Fluctuation of Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Trang													
Mean	74	70	71	76	84	84	84	84	86	87	85	80	80
Mean max.	93	93	94	95	97	97	97	97	97	97	96	94	96
Mean min.	54	46	45	51	63	66	66	66	68	68	68	63	60
Ko Lanta													
Mean	72	72	73	78	83	81	82	82	84	85	82	76	79
Mean max.	86	87	88	91	92	90	91	90	93	94	92	88	90
Mean min.	55	54	56	63	73	73	73	74	76	75	70	62	67
Phuket													
Mean	69	67	68	73	79	78	79	78	81	81	78	73	75
Mean max.	85	85	86	90	93	91	92	90	93	93	91	87	90
Mean min.	54	52	53	57	66	66	67	66	69	68	65	60	62

Table 5.2.3 Monthly Fluctuation of Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Trang													
Mean	49.5	21.0	48.8	118.1	249.4	220.6	273.1	266.2	352.0	279.0	207.5	105.7	2187.3
Daily max.	368.7	53.6	101.3	133.4	116.2	169.7	217.2	157.6	158.2	126.7	125.6	132.3	368.7
Ko Lanta													
Mean	6.5	7.3	36.3	119.6	346.4	204.2	297.1	266.1	391.4	344.8	173.2	38.9	2231.8
Daily max.	22.3	27.0	91.3	72.0	135.8	81.6	112.6	121.0	153.2	167.8	142.9	54.6	167.8
Phuket													
Mean	29.8	20.9	49.1	121.9	319.4	268.9	290.5	272.6	399.0	309.6	175.7	59.4	2316.8
Daily max.	70.8	43.8	111.9	127.5	142.9	129.2	145.9	118.5	172.8	141.2	141.0	73.4	172.8

Table 5.2.4 Wind (knots)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Trang													
Mean speed	6.4	6.2	4.7	2.9	2.0	2.5	2.5	2.7	2.4	2.0	3.2	5.7	-
Prevailing Drct	NE	NE	E	E	W	W	W	W	W	W	NE	NE	-
Max. speed	40	53	41	50	50	60	50	40	54	47	36	40	60
Ko Lanta													
Mean speed	4.2	3.5	3.3	3.1	4.1	6.6	6.0	7.3	6.0	3.9	3.0	4.4	-
Prevailing Drct	NE	NE	NE	W	W	W	W	W	W	W	NE	NE	-
Max. speed	40	35	30	40	55	50	55	60	53	50	32	35	60
Phuket													
Mean speed	3.6	3.3	3.1	2.4	2.4	3.3	3.0	3.7	2.9	2.3	2.6	3.9	-
Prevailing Drct	E	E	E	E	W	W	W	W	W	W	NE	NE	-
Max. speed	20	20	30	35	30	40	33	35	24	40	27	28	40

Table 5.2.5 Mean Volumes of $H_{1/3}$, $T_{1/3}$, H_{max}, T_{max}

Month	Mean Values			
	$H_{1/3}$ (m)	$T_{1/3}$ (secs)	H_{max} (m)	T_{max} (secs)
June	0.16	13.85	0.21	12.79
July	0.26	9.10	0.37	8.45
August	0.21	8.91	0.31	8.36
September	0.25	8.81	0.36	8.13
November	0.14	9.49	0.21	8.74
December	0.14	8.12	0.21	7.87

Table 5.2.6 Maximum Volumes of $H_{1/3}$, $T_{1/3}$, H_{max}, T_{max}

Month	Maximum Values					
	$H_{1/3}$ (m)	$T_{1/3}$ (secs)	H_{max} (m)	T_{max} [1] (secs)	T_{max} [2] (secs)	Date/Time
June	0.30	23.37	0.41	19.20	8.00	96/06/25 13.06
July	0.91	20.83	1.26	16.60	7.25	96/07/29 13.41
August	0.68	20.28	0.93	18.20	7.69	96/08/10 14.18
September	0.85	21.33	1.31	17.70	7.31	96/09/27 00.55
November	1.32	35.80	1.98	17.60	6.70	96/11/30 19.15
December	0.69	22.20	1.21	34.20	14.30	96/12/01 01.15

1 Maximum of Maximum

2 Tmax corresponding to Hmax

Table 5.2.7 Duration of Joint Occurrence of Wave Height and Wave Period (Hours) from June-December, 1996

$T_{1/3}$	$H_{1/3}$													Total Hours	%
	0.0-0.10	0.10-0.20	0.20-0.30	0.30-0.40	0.40-0.50	0.50-0.60	0.60-0.70	0.70-0.80	0.80-0.90	0.90-1.00	1.00-1.10	1.10-1.20	1.30-1.40		
0-1	2													2	0.06
1-2															
2-3	11													11	0.35
3-4	21				1			1						23	0.73
4-5	31					1	1							33	1.04
5-6	52	19										1		72	2.27
6-7	48	72	27	17	3	2	1						1	171	5.40
7-8	69	203	223	187	85	31	17	4	1	1				821	25.92
8-9	68	298	232	91	36	11	1	4						741	23.39
9-10	55	193	129	60	19	3	1							460	14.52
10-11	64	117	60	2	3									246	7.77
11-12	51	73	42	2	1									169	5.34
12-13	40	76	21	3										140	4.42
13-14	25	46	12											83	2.62
14-15	17	39	5											61	1.93
15-16	13	35	5											53	1.67
16-17	4	25	3											32	1.01
17-18	8	8	4											20	0.63
18-19	2	2	5											9	0.28
19-20	2	5	2											9	0.28
20-21	2	2												4	0.13
21-22	1	2												3	0.09
22-23	3													3	0.09
23-24		1												1	0.03
24-25															
25-26															
26-27															
27-28		1												1	0.03
Total Hours	589	1217	770	362	148	48	21	9	1	1		1	1	3168	
%	18.59	38.42	24.31	11.43	4.67	1.52	0.66	0.28	0.03	0.03		0.03	0.03		100.00

5.3. RELOCATION OF FISH PROCESSING FACTORIES

5.3.1. National Policy on Relocation of Factories

(1) Government Incentives for Factories to Relocate

The Seventh National Economic and Social Development Plan has been prepared by the Government of Thailand with major objectives, one of which is redistribution of income and regional development. Based on the objective, the Government of Thailand has initiated a policy to relocate processing factories from the surrounding area of Bangkok to other regions, in order to promote environmental conservation around Bangkok and to resolve the regional disparities between urban and rural areas.

