THAILAND: National Report

Bycatch management in Trawl Fisheries in the Gulf of Thailand[1]

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[1] A national report prepared to submit for the Project Preparation Grant (PPG) from GEF: Bycatch management and reducing discard from trawl fisheries in the coral triangle and Southeast Asian waters.

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Summary

The report is synthesized and reviewed background of the trawl fisheries in the Gulf of Thailand using existing primary and secondary data sources and scientific reports. It covers fishery biology, fishing ground, species and sizes caught, geographic area, fishing capacity, fishing effort, fish production, fish distribution, fishing gear and method, exploitation state, fish stock assessment, conflicts in fisheries, season and area closure, legal framework and institutional arrangement, production and value trend for demersal and trash fish, market and utilization, employment, fishing rent and other social economic issues.

The fish stocks especially for demersal resources in the Gulf of Thailand are already overexploited. These resources are caught mainly by trawl gear which comprises trash fish almost half of the landing catches. These trashfish are identified into about 35% of juvenile economic fish in trash fish component. The management of bycatch (trashfish) should be conducted in terms of scientific evidences with fisher and stakeholder participation in collaboration with relevant agencies. Future project plan activities are formulated to reduce juvenile economic fish, protect area for spawner and nursing ground as well as using VPS in monitoring illegal fishing around existing season and area closure.

The experiment and demonstration of enlargement of cod end mesh size of trawl net, demonstration to install JTED in trawl net, Using VPS for monitoring and enforcement, closed area and closed season demarcated area, bycatch utilization management, office renovation and increase awareness and strengthening capacity in legal framework activities are all project plans for Thailand.

Financial framework plan in term of co-finance of the Department of Fisheries and private sector (The Fisheries Association of Thailand) is formulated to request fund from GEF for implementing the seven activities for 4 years project to support bycatch management from trawl fisheries in the Gulf of Thailand.

SECTION 1: OVERVIEW AND SCOPE OF PROJECT

1. Overview of trawl fisheries:

Before 1960, Thai private sectors and Japanese experts had trained fishers and fishers tried to fish in the Gulf of Thailand using small pair trawlers. Fishers did not success at that time due to rough bottom and demersal fish caught were not familiar to consumers and the fish price was very low as well resulted to loss investment**.**

After 1960, Thai government and the Federal Republic of Germany had signed for Bilateral Economic and Technical Cooperation, further the marine fisheries had been developed. Training and experimental surveyed had been done together with private sectors and German experts, four types of fishing gear had been trialed: pelagic fish trawl, pair trawl, mid water trawl and otter board trawl. The most efficient gear was otter board trawl which could fish with highest production. The demersal resources approximately estimation were rich enough for commercial scale to fish. Hence the introduction for otter board trawl was made to fishers and fishers also expanded to fish in the Andaman Sea. Likewise, fishers also used beam trawl which could get good result.

After the government introduced the trawling gear to fishers, the state of demersal fishery resources has been monitored and documented continuously through routine standardized research vessel trawling surveys. These surveyed research vessels have been conducted by the Marine Fisheries Division (Now, Marine Fisheries Research and Development Bureau), Department of Fisheries since 1966 until now. The fisheries research programs were also formulated to follow the fishery situation after the introduction of otter board trawls to fishers. Research vessels have been conducted research programs since 1966 up until nowadays.

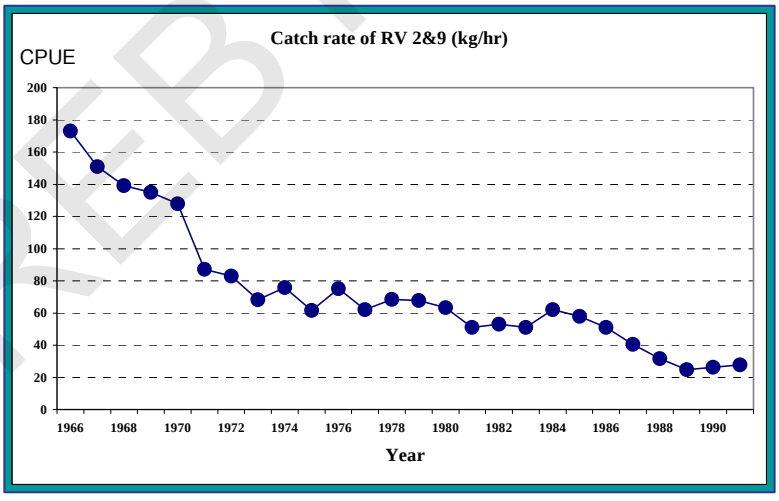


Figure 1. The catch rates (CPUEs) of total catches (including trash fish) in the Gulf of Thailand from 1966 to 2005 surveyed by the Research Vessels, Pramong 2 and 9. Source: Mar. Fish. Res. Div, 1966-2005.

The catch per unit of effort (kg per trawling hour or CPUEs) of the trawling surveys showed continuously decreasing trend from 1966 to 2005. In 1966, an average CPUE of the total

catch of the research vessel was 172.9 kg/hr. A sharp decline occurred from 1966 to 1975 with a CPUE of 61.5 kg/hr. From 1975 to 1983 the catch trend was rather stagnant with CPUE around 50-60 kg/hr and it slightly increased in 1984 to be 62.1 kg/hr. This was the result from gasoline deficit at the second time of the world which made the fishing boats stop fishing for a while. Further, the CPUE declined again and lower to 21 kg/hr in 2005 (Fig. 1).

Trawl fisheries, especially otter board trawlers have been highly developed from now on and expanded to have bigger sizes, modernized and more number of boats. Rapid expansion of otter board trawl fisheries occurred within five years, it was seen that the number of fishing boats increased to be 2,393 in 1965 which increased from 1960 about 23% and the production increased about 83.8% from the year 1960 to be 392,666 mt in 1965. Several species (pelagic fish, demersal fish as well as invertebrate group) had been exploited and later on the exploitations were fully exploited and over-exploited especially for demersal resources. At first, the fisheries were freely developed, no exactly controlling and prohibiting measures. Trawl fisheries had been developed quickly and could fish anytime and anywhere with small cod end mesh size (2.5 cm stretch mesh). More small sizes of economical fish and true trash fish had been fully exploited in terms of trash fish using as fish meal products. As a result, demersal resources were over fished and fishers were also extended to fish farther from coastal areas using bigger boats (>24 m LOA) with longer time (15 day-trip) and modernized fishing boats.

In 1962, the Department of Fisheries has constructed another two big research vessels from Japan for exploring resources and environmental surveys (Kittikajorn, 131 gross ton and Thanarat, 388 gross ton). These two research vessels were stern trawlers and well equipped for surveys and experiments which could also be used for deep sea long line. The research vessels had been conducted in the high sea and going out to other countries waters e.g. Thai water, South China Sea, Bay of Bengal, Indian Ocean, up to Australian water for new fishing grounds for promoting to Thai fishers.

From the results of explorations and initiation to Thai fishers, Thai fishing boats were developed to have more horse power, single band radio communication, fish finder, echo sounder and radar to fish outside Thai water. These developed fishing boats also had storages for food, ice and fuel on outside going and on inside coming for storing fish production as much as they could. Further the Thai fishers went to fish beyond 12 nm of the country and to fish in neighboring country waters about 500 boats. The important fishing grounds were in Vietnam, Cambodia, Malaysia, Myanmar, Bangladesh, and some in Malaysia and Indian waters.

During the years 1973 to 1974, the oil crisis happened in worldwide, the Thai fisheries were also faced the same problem, the fishing boats stopped fishing for a while resulted the resources were rehabilitation as the CPUE of the resources from research vessels surveyed increased a bit (Fig. 1) as well as the number of boats decreased in 1975. Furthermore, the resources and environment were destroyed, fishers stopped to invest for fisheries inside Thai water for a while. After the fish price increased the wider vision fishers had invested outside Thai waters.

During this time our neighboring countries e.g. Vietnam, Cambodia and Malaysia have implemented their Exclusive Economic Zones (EEZ) resulted to reducing fishing grounds for

Thai fishers. Later Thailand has also implemented her EEZ on 16 November 1995. The Exclusive Economic Zones (EEZ) of Thailand covers areas of 420 280 km^2, 304 000 km^2 in the Gulf of Thailand and 116 280 km^2 in the Andaman Sea. Thailand's EEZ within the Gulf of Thailand includes overlapping areas between Thailand and Cambodia (34 000 km^2), Thailand, Cambodia and Vietnam (14 000 km^2), and Thailand and Malaysia (~ 4 000 km^2) (Janekitkosol *et al*., 2003) cited after Nakthon 1992). Thailand has loss her fishing grounds due to EEZ areas proclaims of neighboring countries about 300,000 km^2 and loss her fish production about 600,000 to 800,000 mt annually.