In 1977 the government of Thailand enacted a law to promote investment for industries and to achieve national socioeconomic development. A Board of Investment (BOI) was established under the Prime Minister's Office.

BOI Notification No. 1/1993, No. 2/1993 on investment incentives were announced in 1993. BOI divided the country into three zones and enacted a policy of tax exemption privileges for firms to investing in that zone.

Zone 1	Bangkok, Samut Pracan, Samut Sakhon, Pathum Thani, Nonthaburi, Nakhon Pathom.
Zone 2	Ten provinces around Zone 1 such as Samut Songkhram, Kanchanaburi, Ang thong, Saraburi, etc.
Zone 3	Southern, northern, northeastern, eastern parts of Thailand and Laem Chabang Industrial Estate, excluding Zone 1 and 2.

In particular, the BOI notifications pursued a policy to relocate factories. Factories which relocated from Zone 1 to Zone 3 received the following tax exemptions:

- Income tax is exempted for eight years.
- A fifty percent income tax exemption for five years after the end of the tax exemption period.
- Double deductions on transportation, electricity and water consumption expenses.
- A deduction of 25 percent from net profits for installation of equipment and investments on needed infrastructure.

Fish processing factories located in Zone 1 are eligible to receive the privileges outlined above, if they relocate to Zone 3.

(2) Present Status of Industrial Zone

Industrial zones in Thailand have developed rapidly in the face of energetic investments since 1987. At present, there are 52 industrial zones, including those under construction.

Currently, the development and construction of industrial zones have moved from Zone 1 in the metropolitan area of Bangkok to Zone 2 and Zone 3, due to the BOI investment incentives targeting the regional decentralization of industries.

Industrial zones are largely categorized according to the developer and its use. There are two types of industrial zone developers. One is the Industrial Estate of Thailand (IEAT) under the Ministry of Industry and the other is private firms.

In addition, there are also two categories of industrial zone use. One is the General Industrial Zone (GIZ) and the other is the Export Processing Zone (EPZ). General industry firms are found in the GIZ and firms which export more than 80 percent of their products are placed in the EPZ.

In actuality, the majority of the industrial zones are either GIZ or a combined form of GIZ/EPZ and there are few zones that are exclusively EPZ (refer to Table 5.3.1). The industrial zones are operated and managed by IEAT or a private firm.

All of the industrial zones approved by BOI are GIZ. As a result, when there is a need to create an EPZ annex, it must be developed and operated jointly with IEAT. Most of the private industrial zones developed recently are joint projects with IEAT in the planning, construction and operation of these zones.

Industries operating in an IEAT industrial estate receive the following privileges.

- Industries, including foreign firms, may be permitted to own land in the industrial estate.
- Firms are permitted to bring foreign skilled workers, experts and their sponsor dependents into Thailand. Such foreign nationals are allowed to stay in Thailand and are granted work permits.
- Firms are permitted to take out or remit foreign currency from Thailand if the currency is capital, dividends or other accrued benefits.

In addition, firms operating in an export processing area (EPZ) are granted exemptions from the following taxes.

- Import duty and business taxes on machinery, equipment, tools and supplies, including the components which are essential to the production of goods, and on materials to be used for construction, assembly or installation of factory or building in the EPZ.
- Import duty and business taxes on goods imported and taken into the EPZ.
- Export duty and business taxes on products and by-products manufactured in the EPZ.

Firms in an industrial zone approved by the BOI individually apply for permission to receive the privileges granted under the law to promote investments.

BOI has restricted the area of an industrial zone to more than 500 Rais. It also regulates the ratio of factory land and land for other facilities and the infrastructure within an industrial zone (roads, waste water treatment, garbage collection etc.).

There are sixteen industrial zones in Zone 3. Four of these industrial zones have an EPZ as shown in Table 5.3.1. Three of these four EPZs are concentrated in Rayong and the surrounding area along the eastern coast of the Gulf of Thailand.

Industrial zones in the southern part of Thailand were developed and constructed as part of the Southern Sea Board Development Project. But there is only one industrial zone with an EPZ in Songkhla. However, it's scope is small at 216 Rais and it has been able to procure only five to six factories of various industries. Fish processors are an export industry. Therefore, industrial zones with an EPZ for factories relocating from Zone 1 need to be developed and constructed.

5.3.2. Outline of Fish Processing Industry

(1) Processing Industry and Raw Material Demand

The fish processing industry in Thailand is composed of the modern canning and frozen food processing industry aimed at exporting to foreign markets and the traditional processing industry manufacturing fish sauce and salted/dried fish (refer to Table 5.3.2).

As shown in Table 5.3.2, the number of salted/dried fish processing factories such as salted/dried fish, dried shrimp, dried squid has maintained an overwhelming majority from 1985 to 1993, but their numbers have been decreasing annually.

In contrast, the number of frozen and canned fish and fish meal factories have gradually increased.

Fish and shellfish landed in Thailand are usually used as raw materials for processing. However, processing and re-exporting imported raw materials have been the recent trend due to an increment in raw material demand, following the rapid development of the modern processing industry.

The fish meal processing industry has the highest demand in raw materials, followed by the canning and frozen food industry (refer to Table 5.3.3).

Although the production volume of fish meal plants has increased yearly, the ratio of volume of raw material used by the fish meal industry to volume by entire processing industry has decreased. The volume of raw material processed by fish meal factories in 1985 was 900,000 tons or 55% of the total volume of 1,650,000 tons used by processing industries. In 1993 1,370,000 tons or 42% of the total volume of 3,280,000 tons was used by fish meal factories. Canning and frozen fish industries processed 30% and 25% of the total volume of raw materials, respectively.

(2) Present Status of Frozen Fish Industry

The frozen fish industry is representative of the processing industries targeting exportation; and its major source of raw materials are shrimp, squid and white meat fish.

The production volume of frozen shrimp increased from 127,877 tons in 1989 to 243,858 tons in 1993 due to an especially sustainable supply of raw materials stemming from the development of black tiger aquaculture. In contrast, raw materials of frozen food products such as fish and squid have to be imported because of difficulty in locally securing raw materials due to decreases fishery resources.

There was a total of 129 frozen fish factories in Thailand in 1993 and 834,000 tons of raw materials were consumed by these factories (refer to Table 5.3.2 and 5.3.3). Frozen fish factories in Thailand are concentrated in Samut Prakan, Samut Sakhon in the suburbs of Bangkok, and Songkhla. More than 60 percent of the total volume of raw materials were processed in these three provinces in 1993.

The raw materials for frozen shrimp were mostly natural shrimps until 1986. However, a shift was made to black tiger, due to increased production of black tiger shrimp. Currently, nearly one half of the frozen fish factories utilize black tiger shrimps. Initially, black tiger culture farms were mainly located in the surrounding area of Bangkok. At present, the coastal area along the Gulf of Thailand in the south has become the major production area because of high land costs and water and environmental pollution.

(3) Present Status of Canned Fish Industry

The production volume of the canned fish industry was 170,000 tons in 1985 and it has continued to increase steadily. In 1991, the production volume reached a peak of 440,000 tons and it has more or less maintained a production volume of 400,000 tons since 1990 (refer to Table 5.3.4). The export volume of canned fish increased from 140,000 tons in 1985 to 410,000 tons in 1993. Exports also increased from US$285 million in 1985 to US$1,205 million in 1993. About 60% of canned fish was canned tuna or skipjack.

There are 52 canning factories in Thailand and their total production volume is 580,000 tons/year. However, their operational ratio is low because of a shortage of raw materials. Nearly 80 to 90 percent of the raw material supply for canned tuna factories is imported (refer to Table 5.3.5).

The world production volume of canned skip jack/tuna steadily increased from 800,000 tons in 1985 to 1,100,000 tons in 1989 and stabilized at 1,100,000 to 1,200,000 tons since 1989. Canned skip jack/tuna produced in Thailand are mostly exported to foreign countries such as USA and EU. The production volume increased from 90,000 tons in 1985 to 270,000 tons in 1991 and decreased to 230,000 tons in 1993. This was due to the Oraganoleptic Testing Procedure which was applied to canned tuna since 1992 by the Food and Drug Administration in the USA . As a result, the import of many canned tuna were prohibited. Nearly 40% of the export volume of canned skip jack/tuna was destined for the USA until 1992, but this share dropped to 30% of the total export volume. In addition, the export volume of canned tuna to the EU also decreased due to tax exemption measures for ACF countries such as Senegal and Seychelles, which have joint ventures of canned tuna firms with EU countries.

(4) Present Status of Fish Processing Factories in Zone 1

1) Number of Factories by According to Type of Processing

There are 115 fish processing factories that are members of the Thai Food Processor's Association (TFPA) and the Thai Frozen Food Associations (TFFA) in Zone 1. Ten factories of these factories are located in Bangkok and 31 and 74 factories are located in Samut Prakan and Samut Sakhon, respectively.

These 115 factories consist of 43 canneries and 72 frozen food processing factories. Canneries produce canned skip jack/tuna, sardine, baby clam and shrimp. Frozen food processing factories process shrimp, squid and surimi. Few factories process only one single species (refer to Table 5.3.6).

There are 19 canned skip jack/tuna and other marine product factories in Zone 1. Among the 19 canned skip jack/tuna factories, 14 factories produce not only canned tuna but also other canned marine products which correspond to 10% of the production volume.

2) **Problems in Fish Processing Industry**

The fish processing industry has developed under a system of low prices and a sTableáV supply of raw materials, low labor costs, and a sufficient supply of manpower. However, it has become difficult to secure low priced raw materials in recent years because of deterioration in fishery resources. Moreover, the fish processing industry in Thailand is facing a turning point because of the high cost of labor brought on by the development of industries.

Present fish processing factories in Zone 1 face many problems. The major problems are as follows:

- Shortage of raw materials
- Shortage of manpower and move to other industries such as electronics
- High labor cost
- Low international market price
- Low quality of raw materials
- Traffic congestion of the surrounding area
- Unloading and loading port congestion

Canned skip jack/tuna is a major product of canned sea food and 80% of these raw materials are imported. Other raw materials such as sardine, shrimp and squid are mainly locally supplied, but some are imported in recent years.

Some factories in Zone 1 want to relocate their factories and receive tax exemption privileges under the BOI law on promoting investments; and thereby resolve such problems as high labor costs, shortage of labor and environmental pollution of the area surrounding the factories. A certain firm which is one of biggest manufacturers of frozen sea food and canned tuna plans to relocate its factory to Phechaburi province in Zone 3 within this year.

5.3.3. Estimated Fish Processing Factories Attracted to New Fishery Complex

(1) Selection of Processing Industry Targeted in the Project

Modern processing industries in freezing and canning have mainly developed in Bangkok, Samut Prakan, Samut Sakhon due to low labor costs, sufficient and good quality labor, low material cost and improved quality. However, their growth in recent years has stagnated due to outside factors such as the import quota system, problems in product quality and internal factors such as deteriorating fishery resources, shortage of raw materials, high labor costs and environmental issues in the urban area.

One of the objectives of the Project is to construct a export processing zone as a part of the Fishery Complex in order to resolve the issues of high labor cost, securing manpower, environmental problems, and to give firms a competitive edge by developing an efficient operational system.

The processing industries targeted by the Project is to construct a export processing zone as a part of the Fishery Complex, in order to resolve the issues of man power supply and environmental problems and to give firms a competitive edge by developing an efficient operational system. The processing industries targeted by the Project are the frozen and canned food industries. There is a large difference in the measure of raw material supply between the two industries.

The raw material used in the frozen food industry are mainly fish/shellfish landed domestically, whereas the canned skipjack/tuna industry imports 70 to 80% of its raw materials.

Major raw materials of the frozen food industry are shrimp and squid and much of the frozen shrimp is cultured. The supply/demand of raw materials in the coastal zones is balanced. In a comparison of cultured shrimp production volume according to coastal zones and the volume used for processing, the production volume of cultured shrimp in Zones 1 and 2, located in provinces near Bangkok and eastern Thailand respectively, was 102,000 tons in 1993 in comparison to 123,000 tons consumed for processing.

The production volume in Zones 3, 4 and 5 located in Southern Thailand, was 123,000 tons and the volume used in processing was 123,000 tons (refer to Table 5.3.7). The supply/demand for squid is balanced in each zone (refer to Table 5.3.8. Therefore, if frozen food processing factories located in the surrounding area of Bangkok moves to southern Thailand, the balance in the supply/demand will be destroyed and additional expenses will be necessary to procure raw materials and transport.

According to an interview survey for fish processors, one of the indispensable conditions for relocating factories is a sustainable supply of raw material. Factories will not relocate to an area where raw materials are difficult to procure. Therefore, the frozen food industry is not a suitable target for the Project.