In Thai coastal waters, the fisheries in the Gulf of Thailand can be categorized into commercial fisheries and small scale fisheries. Since the definition of small scale fisheries in the Gulf of Thailand are difficult to define, anyhow the definition was finally defined by DOF and fishers as *"The boat has its capacity less than 10 gross ton, fishing in the coastal area within 3 km from shoreline, the fishing is for subsistence and fish workers are member of the family"*. The small scale fisheries are mostly targeting for certain species and certain size range of fish, it comprises gillnet (fish gillnet, pomfret gillnet, crab gill net, threadfin gill net, Indo-Pacific mackerel gill net etc.), shrimp trammel net, hook and line, long line, trap, beach seine and hand gathering etc. The fishing operations are mostly one night and landed their products at small fishing piers nearby their houses. The commercial fisheries are using bigger boat and more powerful engine. The fishing grounds are beyond 3 km from shoreline up to 200 nm of the Economic Exclusive Zone of the State. The commercial fisheries are divided into trawler (otter board trawl (+otter-boom trawl), pair trawl and beam trawl), push net, purse seines (luring purse seine, Thai purse seine, anchovy purse seine), squid light luring cast net, bamboo stake trap, king mackerel encircling gill net, etc. The commercial fishing boats are categorized into 4 sizes by length overall (LOA) as less than 14 m, 14-18 m, 18-25 m and over 25 m.

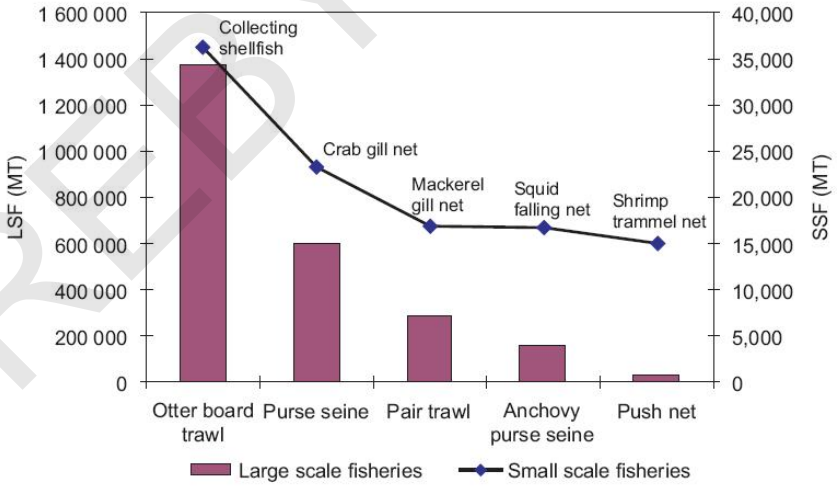


Figure 2. Marine capture production from top five gear types, 2004.
(Lymer *et.al*., 2008).

Figure 2 shows the marine capture production from top five gear types of commercial scale or large scale e.g. otter board trawl, purse seine, pair trawl, anchovy purse seine and push net.

For top five gear types of small scale were collecting shellfish, crab gill net, mackerel gill net, squid falling net and shrimp trammel net.

The bigger size otter board trawlers (LOA > 25 m) are mutual benefit to fish in the EEZs of neighboring countries through the bilateral agreements (e.g. Indonesia, Malaysia and Myanmar). Usually, Thai fishers are not familiar and have no experiences to fish in the high sea, especially for tunas. Consequently, the Department of Fisheries has promoted and initiated the big company to modify their fishing boats to go out fishing in the Indian Ocean. At present, some purse seiners and long liners are fishing in the Indian Ocean for tuna and to keep a right as a member of the Indian Ocean Tuna Commission (IOTC).

In Thai coastal waters, much more number of fishing boats which are not only trawl boats but also other types of fishing e.g. purse seine, light luring fishing and small scale fishing gear, there were several conflicts among them because of the overlapping fishing grounds and resources were scarce as well as the nursing grounds in near shore areas were invaded.

Depletion of the fish stocks are still continuously occurred, even though the Department of Fisheries has established boat tenure system, rehabilitation program, resource enhancement program, closed area and closed season in several areas, as for these, the fish stocks are recovered with slow rate of some species but could not enough to replace for those overall capturing quantity.

Several laws and regulations were issued to protect nursing grounds, juvenile and spawners, no fishing with motorized boats within 3,000 m from shoreline (on 20 July 1972), no trawl and push net fisheries in Lake Songkhla (11 August 1972), Prohibition for motorized fishing in the areas covered Prachuab Kiri Khan – Chumporn - Suratani provinces during 15 February to 15 May, annually in daytime, etc.

Nowadays, the DOF try more efforts to reduce the excess fishing capacity (number of boats) and enlarge cod end mesh size for trawlers. The Master Plan for Marine Fisheries Management has been formulated as a guideline to manage marine capture fisheries in a responsible way and sustainability. This master plan for ten year periods has been approved by the cabinet while the Action Plan has been finalized and will be implemented soon.

1.1 Locations, types and estimated numbers of vessels, fishing effort

1.1.1 Location The Kingdom of Thailand, located in south-east Asia, covers an area of 513 120 km^2 between latitudes 5° 45′ and 20° 30′ N and longitudes 97° 30′ and 105° 45′ E. It is bounded by Myanmar on the north and west, by Laos on the north-east, by Cambodia and the Gulf of Thailand (Siam) on the south-east, by Malaysia on the south and by the Andaman Sea and Myanmar on the south-west. The country is divided into 77 provinces. The sea-coasts of Thailand are the Gulf of Thailand, the main fishing ground, and the Andaman Sea. Thailand has a monsoon climate with a wet season (90 percent of the annual rainfall) from April to September during the south-west monsoon and a dry season from October to May with dry continental northerly winds (north-east monsoon).

The Gulf of Thailand has surface area 320,000 km^2, volume 14,400 km^3, average depth 45 m and maximum depth 80 m. The Gulf of Thailand, formerly the Gulf of Siam, is an inlet of the South China Sea, bordered by Thailand, Cambodia, and the southwestern edge of Vietnam, the gulf's maximum width is 350 miles (560 km), and it extends approximately 450 miles, (725 km) in length. The Gulf of Thailand is quite shallow along the coastal areas, and those

waters provide lucrative fishing grounds. Many rivers flow into the Gulf of Thailand, with the Chao Phraya being the most significant (Fig. 3).

Figure 3. The Gulf of Thailand (WorldAtlas.com. 2009).

1.1.2 Types of fishing gear

The fisheries in Thailand are multi-gear and multi-species. Fishers use several gear types to capture several fish species. Catches from these types of gear comprise multi-species that can be grouped with numerous species into pelagic fish, demersal fish and invertebrate groups. The followings are trawling gear types and their major target species.

Trawl net is the fishing gear using bag net to continuously trawling forward in line upon the surface of sea bottom to catch fish. The operation is trawling by inboard engine boat. The trawling net is stretched out by using otter board or boom or beam or another fishing boat. Trawl net can be categorized into otter board trawl (and otter-boom trawl) pair trawl, and beam trawl. For mesh sizes of all sizes of trawlers in Chumphon province using cod end mesh 2.0 cm (stretch mesh) while pair trawlers using double twine (double thread to make it more strong and rigid). Single trawlers use monofilament to capture both fish and shrimp. Trawlers in another place use cod end mesh 2.5 cm.

Otter board trawler (Figs. 4&5).
The otter board trawler is the majority gear type among trawlers. The trawl net is opening by using a pair of wooden otter boards during operation. Otter board trawlers can be a fish trawler (Fig. 4), shrimp trawler (otter boom trawler, Fig. 5), Acetes (Sergestid shrimp) trawler and jelly fish trawler. The boat sizes are ranging from 6-43 m LOA (Length Over Alll), the majority is 10-18 m LOA. The horse power range 10-1,700; the biggest sized boats install

radar, GPS, echo sounder, wireless for fishing in neighboring countries with bilateral agreements. Crew numbers are also varied from 2 to 20 which depend on the boat sizes. Fish, Acetes and jelly fish trawlers are operated in day time whereas shrimp trawler is catching in night time. In some cases when a school of *Penaeus* shrimp occurs in day time it will be operated. Catches from fish trawler comprise Indo-Pacific mackerel, Indian mackerel, croaker, thread fin bream, red snapper, lizard fish, bigeye, swimming crab, squid and trash fish. Catches from shrimp trawler comprise small sized shrimp, *Metapenaeus*, *Penaeus*, *Silago*, cuttlefish, swimming crab and trash fish. Acetes trawler can catch 95% Acetes (Sergestes shrimp) of the total catches and 5% comprising juvenile fish and crab dwelling at near shore. Jelly fish trawler catches only jelly fish. From the year 1993 up to date, some otter board trawlers and short necked clam dredge fishing boats have been modified and changed to catch jelly fish especially the boat sizes 9 to 20 m in the eastern coast of the Gulf of Thailand.

Figure 4. Otter board trawler targeting for demersal fish capturing.

Figure 5. Otter–boom trawler usually targeting for shrimp, is hauling (LOA 14-18 m).