However, the canned skip jack/tuna industry relies on imported raw material. Therefore, they are able to relocate more easily than frozen food industries if a fishing port is constructed as a landing base for raw materials from the Indian Ocean.

The tuna canning industries are able to decrease transport costs for raw materials and easier to secure labour than Bangkok by the relocation to Phuket Fishing Port. The minimum daily labour wage is B145 in Phuket as same as Bangkok, even Phuket is categorised Zone 3. However, daily labour cost which is composed of minimum daily labour wage and allowance such as transportation fee, accommodation, etc., is decreased from B230 in Bangkok to B200 in Phuket, due to the allowance is cheaper than it in Bangkok. These decrease of costs are in accord with the objective of fostering a competitive edge in the international market.

Therefore, the canned skipjack/tuna factories located in metropolitan Bangkok and its surrounding area should be targeted for relocation to the fishery complex.

(2) Incentives for Canning Factories in Zone 1 to Relocate to Phuket

Processing factories will receive the following benefits by relocating from Zone 1 to the Project site in Phuket.

Items	No Relocation	Relocation
Supply of raw materials from Indian Ocean	Far from fishing ground to fish landing site.	Near fishing grounds and fish landing site. Therefore, purchase price of raw material is cheaper because of lower transport cost.
Cost of land transport	Far from fish landing site to factory, and from factory to shipping port	Near fish landing site to factory and from factory to shipping port, resulting in lower transport costs.
Labour cost	B230 person/day	B200 person/day
Securing labour	Difficult.	Easy in comparison to Zone 1.
Infrastructure	There is little to choose between both.	
Incentives by the Government		
BOI Privileges	End of tax exemption benefits	Will receive tax exemption benefits
IFCT Privileges	–	Will be funded for relocation at an interest lower than that of commercial banks
Area to be located	Some factories do not locate to EPZ.	Will be authorised as EPZ.

(3) Canned Skipjack/Tuna Factories Attracted to the Fishery Complex

1) Import Volume of Skip Jack/Tuna by Canning Factories According to Production Area and Fishing Grounds

Canned skip jack/tuna factories are located in the surrounding area of Bangkok (Zone 1) and Songkhla and they utilize imported raw materials. These raw materials are imported through importers from the western Pacific Ocean and Indian Ocean to Bangkok and Songkhla by refrigerated carrier vessels of 1,000 to 5,000 tons. The total import volume was 407,000 tons in 1993. Approximately 290,000 tons or 71% of the total import volume were imported from the western Pacific Ocean and 101,000 tons or 25% were imported from the Indian Ocean. The remaining 70,300 tons or 4% were imported from other areas such as the Atlantic Ocean (refer to Table 5.3.9, 5.3.10, 5.3.11). Of the 101,000 tons of raw materials imported from the Indian Ocean, 70,300 tons were imported to Bangkok and 30,700 tons to Songkhla, respectively (refer to Table 5.3.12).

2) Processing Volume of Potential and Relocated Canning Factories

When the fishery complex is constructed in Phuket, skipjack/tuna from the Indian Ocean will be transported by reefer and unloaded at Phuket. Therefore, processing factories relocating from Zone 1 to Phuket will be close to fishing grounds and given priority to use 101,000 tons of skipjack/tuna from the Indian Ocean. Therefore, assuming that the processing factories relocating to the fishery complex will be able to process the entire 101,000 tons, the remaining factories in Zone 1 will process raw materials from the Pacific Ocean. Plans to expand of Songkhla commercial port will be started shortly. If the remaining factories in Zone 1 transfer to southern Thailand, they will most likely relocate to the suburbs of Songkhla since that will place them in close proximity to the fishing grounds in the Pacific Ocean and the commercial port.

(4) Estimates of Raw Material Demand of Canned Skipjack/Tuna According to Production Area and Fishing Grounds

1) Conditions for Estimation

As shown in Table 5.1.13, the total production volume of canned skip jack/tuna in 1993 and 1994 were 1,371 and 1,342 tons/day, respectively. The total production volume sharply decreased to 885 tons/day in 1995 and 968 tons/day in 1996 when the largest firm with a production volume 400 tons/day or about 30% of the total volume stopped production in 1995.

Conditions for estimation of the production volume for short and long-term target years of this project are as follows:

- Production volume of canned skip jack/tuna will not surpass present levels and the supply volume of raw materials according to fishing grounds will remain at present levels.
- Total production volume per day of canned skip jack/tuna has been estimated at 1,118 tons/day in 1997, based on the past maximum production volume of each factory and their production increase plans from in 1995 to 1996. Thereafter, the total national production volume will recover to 1993 levels of 1,357 tons/day in 2002 (refer to Table 5.1.13).
- The production volume of each factory in 2012 will remain the same as in 2002 and it will not change.
- Raw materials caught in the fishing grounds, excluding the Pacific and Indian Ocean, will remain at present levels and they will be utilized in Zone 1 and in Songkhla.
- Processing factories relocated from Zone 1 to Phuket will be given priority to use raw material from the Indian Ocean. The total volume of raw materials will be 101,000 tons in 2002 and 2012.
- Skip jack/tuna from the Indian Ocean are processed at Phuket in advance. Therefore, processing factories in Zone 1 and Songkhla will use the surplus raw material from the Indian Ocean, in order to supplement a shortage of raw material from the Pacific Ocean.

2) Future Estimates of Raw Material Demand of Canned Skip Jack/Tuna Factories by Production Area and Fishing Ground

a. Year 2002

The volume of raw materials processed by canned skip jack/tuna factories in 1993 was 318,500 tons in Zone 1 or 78% of the total national processed volume of 407,000 tons. The remaining 88,500 tons or 22% were processed in Songkhla (refer to TableáV-2.3.6). Although the processing volume in 1994 were of the same levels as in 1993, it declined in 1995 due to a production stop by a major factory in 1995.

Raw material demand by production area and fishing ground were estimated on the assumption that the national processing volume will recover to 1993 levels since each factory will have attempted to increase production from 1995. In addition, some factories will relocate to Phechaburi and Phuket.