Pair trawlers (PT, Fig. 6 and Fig. 7, left)
Pair trawlers are the fishing gear using two fishing boats to stretch out the net mouth opening when in operation. The distance and the boat speed between the two boats are constant during fishing. The two fishing boats are the same or different in sizes. In the case of different size, the bigger one is used for hauling, fish sorting and fish preservation. It is called mother boat or fish boat or trawl boat. On the other hand, the smaller is called ear boat which is installed radar, echo sounder and wireless for communication. The sizes of the boats are varied from 14-25 m in LOA**.** The majority size is 18-25 m LOA. The horse power ranges 60-550. Crew numbers are 18-22, including one skipper and one engineer. The upper part of the net mouth opening is 32-38 m and the lower part is 36-38 m. The length of the net is 48-55 m. The mesh sizes are bigger at the net opening and gradually smaller and at the cod end is the smallest mesh size. The fishing operation is done in daytime, all year round except in strong wind monsoons. Catches from pair trawlers comprise Indo-Pacific mackerel, Indian mackerel, Spanish mackerel, scad, red snapper, silver swordfish, bigeye, croaker, squid, cuttlefish, swimming crab and trash fish.

Beam trawler (BT, Fig. 7 right)
Beam trawler has been introduced to Thailand for more than 50 years. Beam trawler is using a pair of metal beams installing aside of the boat to open the mouth of two nets during operation.

Figure 6. Pair trawlers in operation, usually for pelagic fish as major target group.

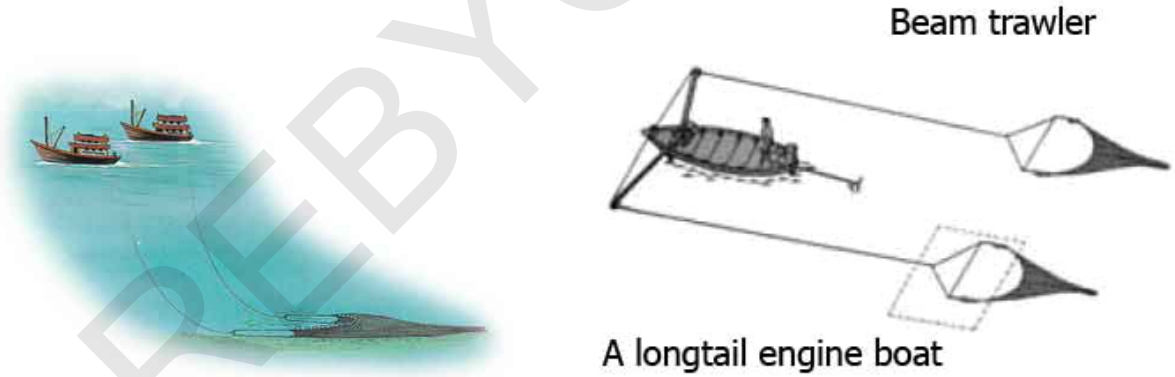


Figure 7. (Left) Pair trawlers and (right) beam trawler.

Two types of beam trawlers are popular used namely shrimp and jelly fish beam trawlers. The beam trawlers are 6 - 20 m LOA with engine 5-250 hp and have wireless for communication. Nowadays, the bigger sized and more powerful boat is prohibited by fishery regulation.

1.1.3 Fishing efforts and Fishing grounds. The fishing efforts of trawlers using in capturing marine resources in the whole country and in the Gulf of Thailand are recorded in terms of fishing hour per day as shown in the Table 1. The fishing efforts are also recorded in terms of day, haul, and trip e.g. an average fishing effort in hour per haul is 4.3; haul per day is 3.3; day per trip is 6.8.

The small size OBT (<14m) has fished densely in the Area 4 (Fig.8) and followed by Area 2; OBT 14-18 m has fished densely in the Area 4 and followed by Area 3; OBT 18-25 m has fished densely in the Area B and followed by Area 4; OBT >25 m has fished only in the Area B (Table 1). Medium size PT has fished densely in Areas 2 and 4; large size PT has fished densely in the Areas 3 and 1. Beam trawler has fished in the Areas 3 and 4. No fishing in the Area 5.

The fishing efforts in gross ton related to size of fishing boats are measured as follow:

The small size OBT (LOA<14 m) has an average gross ton of 9; OBT 14-18 m has an average 27 gross ton; OBT 18-25 m has an average 56 gross ton and OBT >25 m has an average 180 gross ton. For PT <14m has an average 15 gross ton; PT 14-18 m has an average 29 ; PT 18-25 m has an average 59 gross ton and PT >25 m has an average 118 gross ton. For BT<14 m has an average 11 gross ton; BT 14-18 m has an average 22 gross ton and BT 18-25 m has an average 45 gross ton. In the Area 5, central gulf is no fishing from trawlers due to untrawlable area. In this area, it is suitable fishing ground for purse seine and fish trap (Fig. 8).

Table 1. Fishing effort (hour per day) of trawlers categorized by size and area in the Gulf of Thailand, 2007.

			Area						
Boat size	Country	GOT	1	2	3	4	5	A	B
Total									
OBT	1,225,831	8,773,082	660,348	1,697,488	1,406,249	2,642,426		521,306	1,845,265
<14m	2,500,419	2,168,096	330,734	784,255	218,419	834,688			
14-18m	4,246,822	3,087,921	209,224	464,638	764,411	1,313,020		130,460	206,168
18-25m	4,716,214	2,973,756	120,390	448,595	423,419	494,718		390,846	1,095,788
>25m	794,859	543,309							543,309
Total PT	1,560,794	1,292,929	289,707	273,336	525,052	204,834			
14-18m	357,180	271,547	50,470	82,503	56,560	82,014			
18-25m	1,203,614	1,021,382	239,237	190,833	468,492	122,820			
Total BT	139,844	139,844			58,007	81,837			

Sources: Fisheries statistic of Thailand, Department of Fisheries, 2007.

Remarks: Country = fishing efforts of the whole country; GOT = Fishing efforts of the Gulf of Thailand;

1-5 Fishing areas (statistical area) in EEZs

A and B = fishing areas in the Gulf of Thailand beyond EEZs.

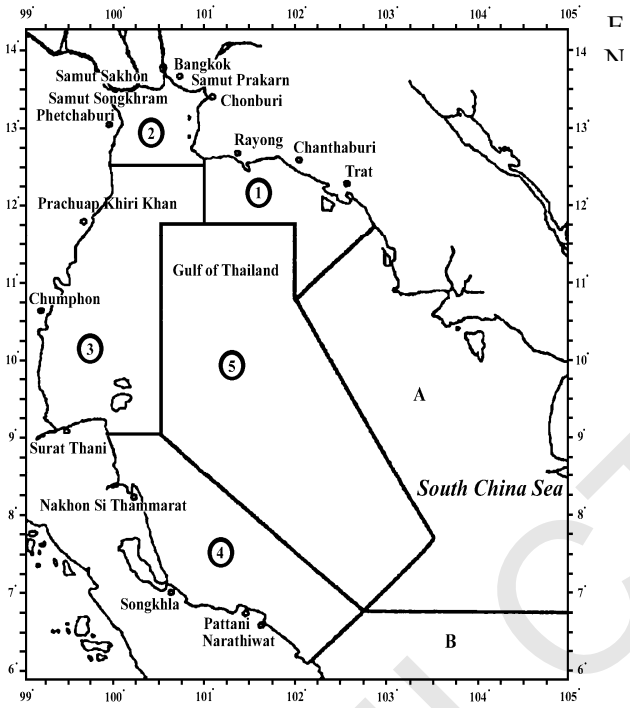


Figure 8. The statistical fishing areas in the Gulf of Thailand (Areas 1 to 5; A and B). Sources: Fisheries statistic of Thailand, Department of Fisheries, 2007.

Fishing grounds

From research surveys, the fishing ground of small otter board trawlers are within 20 m depth at near shore and medium size trawlers are within 30 m at coastal zone. Pair trawlers are in deeper water up to 50 m depth (Figs. 9, 10 and 11). No fishing by trawlers at central gulf.

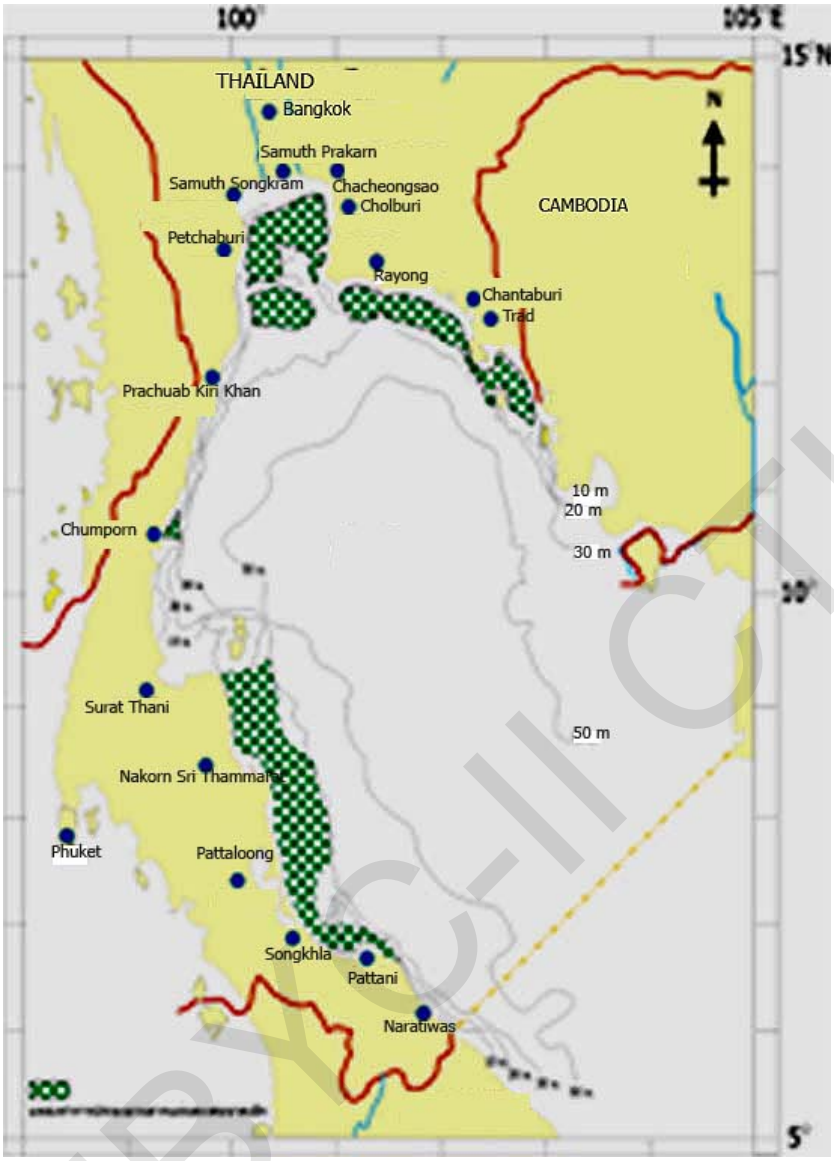


Figure 9. Fishing ground of small OBT in the Gulf of Thailand.

Sources: Kongprom *et.al*, 2008.

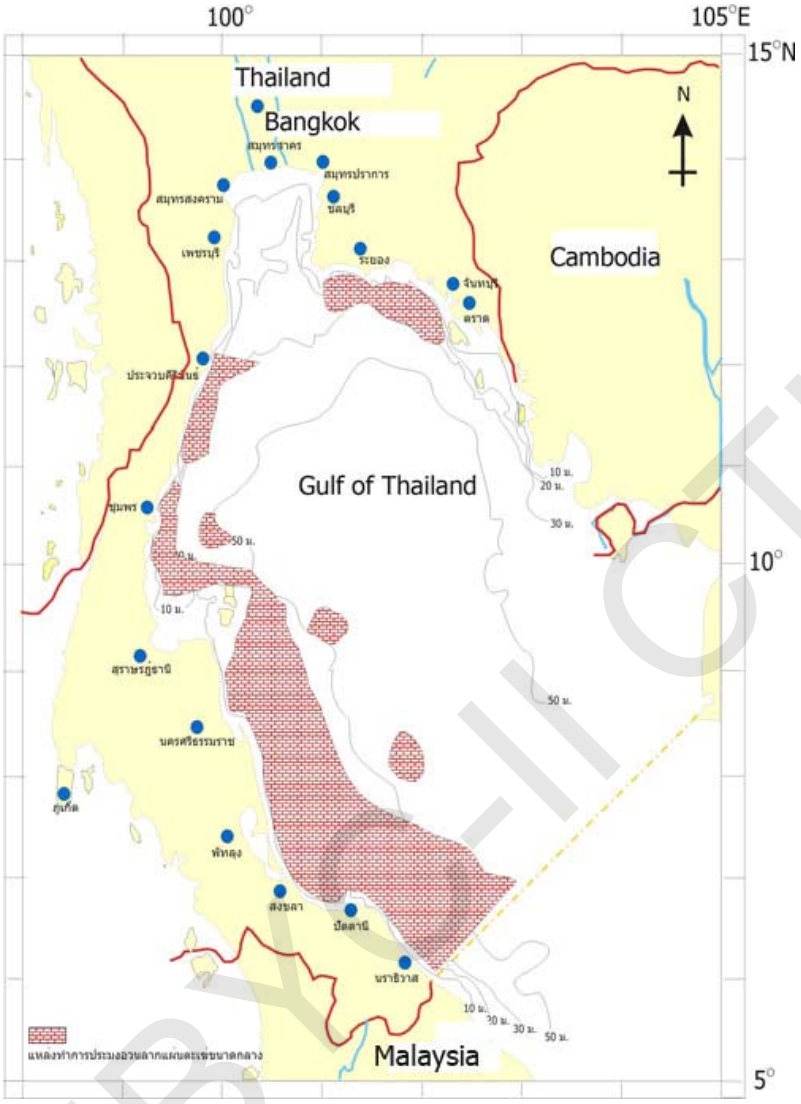


Figure 10. Fishing ground of medium size OBT in the Gulf of Thailand.

Sources: Kongprom *et.al*, 2008.

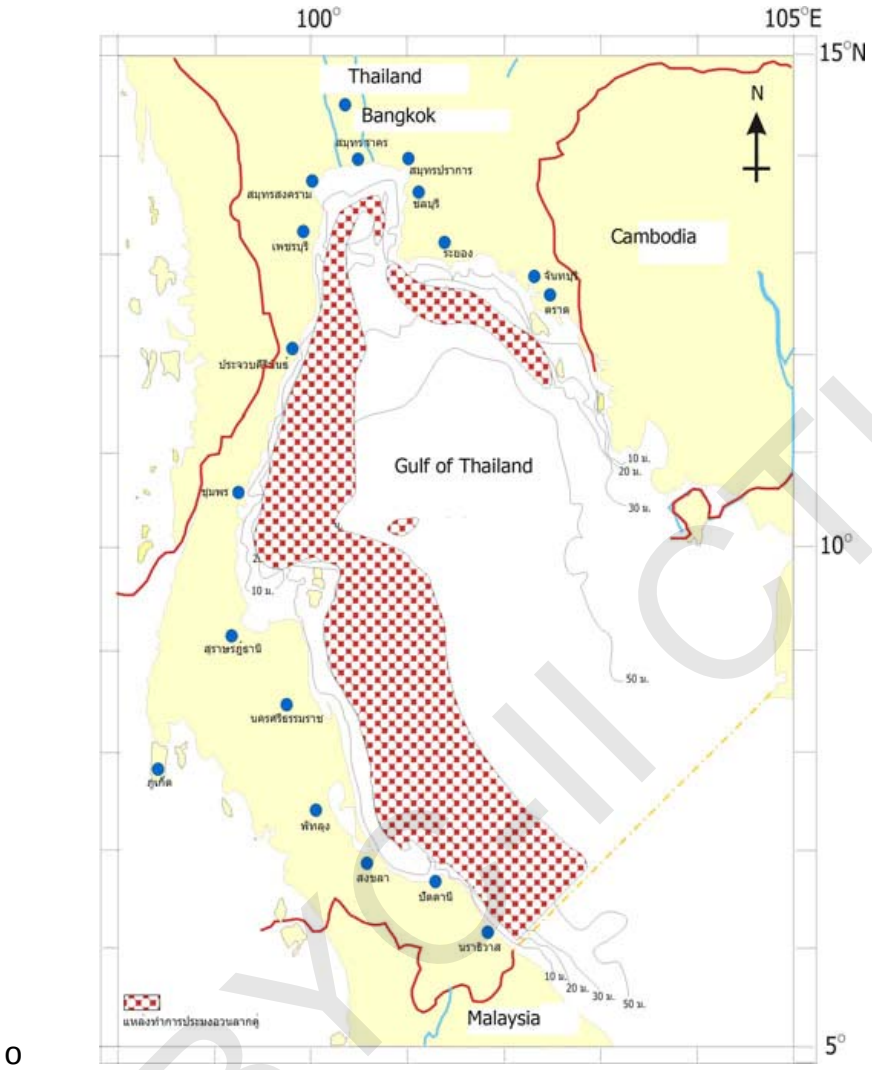


Figure 11. Fishing ground of PT in the Gulf of Thailand.

Sources: Kongprom *et.al,* 2008.

1.2 Catch quantities, catch values, species harvested, seasonal capture and production trends

1.2.1 Catch and percentage of marine capture

In the Gulf of Thailand, the total marine capture (1,459,510 mt) from all types of gear in year 2007 comprised pelagic fish group 563,614 mt (39%), demesal fish group 247,313 mt (17%), other food fish 88,070 mt (6%), trashfish 367, 505 mt (25%), crustacean 70,321 mt (5%), mollusk 114,364 mt (8%), jelly fish and others 8,323 mt (0.6%). (Fig. 12).