If the Project is implemented, skipjack/tuna imported from the Indian Ocean in 2002 will be entirely processed in Phuket. Fish imported from the Pacific Ocean or other areas will be processed in Zone 1, Phechaburi and Songkhla (refer to TableáV-2.3.9). About 101,000 tons or 25% of the total volume of 407,000 tons will be processed in Phuket, 125,000 tons and 81,900 tons or 31% and 20%, respectively will be processed in Songkhla and Phechaburi. The processed volume in Zone 1 will be sharply drop to 98,400 tons or 24% compared to 1993 levels.

b. Year 2012

Estimated FigureáVs for 2012 will remain the same as 2002.

(5) Examination of Future Fish Landing Volume of Raw Material for Canned Skip Jack/Tuna Factories at Phuket Fishing Port According to Type Fishing Boat

1) Assumption

- Sixty percent of the fish landing volume by long line boats (Taiwan, China, and local Thai) operating in the Indian Ocean will be exported either in fresh or frozen form and the remaining 40% be processed in local canneries.
- Fish landed by local purse seine boats operating in the Indian Ocean will be entirely processed in local canneries.
- Fish landed by Japanese purse seine boats operating in the Indian Ocean will be processed in local canneries.
- The supply volume of long line boats (Taiwan, China, and local Thai) and purse seiners (local and Japan) will not be sufficient for the canneries. The shortage will be transported from the Indian Ocean to Phuket by reefer.

2) Fish Landing Volume According to Fishing Boat and Volume Used by Canneries

a. Year 2002

There will be 200 long line boats operating in 2002 with a landing volume of 26,600 tons. Of this volume, 10,640 tons or 40% will be processed at canning factories (refer to Table 5.3.16).

There will be only one local purse seine boat operating in 2002 with a landing volume of 2,880 tons. The entire landing volume will be processed at canning factories.

Two Japanese purse seine boats will be in operation with a landing volume of 9,900 tons. This entire volume will be processed at canning factories.

b. Year 2012

In 2012, the number of long line boats will increase to 300 units and the landing volume will be 39,900 tons. Of this volume, 15,690 tons will be processed at canning factories (refer to Table 5.3.16).

Local purse seiners will increase to 3 units with a landing volume of 8,640 tons. All will be processed at canning factories.

The number of Japanese purse seine boats will not increase and their landing volume will remain at 9,900 tons, the same levels as in 2002 and the entire volume will be processed at canning factories.

3) Landing Volume by Reefers

The landing volume of reefers is the amount deducted the landing volume of long line and purse seine boats from a total of raw material to be processed in Phuket. Approximately 77,580 tons and 66,500 tons will be landed in 2002 and 2012, respectively (refer to Table 5.3.18).

(6) Number of Reefers Landing at Phuket and Intervals of Port Entry

The capacity of reefers operating in the Indian Ocean presently range from 1,500 to 5,000 gross tons. The maximum carring capacity range from 1,500 to 3,000 tons, but the actual carring capacity is 1,000 to 2,000 tons. Therefore, if the volume transported by reefer is 1,500 tons in future, the number of reefers entering the port and their intervals of port entry are shown in Table 2.3.12.

- Year 2002

Number of boats entering the port: 51 units/year, 4.3 units/month

Intervals of port entry: 7 days

- Year 2012

Number of boats entering the port: 41 units/year, 3.4 units/month

Intervals of port entry: 9 days

Normally, the landing volume of reefers are 100 to 200 tons per day and it takes 8 to 15 days (average 12 days) to unload 1,500 tons.

(7) Number of Processing Factories to be Relocated

The government incentives are necessary to relocate the fish processing factories located in Zone 1 (surrounding area of Bangkok) to southern Thailand.

The present tax system as a relevant policy in Thailand is as shown in Table 5.3.19

This Table 5.13.19 shows the difference tax exemption privileges between factories which choose to relocate and factories which do not. The relocation of fish processing factory to southern Thailand depends on the situation and financial condition of each individual firm. However, the tax privileges mentioned above, will be a large incentive for factories to relocate.

The number of processing factories which will be relocated have been estimated based on such considerations as tax privileges and convenient location for raw material procurement.

Total volume of raw material which will be processed by relocated factories is estimated at 101,000 tons of skip jack/tuna from the Indian Ocean. If the relocated factory processes 40 tons/day of raw material, operating 300 days per year, the production capacity will be 12,000 tons annually. Therefore, eight factories will relocate due to the incentive of raw material supply (refer to Table 5.3.14).

Table 5.3 1 Present Status of Industrial Zone in Thailand (1996)

Zone	Developing Body	Type of Industrial Zone			
		GIZ	EPZ	GIZ/EPZ	Total
Zone 1	IEAT	1	0	1	2
	IEAT+Private Party	1	1	3	5
	IEAT+Other State Agency	1	0	0	1
	Private Party	8	0	0	8
		11	1	4	16
Zone 2	IEAT	0	0	0	0
	IEAT+Private Party	5	1	4	10
	IEAT+Other State Agency	0	0	0	0
	Private Party	10	0	0	10
		15	1	4	20
Zone 3	IEAT	2	0	3	5
	IEAT+Private Party	2	0	1	3
	IEAT+Other State Agency	0	0	0	0
	Private Party	8	0	0	8
		12	0	4	16
	Grand Total	38	2	12	52

Remarks: IEAT; Industrial Estate Authority of Thailand
GIZ; General Industrial Zones
EPZ; Exprot Processing Zones

Source; State of Industrial Estates in Thailand in July 1996, IEAT
State of Industrial Estates in Thailand in 1993, Japan Chamber of Commerce and Industry in BKK

Table 5.3.2 Number of Fish Processing Factories by Type from 1985 to 1993

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Freezing	80	84	80	84	94	108	100	120	129
Canning	39	41	41	45	43	42	42	49	52
Fish sauce	114	111	110	116	118	116	110	110	104
Budu sauce	33	30	23	23	29	29	27	27	81
Steamming	115	94	78	65	65	55	62	71	107
Smoking	171	180	86	40	38	36	30	28	28
Salted fish	978	943	671	743	830	750	632	621	702
Dried shrimp	148	165	176	195	213	205	168	188	192
Dried squid	879	828	711	671	772	712	642	605	604
Dried shellfish	674	613	580	646	646	646	523	456	484
Fish ball	54	69	79	82	95	94	86	86	86
Fish-shrimp cracker	76	107	65	71	95	90	89	92	112
Fish meal	92	93	95	96	98	104	102	106	115
Total	3,453	3,358	2,795	2,877	3,136	2,987	2,613	2,559	2,796

Source : Statistics of Fisheries Factory 1989-1993

Table 5.3.3 Raw Materials Consumed by Processing Factories by Type from 1985 to 1993