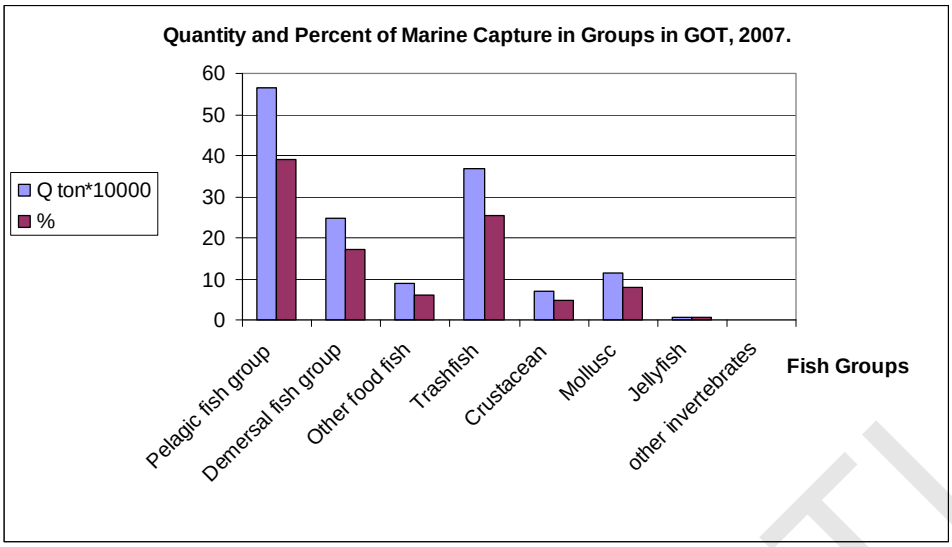


Figure 12. Marine capture by fish groups in quantity and percentage from all types of gear in the Gulf of Thailand, year 2007.
Sources: Fisheries statistic of Thailand, Department of Fisheries, 2007.

The marine captured in the Gulf of Thailand in 2007 decreased from the year 2006 about 9%. Capture from neighboring countries (mixed fish groups) through the bilateral agreement in year 2007 accounted for 524,881 mt or about 42% of the total capture in the gulf which also decreased from year 2006 about 13% (Information Technology Center, Department of Fisheries, December 2009 from Sampling survey in 2007).

The total marine capture of 1,243,654 mt from only trawling gear in the Gulf of Thailand, in the year 2007 comprised food fish 573,667 mt (46%), trash fish 519,540 mt (42%), shrimp 39,941 mt (3%), crab 9,210 mt (0.7%), cephalopod 101,008 mt (8%) and shellfish 288 mt (0.02%). The capturing from trawl gear in 2007 of the gulf was sharing among types of trawlers viz. 651,372 mt (80%) from OBT; 162,538 mt (19.9%) from PT and 916 mt (0.1%) from BT.

1.2.2 The value of marine captured by trawlers

Total value from marine capture of the country by all gear types of the year 2007 accounted 54,827 million baht (million USD 1,661) capturing from the Gulf of Thailand about 70% and from Andaman Sea about 30%. In the Gulf of Thailand, the value of the marine capture comprised pelagic fish group million Baht 13,122.9 (34%); demersal fish million Baht 6,469.7 (17 %); other food fish million Baht 2,380.4 (6%); trash fish Million Baht 1,848.8 (5%); shrimp million Baht 5,811.8 (15%); crab mil Bah 2,255.7 (6%); cephalopod mil Baht 6,412.9 (17%); and etc. (Table 2).

Table 2. Value of marine capture in groups by all gear types in the country, Gulf of Thailand and Andaman Sea, 2007.

(Thousand baht)

Item	Whole Country	GOT	Percent Value GOT	Andaman Sea	Percent Value And Sea
Total value	54,827,189	38,626,348	70	16,200,841	30
Subtotal pelgic fish	18,390,249	13,122,866	34	5,267,383	33
Subtotal demersal fish	9,885,581	6,469,675	17	3,415,906	21
Other foodfish	3,492,354	2,380,395	6	1,111,959	7
Trashfish	2,934,185	1,848,765	5	1,085,420	6
Sub total shrimp	8,280,511	5,811,763	15	2,468,748	15
Subtotal crab	3,223,441	2,255,714	6	967,727	6
Subtotal cephalopod	8,296,516	6,412,877	17	1,883,639	12
Subtotal shellfish	283,470	283,458		12	
Subtotal other invertebrate	40,882	40,835		47	

Sources: Fisheries statistic of Thailand, Department of Fisheries, 2007.

1.2.3 Species harvest by trawlers

From sampling surveyed of the Central Gulf Marine Fisheries Research and Development Center, at Chumphon landing site in October 2009, marine captured results from each type of gear and size were shown as follow:

Small sized otter board trawler (OBT- LOA<14m)

The total capture was 283 kg per trip (OBT <14 m has operated for 1 or 2 days for 1 trip, 2 or 3 haul per day), the total fish captured comprised demersal fish group 160 kg (56%); Trash fish 60 kg (21%); pelagic fish group 31 kg (11%); cephalopod 26 kg (9%); shrimp 6 kg (21%) and crab 0.9 kg (0.3%).

Medium sized otter board trawler (OBT-LOA 14-18 m)

The total capture was 12,931 kg per trip (The OBT 14-18 m has operated for 8 days for 1 trip, 2 haul per day), the total fish captured comprised demersal fish group 8,768 kg (68%); Trash fish 1,987.9 kg (15%); pelagic fish group 456 kg (3%); cephalopod 682 kg (5%); shrimp 293 kg (2%); crab 452 kg (3%) and other invertebrate 291 kg (2%).This sampling surveys were taken in 2008 and 2009 at Prachuab Kiri Khan landing places.

Research vessel - otter board large sized (18-25 m)

From the research vessel survey data, the species groups caught by area surveyed are summarized in Table 3. The results in CPUEs from years 1966 to 1991 are ranking to consider for which groups are more abundance for top ten species groups.

It was shown that the common groups for all areas are trashfish, *Loligo, Nemipterus*, *Priacanthus, Saurida*, carangids and *Scolopsis*. Trashfish was a major part of the catches in all area except in Area II which has higher catches for good fish and Area III has higher catch for *Loligo.*

Although the definition and the juvenile economic fish sizes in trashfish composition were not clearly point out between the scientists and fishers, it was noticeable that the top ten species ranking for all areas were trash fish, food fish (miscellaneous fish), *Loligo* (squid), *Nemipterus* (threadfin bream), *Priacanthus, Saurida*, Carrangidae, *Scolopsis* etc. The species groups caught in each area was quite similar.

Table 3. Top ten species ranking caught by research vessels during 1966 – 1991.

Ranking	AREA I	AREA II	AREA III	AREA IV	AREA V	AREA VI	AREAVII	AREA VIII	AREA IX	I-IX
1	Trash fish	Good fish	Loligo spp.	Trash fish	Trash fish	Trash fish	Trash fish	Trash fish	Trash fish	Trash fish
2	Good fish	Trash fish	Good fish	Good fish	Good fish	Good fish	Good fish	Good fish	Good fish	Good fish
3	Loligo.	Loligo	Trash fish	Loligo.	Loligo	Loligo	Loligo	Nemipterus.	Loligo.	Loligo.
4	Nemipterus	Priacanthus	Carangidae	Nemipterus	Nemipterus	Nemipterus.	Nemipterus spp.	Loligo	Nemipterus.	Nemipterus
5	Priacanthus.	Nemipterus.	Nemipterus.	Priacanthus	Priacanthus	Carangidae	Priacanthus	Mullidae	Priacanthus	Priacanthus.
6	Saurida	Saurida	Sepia	Saurida.	Saurida spp.	Saurida	Saurida	Carangidae	Mullidae	Carangidae
7	Carangidae	Carangidae	Scolopsis	Carangidae	Carangidae	Priacanthus.	Carangidae	Priacanthus	Carangidae	Saurida
8	Lutianidae	Scolopsis.	Saurida	Scolopsis	Mullidae	Sepia	Sepia	Rays	Saurida	Mullidae
9	Mullidae	Sepia	Priacanthus	Sepia	Sepia	Trichiurus haumela	Rays	Saurida	Scolopsis	Sepia.
10	Scolopsis	Lutianidae	Lutianidae	Mullidae	Trichiurus haumela	Sciaenidae	Sciaenidae	Scolopsis	Lutianidae	Rays

Pair trawlers (PT-LOA 18-25 m). Commercial pair trawlers in Prachuab Kiri Khan has been sampling to study the catch, species caught and biological character and etc. The sampling was done in October 2009. Pair trawlers in Prachuab Kiri Khan has operated 6 day per trip, 2 haul per day, 6 hour per haul. The result showed that the total capture was 14,154 kg per trip (in an average). The total capture comprised pelagic fish group 4,560 kg (32%); demersal fish group 3,515 kg (25%); trash fish 383 kg (3%);cephalopod 5,399 kg (38%); shrimp 20 kg (0.1%); crab 57 kg (0.4%) and other invertebrate 220 kg (2%).