Unit : tons

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Freezing	247,272	323,289	338,814	345,400	460,277	548,614	527,925	800,118	833,853
Canning	310,421	454,256	504,851	609,717	684,614	761,391	775,608	923,362	899,952
Fish sauce	19,066	47,247	41,755	27,346	31,467	35,989	37,550	34,762	38,671
Budu sauce	356	368	254	251	347	356	369	352	346
Steamming	9,265	7,801	5,569	3,876	4,219	3,808	4,297	4,707	4,721
Smoking	2,578	2,833	6,447	3,111	3,674	3,150	3,194	1,904	1,745
Salted fish	62,144	61,766	53,010	56,686	63,175	65,216	60,541	53,163	52,283
Dried shrimp	39,879	36,661	38,893	25,205	31,083	27,765	26,716	37,723	32,491
Dried squid	46,871	46,641	37,467	34,481	34,728	33,955	34,505	35,184	34,688
Dried shellfish	6,219	3,377	4,270	2,662	2,669	2,947	2,938	3,024	2,429
Fish ball	2,870	3,889	4,790	5,117	6,192	5,962	5,993	6,009	5,888
Fish-shrimp cracker	378	836	698	616	832	906	948	1,919	1,414
Fish meal	899,684	870,029	894,516	943,780	1,071,025	1,087,026	1,115,298	1,389,521	1,374,683
Total	1,647,023	1,859,013	1,931,334	2,058,248	2,394,302	2,577,085	2,596,087	3,291,748	3,283,164

Source : Statistics of Fisheries Factory 1989-1993

Table 5.3.4 Production Volume of Canned Fish from 1985 to 1993

Unit : tons

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Tunas									
Skipjack	69,700	113,600	115,900	160,700	169,600	175,100	210,800	194,880	183,923
Albacore				6,897	13,166	14,037	9,334		
Other tunas	17,434	28,352	29,040	40,159	42,354	43,835	52,666	48,720	45,981
Sub-total	87,134	141,952	144,940	207,756	225,120	232,972	272,800	243,600	229,904
Mackerels				13,200	12,200	17,167	18,700	15,000	20,275
Other fishes	50,774	39,805	49,216	42,866	21,364	20,682	68,453	55,242	61,711
Crab meat	8,502	20,560	33,892	26,837	27,400	15,456	4,100	4,020	4,115
Shrimp & prawn	20,387	28,946	32,395	36,069	37,000	37,050	73,815	68,024	77,101
Cephalopods	1,102	1,974	3,786	3,976	4,060	6,375	4,025	2,963	3,019
Total	167,899	233,237	264,229	330,704	327,144	329,702	441,893	388,849	396,125

Source : FAO Yearbook, Fishery Statistics Commodities, 1993

Table 5.3.5 Export Volume and Value of Canned Fish from 1985 to 1993

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Quantity (tons)									
Canned fish	104,495	173,127	188,896	256,506	279,202	306,891	370,065	345,598	346,883
Canned crustacean and molluscs	32,361	39,245	47,169	57,462	56,855	63,097	64,001	66,624	65,002
Total	136,856	212,372	236,065	313,968	336,057	369,988	434,066	412,222	411,885
Value (1,000 US$)									
Canned fish	193,482	326,243	376,442	593,006	620,127	691,271	828,771	724,520	732,749
Canned crustacean and molluscs	91,516	120,813	178,314	232,588	228,555	301,960	359,690	425,991	471,765
Total	284,998	447,056	554,756	825,594	848,682	993,231	1,188,461	1,150,511	1,204,514

Source : FAO Yearbook, Fishery Statistics Commodities, 1985-1993

Table 5.3.6 Number of Fish Processing Factories in Zone 1, 1996

	Canning									Frozen Sea Food									Ground Total
	Tuna/Skipjack				Other Sea Food				Total	Surimi				Other Sea Food				Total	
	B	M	S	Total	B	M	S	Total		B	M	S	Total	B	M	S	Total		
Bangkok	-	1	-	1	-	1(0)	-	1(0)	2	-	-	-	-	1	2	5	8	8	10
Samut Prakan	-	1	5	6	1(1)	-	3(1)	4(2)	10	-	-	1	1	8	3	9	20	21	31
Samut Sakhon	2	2	8	12	1(1)	4(2)	14(9)	19(12)	31	2	2	2	6	10	7	20	37	43	74
Total	2	4	13	19	2(2)	5(2)	17(10)	24(14)	43	2	2	3	7	19	12	34	65	72	115

Remarks: (1) B: Big scale factory, M: Middle scale factory, S: Small scale factory

(2) Canning factory

	Big scale	Middle scale	Small scale
Production Capacity of Tuna/Skipjack (tons/day of raw material)	≧100	>100≧50	<50

(3) Frozen sea food factory

	Big scale	Middle scale	Small scale
Number of employees	≧1000	>1000≧500	<500

(4) Ten factories out of 24 canning factories of other sea food produce Tuna/Skipjack cans. Figures of ( ) are numbers of factories after deduction of duplicating numbers of Tuna/Skipjack factories.

Source: TFPA and TFFA

Table 5.3.7 Production Volume and Disposition (Frozen) of Cultural Shrimp by Zone in 1993

Unit : tons

	Production volume					Disposition of shrimp
	Banana shrimp	Jumbo tiger prawn	School prawn	Other shrimp	Total	
Zone 1						
Trat		10,653			10,653	504
Chanthaburi	543	55,452	570		56,565	
Rayong		12,192			12,192	14,840
Sub-total	543	78,297	570	0	79,410	15,344
Zone 2						
Chon Buri	13	1,064	12	62	1,151	4,900
Chackoengsao	13	14,554	1	1	14,569	
Prachin Buri		1,568			1,568	
Samut Prakan	298	256	103	96	753	35,258
Bangkok	265	255	63	73	656	15,230
Samut Sakhon	394	1,152	89	47	1,682	50,031
Samut Sonnkhran	396	140	30	30	596	
Phetchaburi	66	1,907	23		1,996	
Sub-total	1,445	20,896	321	309	22,971	105,419
Zone 3						
Prachuab Khiri Khan	36	2,680			2,716	
Chumphon		4,973			4,973	18,592
Surat Thani	1,243	23,097	356	665	25,361	14,671
Sub-total	1,279	30,750	356	665	33,050	33,263
Zone 4						
Nakhon Si Thammarat	18	29,797	10	6	29,831	12,617
Songkhla		17,345			17,345	62,486
Phatthalung		1,106			1,106	
Pattani		7,846			7,846	8,900
Narathiwat		11			11	
Sub-total	18	56,105	10	6	56,139	84,003
Zone 5						
Ranong		2,658			2,658	
Phang-nga		8,064			8,064	
Phuket		3,320			3,320	504
Krabi		5,201			5,201	
Trang		7,342			7,342	5,325
Satun		7,268		93	7,361	
Sub-total	0	33,853	0	93	33,946	5,829
Total	3,285	219,901	1,257	1,073	225,516	243,858