1.2.4 Species and size caught

Species caught by research vessels (R.V.) in the Gulf of Thailand during 2003 to 2005 were shown in Table 4. (Chuapun *et.al*; 2008).

At present the surveyed grids of R.V. have been reduced due to the fuel economization. One grid area is equal to 15*15 nautical miles and the research vessels using bottom otter board trawling and having length over all in the size category of 18-25 m. The surveyed areas by research vessels are divided into fixed stations as shown in Figure 13.

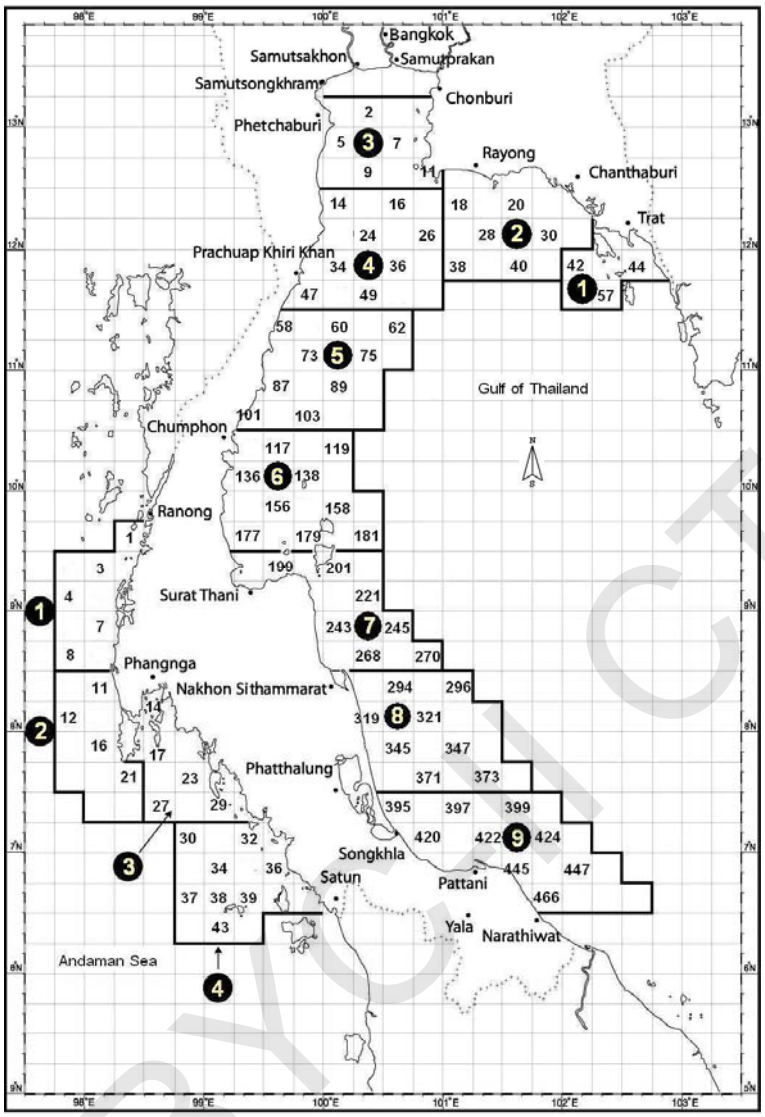


Figure 13. The fixed grids surveyed by the research vessels (bottom trawl) during 2003 to 2005 in the Gulf of Thailand (and in the Andaman Sea). One grid is equally 15*15 nm.

Table 4. Comparison of the catch per unit effort (CPUE, kg/hr) and percentage of fish species caught by research vessels during 2003 to 2005.

Taxa	2003		2004		2005	
	CPUE	**%**	**CPUE**	**%**	**CPUE**	**%**
Stolephorus spp.	0.045	0.20	0.020	0.08	0.058	0.24
Thryssa spp.	0.001	0.01	0.112	0.45	0.008	0.03
Chirocentrus dorab	0.073	0.33	0.059	0.24	0.067	0.28
Dussumieriidae	0.001	0.00	0.001	0.00	0.003	0.01
Clupeidae	0.037	0.17	0.024	0.10	0.039	0.16
Alepes djedaba	0.002	0.01	0.003	0.01	0.004	0.02
A. kleinii	0.044	0.20	0.063	0.25	0.014	0.06
A. melanoptera	0.109	0.48	0.110	0.44	0.059	0.24
Atule mate	0.053	0.24	0.045	0.18	0.131	0.54
Carangoides malabaricus	0.063	0.28	0.056	0.22	0.053	0.22
Megalaspis cordyla	0.053	0.24	0.030	0.12	0.039	0.16
Parastromateus niger	0.073	0.34	0.074	0.30	0.048	0.20
Scomberoides tol	0.001	0.01	0.006	0.02	0.002	0.01
Selar crumenophthalmus	0.029	0.13	0.020	0.08	0.011	0.05
Selaroides leptolepis	0.009	0.04	0.006	0.02	0.001	0.00
Seriolina nigrofasciata	0.013	0.06	0.018	0.07	0.010	0.04
Carangidae	0.057	0.26	0.014	0.06	0.026	0.11
Rastrelliger brachysoma	0.090	0.40	0.094	0.38	0.049	0.20
R. kanagurta	0.096	0.43	0.144	0.58	0.068	0.28
Scomberomorus commerson	0.093	0.42	0.125	0.50	0.126	0.52
S. guttatus	0.001	0.01	0.009	0.04	0.007	0.03
Pampus argenteus	0.020	0.09	0.023	0.09	0.093	0.38
P. chinensis	0.016	0.07	0.013	0.05	0.002	0.01
other pelagic fish	0.034	0.145	0.011	0.05	0.025	0.11
total pelagic fish	**1.013**	**4.53**	**1.080**	**4.33**	**0.943**	**3.90**
sharks	0.092	0.41	0.046	0.18	0.101	0.42
Dasyatidae	0.092	0.41	0.053	0.21	0.046	0.19
Muraenesocidae	0.022	0.10	0.012	0.05	0.011	0.05
Anodontostoma chacunda	0.028	0.13	0.019	0.08	0.016	0.07
Ariidae	0.039	0.17	0.286	1.15	0.007	0.03
Saurida elongata	0.340	1.52	0.602	2.41	0.569	2.35
S. isarankurai	0.381	1.70	0.806	3.23	0.793	3.28
S. micropectoralis	0.016	0.07	0.011	0.04	0.042	0.17
S. undosquamis	0.457	2.04	0.978	3.92	0.738	3.05
Trachinocephalus myops	0.035	0.16	0.010	0.04	0.014	0.06
Platycephalidae	0.066	0.30	0.048	0.19	0.022	0.09
Epinephelus areolatus	0.070	0.31	0.061	0.25	0.019	0.08
E. bleekeri	0.014	0.06	0.007	0.03	0.003	0.01
E. morrhua	0.001	0.00	0.000	0.00	0.000	0.00
E. sexfasciatus	0.061	0.27	0.047	0.19	0.052	0.22
E. tauvina	0.002	0.01	0.001	0.00	0.003	0.01
Serranidae	0.014	0.06	0.002	0.01	0.047	0.19
Priacanthus macracanthus	0.198	0.88	0.008	0.03	0.033	0.14
P. tayenus	0.649	2.90	0.504	2.02	0.462	1.91
Sillago sihama	0.002	0.01	0.000	0.00	0.001	0.00
Sillaginidae	0.001	0.00	0.003	0.01	0.003	0.01
Lactarius lactarius	0.000	0.00	0.001	0.00	0.001	0.00
Rachycentron canadum	0.024	0.11	0.030	0.12	0.046	0.19
Gazza minuta *	0.049	0.22	0.023	0.09	0.060	0.25
Leiognathidae *	0.038	0.17	0.098	0.39	0.066	0.27
Lutjanus lineolatus	0.055	0.25	0.104	0.42	0.046	0.19
L. malabaricus	0.033	0.15	0.023	0.09	0.008	0.03

Table 4 (Cont.) Comparison of the catch per unit effort (CPUE, kg/hr) and percentage of fish species caught by research vessels during 2003 to 2005.