Source : Statistics of Fisheries Factory 1993, The Landing Place Survey 1993, DOF

Table 5.3.8 Landing Volume and Disposition (Frozen) of Squid by Zone in 1993

Unit : tons

	Production volume				Disposition of Squid & Cuttlefish
	Squid	Cuttlefish	Octopus	Total	
Zone 1					
Trat	3,440	4,357	2,417	10,214	
Chanthaburi	561	584	160	1,305	
Rayong	2,936	930	490	4,356	22
Sub-total	6,937	5,871	3,067	15,875	22
Zone 2					
Chon Buri	1,556	1,172	549	3,277	
Chackoengsao		12	12	24	
Prachin Buri				0	
Samut Prakan	4,242	9,490	7,244	20,976	15,563
Bangkok				0	3,722
Samut Sakhon	5,043	2,971	1,790	9,804	34,284
Samut Sonnkhran	217	290	211	718	
Phetchaburi	271	255	107	633	
Sub-total	11,329	14,190	9,913	35,432	53,569
Zone 3					
Prachuab Khiri Khan	3,495	481	422	4,398	
Chumphon	162	179	44	385	
Surat Thani	764	709	377	1,850	8,417
Sub-total	4,421	1,369	843	6,633	8,417
Zone 4					
Nakhon Si Thammarat	741	758	417	1,916	1,536
Songkhla	18,973	14,472	996	34,441	18,728
Phatthalung				0	
Pattani	14,629	7,610	695	22,934	32,850
Narathiwat	150	68		218	
Sub-total	34,493	22,908	2,108	59,509	53,114
Zone 5					
Ranong	129	1,968	75	2,172	
Phang-nga	492			492	
Phuket	2,294	898	355	3,547	
Krabi	1,626	116		1,742	
Trang	481	243	161	885	2,200
Satun	5,825	6,352	2,605	14,782	
Sub-total	10,847	9,577	3,196	23,620	2,200
Total	68,027	53,915	19,127	141,069	117,321

Source : Statistics of Fisheries Factory 1993, The Landing Place Survey 1993, DOF

Table 5.3.9 Import Volume of Skip Jack/Tuna by Fishing Ground, 1993

Unit: tons

Name of Country	Total	Western Pacific Ocean	Indian Ocean	Others
Spain	12,551	10,041	2,510	-
France	39,388	27,572	11,816	-
Indonesia	2,562	2,562	-	-
India	1,422	1,422	-	-
Japan	57,494	43,415	14,079	-
Korea	47,444	33,211	14,233	-
Norway	2,930	-	-	2,930
New Zealand	10,756	10,756	-	-
Ireland	1,500	-	-	1,500
Seychel	13,960	-	13,960	-
Singapore	5,775	5,775	-	-
Taiwan	87,462	69,970	17,492	-
U.S.A.	45,731	45,731	-	-
South Africa	1,288	-	1,288	-
Australia	2,445	2,445	-	-
Balize	498	498	-	-
Ivory Coast	5,105	-	-	5,105
Czechoslovakia	475	-	-	475
Micronesia	1,922	1,922	-	-
Kenya	4,631	-	4,631	-
Kiribati	2,035	2,035	-	-
Kuwait	320	-	320	-
Madagascar	8,327	-	8,327	-
Mauritius	908	-	908	-
Maldives	5,106	-	5,106	-
Malaysia	756	-	756	-
Oman	150	-	150	-
Panama	11,437	11,437	-	-
Pakistan	20	-	20	-
Us Pacific Is.	55	55	-	-
Reunion	109	-	109	-
U.S.S.R.	7,839	6,272	1,567	-
Solomon Is.	3,680	3,680	-	-
Sweden	1,50	-	-	1,500
Sao Tome and Principe	435	-	-	435
China	142	142		-
Micronesia	12,912	12,912	-	-
Ghana	600	-	-	600
Hong Kong	175	175	-	-
North Korea	500	500	-	-
P.N.G.	100	100	-	-
Philippine	270	270	-	-
Puertorico	408	-	-	408
Turkey	354	-	-	354
Bangladesh	23	-	23	-
Netherlands	8	-	-	8
Others	3,179	-	-	3,179
Total	406,679	288,914	101,279	16,486
	(100%)	(71.0%)	(24.9%)	(4.1%)

Remarks (1)Tuna category includes Albacore, Yellow Fin, Skipjack and others.
(2)Due to unavailable data of import volume by fishing ground, this table was made by following assumption.

Country	Pacific Ocean	Indian Ocean
Spain	80%	20%
France	70%	30%
Korea	70%	30%
Taiwan	80%	20%
U.S.S.R.	80%	20%

(3)Import volume from Indian Ocean by Japanese fishing boats depend upon volume unloaded in 1995 at Phuket Port

Source: JICA Study Teams

Table 5.3.10 Present Status of Importers of Skip Jack/Tuna, 1995

	1	2	3	4
Approx. Import volume in 1995	50 x 10^3 MT	40 x 10^3 MT	100 x 10^3 MT	100 x 10^3 MT
Ownership of Cargo	Major, Spain	Korea, Taiwan	Taiwan	Japan
Number of Fishing Boats belonged to the group.	30 units	15 units	43 units	-
Number of carrier vessels belonged to the group.	3 units (3000 - 1000 tons)	1 unit (800 tons)	5 units (2000 tons)	- -
Share of Import by fishing ground				
W. Pacific Ocean	80%	70%	80%	100%
Indian Ocean	20%	30%	20%	-
Total	100%	100%	100%	100%
Unloading Capacity	100-250 t/day	-	-	-
Unloading Cost	US$3-4/t at private jetty in BKK. B 80/t at Songkhla Deep Sea Port.	-	-	-

Remarks: ( ): Capacity of carrier vessels is cargo weight

Source: JICA Study Team.