Taxa	2003		2004		2005	
	CPUE	%	CPUE	%	CPUE	%
L. vitta	0.025	0.11	0.069	0.28	0.013	0.05
Lutjanidae	0.027	0.12	0.031	0.12	0.046	0.19
Gerres abbreviatus	0.000	0.00	0.001	0.00	0.001	0.00
G. filamentosus	0.002	0.01	0.003	0.01	0.002	0.01
G. oyena	0.005	0.02	0.002	0.01	0.001	0.00
G. macracanthus	0.000	0.00	0.000	0.00	0.000	0.00
Gerreidae	0.014	0.06	0.009	0.04	0.006	0.02
Haemulidae	0.000	0.00	0.000	0.00	0.001	0.00
Plectorhinchus pictus	0.072	0.32	0.050	0.20	0.063	0.26
Lethrinidae	0.025	0.11	0.054	0.22	0.012	0.05
Nemipterus bleekeri	0.000	0.00	0.000	0.00	0.000	0.00
N. hexodon	0.232	1.04	0.204	0.82	0.153	0.63
N. japonicus	0.069	0.31	0.062	0.25	0.019	0.08
N. marginatus	0.002	0.01	0.015	0.06	0.011	0.05
N. mesoprion	0.186	0.83	0.168	0.67	0.116	0.48
N. nematophorus	0.043	0.19	0.026	0.10	0.022	0.09
N. nemurus	0.011	0.05	0.043	0.17	0.024	0.10
N. peronii	0.057	0.26	0.052	0.21	0.022	0.09
N. tambuloides	0.005	0.02	0.008	0.03	0.010	0.04
N. tolu	0.002	0.01	0.001	0.00	0.001	0.00
Nemipteridae	0.000	0.00	0.000	0.00	0.010	0.04
Scolopsis taeniopterus	0.778	3.48	0.842	3.37	0.639	2.64
Scolopsidae	0.003	0.01	0.016	0.06	0.002	0.01
Sciaenidae	0.032	0.14	0.018	0.07	0.027	0.11
Parupeneus heptacanthus	0.026	0.12	0.028	0.11	0.025	0.10
Upeneus bensasi	0.273	1.22	0.115	0.46	0.107	0.44
U. luzonius	0.519	2.32	0.669	2.68	0.516	2.13
U. moluccensis	0.021	0.09	0.028	0.11	0.009	0.04
U. sulphureus	0.134	0.60	0.156	0.62	0.207	0.86
U. sundaicus	0.443	1.98	0.238	0.95	0.405	1.67
U. tragula	0.014	0.06	0.015	0.06	0.020	0.08
Mullidae	0.440	1.97	0.369	1.48	0.132	0.55
Teraponidae	0.046	0.21	0.030	0.12	0.014	0.06
Siganus oramin	0.021	0.09	0.038	0.15	0.012	0.05
Siganidae	0.039	0.17	0.020	0.08	0.024	0.10
Sphyraena jello	0.044	0.20	0.123	0.49	0.061	0.25
S. obtusata	0.023	0.10	0.821	3.29	0.044	0.18
Sphyraenidae	0.109	0.49	0.019	0.07	0.065	0.27
Trichiurus haumela	0.006	0.03	0.022	0.09	0.004	0.02
Trichiuridae	0.093	0.42	0.132	0.53	0.054	0.22
Bothidae *	0.001	0.00	0.002	0.01	0.006	0.03
Cynoglossidae	0.013	0.06	0.014	0.06	0.014	0.06
Alutera monoceros	0.152	0.68	0.117	0.47	0.097	0.40
Psettodes erumei	0.013	0.60	0.000	0.00	0.009	0.04
other demersal fish	0.053	0.24	0.109	0.44	0.163	0.67
total demersal fish	**6.852**	**30.63**	**8.522**	**34.17**	**6.398**	**26.44**
Sepiolidae	0.004	0.02	0.009	0.04	0.003	0.01
Sepia aculeata	0.162	0.72	0.108	0.43	0.065	0.27
S. brevimana	0.036	0.16	0.035	0.14	0.023	0.10
S. lycidas	0.047	0.21	0.024	0.10	0.010	0.04
S. recurvirostra	0.054	0.24	0.055	0.22	0.042	0.17
Sepia pharaonis	0.059	0.26	0.042	0.17	0.029	0.12
S. inermis	0.010	0.05	0.012	0.05	0.007	0.03
cuttle fish	0.003	0.01	0.008	0.03	0.024	0.03
Nipponololigo sumatrensis	0.267	1.19	0.482	1.93	0.587	2.42

Table 4 (Cont.). Comparison of the catch per unit effort (CPUE, kg/hr) and percentage of fish species caught by research vessels during 2003 to 2005.

Taxa	2003 (2546)		2004 (2547)		2005 (2548)	
	CPUE	%	CPUE	%	CPUE	%
Photololigo chinensis	1.302	5.82	1.705	6.84	1.826	7.55
P. duvaucelii	1.750	7.82	2.657	10.65	2.845	11.76
Sepioteuthis lessoniana	0.247	1.10	0.296	1.18	0.234	0.97
Octopus spp.	0.104	0.47	0.126	0.51	0.104	0.43
total cephalopod	**4.045**	**18.08**	**5.559**	**22.29**	**5.799**	**23.97**
Metapenaeus affinis	0.001	0.01	0.000	0.00	0.001	0.00
M. brevicornis	0.000	0.00	0.000	0.00	0.000	0.00
M. ensis	0.001	0.00	0.002	0.01	0.001	0.00
M. intermedius	0.001	0.00	0.000	0.00	0.000	0.00
M. lysianassa	0.010	0.05	0.018	0.07	0.009	0.04
M. moyebi	0.000	0.00	0.000	0.00	0.000	0.00
Penaeus japonicus	0.000	0.00	0.001	0.00	0.001	0.00
P. latisulcatus	0.000	0.00	0.000	0.00	0.000	0.00
P. merguiensis	0.003	0.01	0.003	0.01	0.003	0.01
P. monodon	0.004	0.02	0.001	0.00	0.000	0.00
P. semisulcatus	0.003	0.01	0.002	0.01	0.007	0.03
Metapenaeopsis barbata	0.006	0.03	0.018	0.07	0.014	0.06
M. palmensis	0.015	0.07	0.024	0.10	0.020	0.08
M. stridulans	0.001	0.01	0.002	0.00	0.001	0.00
M. toloensis	0.030	0.13	0.000	0.00	0.000	0.00
Metapenaeopsis spp.	0.000	0.00	0.000	0.00	0.000	0.00
Parapenaeopsis hardwickii	0.000	0.00	0.000	0.00	0.001	0.00
P. hungerfordi	0.021	0.09	0.001	0.00	0.000	0.00
P. maxillipedo	0.000	0.00	0.000	0.00	0.000	0.00
P. scultilis	0.000	0.00	0.002	0.01	0.000	0.00
Parapenaeopsis spp.	0.001	0.01	0.000	0.00	0.000	0.00
Trachypenaeus curvirostris	0.000	0.00	0.000	0.00	0.000	0.00
T. fulvus	0.005	0.02	0.002	0.01	0.001	0.00
T. pescadoreensis	0.000	0.00	0.001	0.00	0.000	0.00
Trachypenaeus spp.	0.000	0.00	0.000	0.00	0.000	0.00
other small size shrimps	0.005	0.02	0.011	0.04	0.002	0.01
total shrimp	**0.107**	**0.48**	**0.088**	**0.353**	**0.061**	**0.25**
Charybdis feriatus	0.138	0.62	0.099	0.40	0.098	0.41
Portunus pelagicus	0.052	0.23	0.030	0.12	0.038	0.16
other crabs	0.078	0.35	0.042	0.17	0.090	0.37
total crab	**0.268**	**1.20**	**0.171**	**0.69**	**0.226**	**0.93**
Amusium pleuronectes	0.223	1.00	0.276	1.11	0.201	0.83
other shells	0.037	0.16	0.006	0.02	0.018	0.08
mantis shrimps	0.152	0.68	0.085	0.34	0.071	0.29
Scyllaridae	0.076	0.34	0.039	0.16	0.078	0.32
other	0.011	0.05	0.018	0.07	0.025	0.10
miscellaneous group	**0.499**	**2.23**	**0.424**	**1.70**	**0.393**	**1.62**
Elates ransonnetii	0.045	0.20	0.087	0.35	0.054	0.22
Apogonidae	0.498	2.23	0.437	1.75	0.550	2.27
Mene maculata	0.021	0.09	0.018	0.07	0.125	0.52
Leiognathus bindus	3.472	15.52	3.849	15.43	4.993	20.64
L. brevirostris	0.026	0.12	0.096	0.38	0.014	0.06
L. dussumieri	0.077	0.34	0.023	0.09	0.031	0.13
L. elongatus	0.166	0.74	0.090	0.36	0.128	0.53
L. leuciscus	1.466	6.55	1.410	5.65	1.324	5.47
L. splendens	1.876	8.39	1.676	6.72	1.344	5.55
Secutor insidiater	0.065	0.29	0.062	0.25	0.181	0.75
S. ruconius	0.160	0.72	0.062	0.25	0.174	0.72
Leiognathidae	0.247	1.10	0.086	0.35	0.164	0.68
Pentaprion longimanus	0.021	0.09	0.015	0.06	0.014	0.06
Pentapodidae	0.019	0.09	0.033	0.13	0.029	0.12

Table 4 (Cont.). Comparison of the catch per unit effort (CPUE, kg/hr) and percentage of fish species caught by research vessels during 2003 to 2005.