Table 5.3.11 Share of Import Volume of Skip Jack/Tuna by Fishing Ground, 1993

Unit: tons/year

Fishing Ground	Import Volume	%
Pacific Ocean	289,000	71
Indian Ocean	101,000	25
Others	17,000	4
Total	407,000	100

Table 5.3.12 Demand of Raw Materials for Canned Skip Jack/Tuna by Production Area by Fishing Ground, 1993

Unit: tons/year

Fishing Ground	Zone 1	Phechaburi	Songkhla	Phuket	Total
Pacific Ocean	237,500	0	51,500	0	289,000
Indian Ocean	70,300	0	30,700	0	101,000
Others	10,700	0	6,300	0	17,000
Total	318,500 (78%)	0	88,500 (22%)	0	407,000 (100%)

Table 5.3.13 Actual and Estimated Volume of Raw Materials Processed by Canned Skip Jack/Tuna Factories from 1993 to 2012

Unit: tons/day (tons/year)

No. of Company	1993	1994	1995	1996	2002	2012	Remarks
1	200	200	200	225	273	273	Relocate to Phetchaburi
2	100	100	100	125	152	152	Located in Songkhla
3	400	400	-	-	-	-	Stop in 1995, Reoperation in 2002
4	60	60	60	60	73	73	
5	20	20	10	20	24	24	
6	70	70	70	60	85	85	Located in Songkhla
7	125	125	150	150	182	182	Located in Songkhla
8	60	60	40	38	73	73	
9	15	4	5	5	18	18	
10	25	10	NA	NA	30	30	
11	10	10	-	-	-	-	Closed in 1995
12	18	18	20	25	30	30	
13	20	20	NA	20	24	24	
16	100	100	50	50	121	121	
17	-	-	70	70	85	85	
18	35	35	35	30	43	43	
19	8	8	NA	8	10	10	
14	70	70	70	60	85	85	
15	12	12	NA	12	15	15	
20	8	8	NA	NA	10	10	
21	15	15	NA	NA	18	18	
22	5	5	5	NA	6	6	
Total	1,371 (407,000)	1,342 (402,600)	885 (265,500)	968 (290,400)	1,357 (407,000)	1,357 (407,000)	

Source: Thai Food Processor's Association, 1996

Table 5.3.14 Average Volume of Raw Materials Processed per Day by Canned Skip Jack/Tuna Factories in Zone 1

Unit: tons/day

Raw material volume processed	No. of factories	Total	Average raw material volume processed
70	2	140	--
60	1	60	--
50	1	50	--
40	1	40	--
35	1	35	--
20	1	20	--
10	1	10	--
5	2	10	--
Total	10	365	36.5

Table 5.3.15 Demand of Raw Materials for Canned Skip Jack/Tuna by Production Area by Fishing Ground, 2002, 2012

Unit: tons/year

Fishing Ground	Zone 1	Phechaburi	Songkhla	Phuket	Total
Pacific Ocean	93,300	77,650	118,050	0	289,000
Indian Ocean	0	0	0	101,000	101,000
Others	5,100	4,250	7,650	0	17,000
Total	98,400	81,900	125,700	101,000	407,000
(%)	(24)	(20)	(31)	(25)	(100)

Table 5.3.16 Fish Landing Volume of Raw Materials for Canned Skip Jack/Tuna Factories at Phuket Fishing Port by Type of Fishing Boat

Unit: tons/year

Type of Fishing Boat	Year	No. of Operating Fishing Boat	Fish Landing Volume	
			Total	Volume of Factories
Longlines	2002	200	25,200	10,080
(Taiwan, China)	2012	300	37,800	15,120
Purse Seine	2002	1	4,950	4,950
(Local)	2012	3	14,850	14,850
Purse Seine	2002	2	10,000	10,000
(Japan)	2012	2	10,000	10,000

Table 5.3.17 Unloading Volume of Skip Jack/Tuna for Canneries by Type of Boat at Phuket Fishing Port, 2002, 2012

Unit: tons/year

Type of Boats	2002	2012
Longline (Taiwan, China)	10,080	15,120
Purse Seime (Local)	4,950	14,850
Purse Seine (Japan)	10,000	10,000
Reefer	75,970	61,030
Total	101,000	101,000

Table 5.3.18 Number of Reefers Landing at Phuket Fishing Port and Intervals of Port Entry, 2002, 2012

Unit: tons/year

Item	2002	2012
Total Transport Volume (tons/year)	72,970.0	61,030.0
Transport Volume per trip (tons/boat/trip)	1,500.0	1,500.0
Number of Boats per year (units)	51.0	41.0
Number of Boats per month (units)	4.3	3.4
Intervals of Arrival (days)	7.0	9.0

Table 5.3.19 Encouragement of investment under BOI

With-case	Without-case
1. Special favor on tax under BOI Act (1) Corporation tax: Exemption for 8 years, 50 %reduction for 5 years after the 9th year (2) Special favor: * Allowable deduction of 200 % operation costs from taxable income for 10 years * Deduction of 25% of total costs for equipment investment from net profits for 1 year (3) Tax on imported machine: no (4) Exemption of tax on imported raw material being processed for export. 2. Special favor under ACT for IEAT For GIZ & EPZ designated by IEAT (1) Land ownership (2) Resident & work permits to skilled foreigners (3) Remittance or carring-ou tof foreign invested capital and dividends 3. Favor by the law for encouraging export business For EPZ (1) Import tax exemption from construction material costs for factories. (2) Import tax exemption from machine & equipment (3) Import tax exemption from raw material & spare parts (4) Export tax exemption from export products & sub-products. 4. Tax system (1) Corporation tax: 30% of taxable income (2) Added value tax: Tax exemption from purchase costs for export. (3) Business tax on import goods: 1.5 - 9 % (4) Export tax: exemption	1. Special favor on tax under BOI Act (1) Corporation tax: Exemption for 3 years with contions below: *Over 80 % of total sales for export *Being located in the indudtrial estate or industrial area designated by BOI (2) Special favor: No (3) Tax on imported machine: 50% reduction of import tax with conditions below: *Over 80 % of total sales for export *Being located in the indudtrial estate or industrial area designated by BOI (4) Exemption of tax on imported raw material being processed for export. 2. Special favor under ACT for IEAT For GIZ & EPZ designated by IEAT * Factory in IEAT estate to receive the favors as stated in the left column. * Factories out of the estate: no favor. 3. Favor by the law for encouraging export business : No 4. Tax system Same as the left.