Taxa	2003 (2546)		2004(2547)		2005(2548)	
	CPUE	%	CPUE	%	CPUE	%
Callionymidae	0.011	0.05	0.006	0.02	0.006	0.02
Gobiidae	0.025	0.11	0.015	0.06	0.008	0.03
Bothidae	0.119	0.53	0.137	0.55	0.171	0.71
Pleuronectidae	0.030	0.13	0.058	0.23	0.008	0.03
Soleidae	0.006	0.03	0.007	0.03	0.001	0.00
Balistidae	0.081	0.36	0.086	0.35	0.065	0.27
Tetraodontidae	0.628	2.81	0.554	2.22	0.626	2.59
crabs (trash)	0.361	1.61	0.116	0.47	0.114	0.47
misc. trash fish	0.165	0.73	0.176	0.71	0.253	1.05
total true trash fish	**9.585**	**42.85**	**9.099**	**36.48**	**10.376**	**42.89**
total catch	**22.369**	**100.00**	**24.943**	**100.00**	**24.196**	**100.00**

From research vessels surveyed during the years 2003 to 2005 it can be grouped into three groups as follow:

1. The increasing trend species from 2003 to 2005 were 10 species: *Stolephorus* spp., *Alepes djedaba*, Lutjanidae, *Scomberomorus commerson*, *Pampus argenteus*, Bothidae, cuttlefish, *Photololigo chinensis, P. duvaucelii* and *Leiognathus bindus*.
2. Species increased from year 2003 to 2004 and decreased in year 2005 were 11 species: *Saurida elongate*, *S. undosquamis*, Leiognathidae, *Lutjanus lineolatus*, *Scolopsis taeniopterus*, *Sphyraena jello, S. obtusata*, *Sepioteuthis lessoniana, Octopus* spp., *Metapenaeopsis barbata and M. palmensis*
3. The decreasing groups of 148 species in Table 6 apart from groups one and two were shown decreasing trend from year 2003 to 2005.

Sizes of fish caught

The sizes and species of fish caught by research vessel in 2003 were identified by Chaupun *et.al.,* (2008). Table 5 shows minimum, maximum, mean sizes (cm) and standard deviation of fish species caught.

Table 5. Minimum, maximum, mean sizes (cm) and standard deviation of fish species caught by research vessel.

Taxa	Sampling Number	min	max	mean	SD
Stolephorus spp.	238	4.8	14.3	9.8	2.45
Thryssa spp.	6	12.8	13.8	13.4	0.41
Chirocentrus dorab	45	11.3	46.3	33.7	6.90
Alepes djedaba	19	8.8	19.8	15.1	2.56
A. kleinii	211	4.8	18.8	12.3	1.76
A. melanoptera	235	6.3	27.3	18.3	3.05
Atule mate	266	3.8	23.8	12.6	4.17
Carangoides malabaricus	396	5.3	22.3	10.9	2.86
Megalaspis cordyla	162	8.8	25.8	15.7	2.70
Parastromateus niger	180	3.8	29.3	13.4	3.84
Scomberoides tol	5	22.3	25.8	23.9	1.56
Selar crumenophthalmus	59	8.8	24.3	13.3	4.37
Selaroides leptolepis	6	22.8	34.3	27.9	5.44
Seriolina nigrofasciata	153	3.3	21.3	8.5	3.65
Rastrelliger brachysoma	116	10.3	20.8	14.1	2.98
R. kanagurta	216	11.8	24.8	18.0	2.73
Scomberomorus commerson	122	14.8	50.8	25.4	6.67
S. guttatus	4	17.i	20.3	18.8	1.08
Pampus argenteus	13	8.8	27.8	16.6	5.95
P. chinensis	11	12.3	28.8	22.3	5.01
Anodontostoma chacunda	101	12.3	16.8	14.6	0.82
Saurida elongata	425	5.8	42.8	20.3	8.12
S. isarankurai	2,602	3.8	16.3	8.9	2.01
S. micropectoralis	95	9.3	21.3	15.2	2.67
S. undosquamis	1,743	1.3	31.8	14.8	5.22
Trachinocephalus myops	10	7.8	30.3	18.2	7.81
Epinephelus areolatus	62	2.3	38.8	21.4	8.12
E. bleekeri	6	19.8	34.8	27.3	4.86
Epinephelus morrhua	2	6.3	20.3	13.3	9.90
E. sexfasciatus	109	4.8	32.3	14.7	7.03
E. tauvina	14	5.8	16.3	10.0	3.23
Priacanthus macracanthus	1,136	6.8	20.8	12.5	2.46
P. tayenus	1,392	1.3	23.8	11.3	3.63

Table 5 (Cont.)

Taxa	Sampling Number	min	max	mean	SD
S. pharaonis	35	3.3	21.3	11.6	4.72
Sepiella inermis	66	2.3	7.8	4.0	1.34
Photololigo chinensis	3,194	2.3	40.8	12.5	5.82
P. duvaucelii	7,871	2.3	21.8	8.6	2.28
Sepioteuthis lessoniana	519	4.3	29.8	9.7	3.73
Metapenaeus affinis	3	11.8	12.3	11.9	0.29
M. ensis	12	6.3	13.8	10.1	2.04
M. intermedius	9	5.3	17.8	9.4	4.78
M. lysianassa	315	3.3	11.8	6.6	1.14
Penaeus japonicus	1	14.3	14.3	-	-
P. longistylus	11	9.3	31.3	16.4	8.54
P. merguiensis	12	12.8	21.3	17.3	2.04
Penaeus monodon	9	13.8	26.3	21.4	4.41
P. semisulcatus	12	11.3	19.3	15.3	2.32
Metapenaeopsis barbata	125	4.3	9.8	6.7	1.27
M. palmensis	131	3.8	9.3	5.3	1.02
M. stridulans	8	4.3	6.3	5.0	0.76
Metapenaeopsis toloensis	94	5.3	10.8	7.0	1.13
Parapenaeopsis hardwickii	6	7.8	12.8	10.3	1.92
P. hungerfordi	62	6.8	18.3	15.2	2.12
Trachypenaeus fulvus	47	3.8	9.3	7.1	1.16
T. pescadoreensis	6	7.3	8.3	7.7	0.38
Charybdis feriatus	157	1.8	16.3	9.3	2.05
Portunus pelagicus	28	4.3	16.3	13.0	2.70
Amusium pleuronectes	567	3.3	9.3	5.9	1.20
Mene maculata	4	17.3	19.8	17.4	0.48
Leiognathus bindus	5,135	1.3	11.8	5.2	0.99
L. brevirostris	130	3.3	10.8	8.6	1.47
L. dussumieri	254	6.3	14.3	10.2	0.90
L. elongatus	1,569	2.3	11.8	7.6	1.37
L. leuciscus	6,209	2.8	10.8	6.7	1.04
L. splendens	1,063	4.8	13.3	8.4	0.96
Secutor insidiater	384	3.3	17.8	7.8	1.31
S. ruconius	762	3.3	8.3	5.1	0.63
Pentaprion longimanus	**17**	**6.8**	**11.3**	**9.6**	**1.03**

1.2.4 Seasonal capture of trawlers (Kongprom *et. al.*, 2008).

From research works during 2004 - 2005 on commercial trawlers in the Gulf of Thailand, the results showed:

Small sized otter board trawler (OBT <14 m) showed no significant different in catches among northeast–inter–southwest monsoons. The CPUE of all months showed no significant in seasonal variation. The highest catch rate (CPUE) was 29 kg/hr in May. Among Area 1- 5, the Area 3 was more abundant than other areas.

Medium sized otter board trawler (OBT 14-18 m) showed no significant different in catches among northeast–inter–southwest monsoons. This medium trawler was more advanced to fish farther in the deeper part of the gulf. The highest capture month was in September with 47.9 kg/hr, the most abundant area was in area 5 (central gulf).

Large sized pair trawler (PT 18-25 m) showed the highest capture month was 212.5 kg/hr in May. There was no significantly in catches among northeast–inter– southwest monsoons.

1.2.5 Capture by Area

Capture by area of commercial trawlers in the Gulf of Thailand during 2004-2005 (Kongprom, 2008) was shown as following:

Small OBT <14 m. The small otter board trawlers can catch more abundant in area 3 with an average of 35 kg per hr.

Medium OBT 14-18 m. The medium size otter board trawlers can catch more abundant in area 5 with an average of 50 kg per hr.

Pair trawler (PT). The pair trawler can catch more abundant in area 3 with an average of 167 kg per hr.

1.2.6 Distribution

Comparison of the distributions of total capture, demersal fish group and trash fish group surveyed by research vessels during the years 2003 to 2005 were shown in Figures 14, 15 and 16 (Chuapun *et.al*; 2008). The CPUE of total catches, demersal fish and trash fish decrease during the year 2003 to 2005.

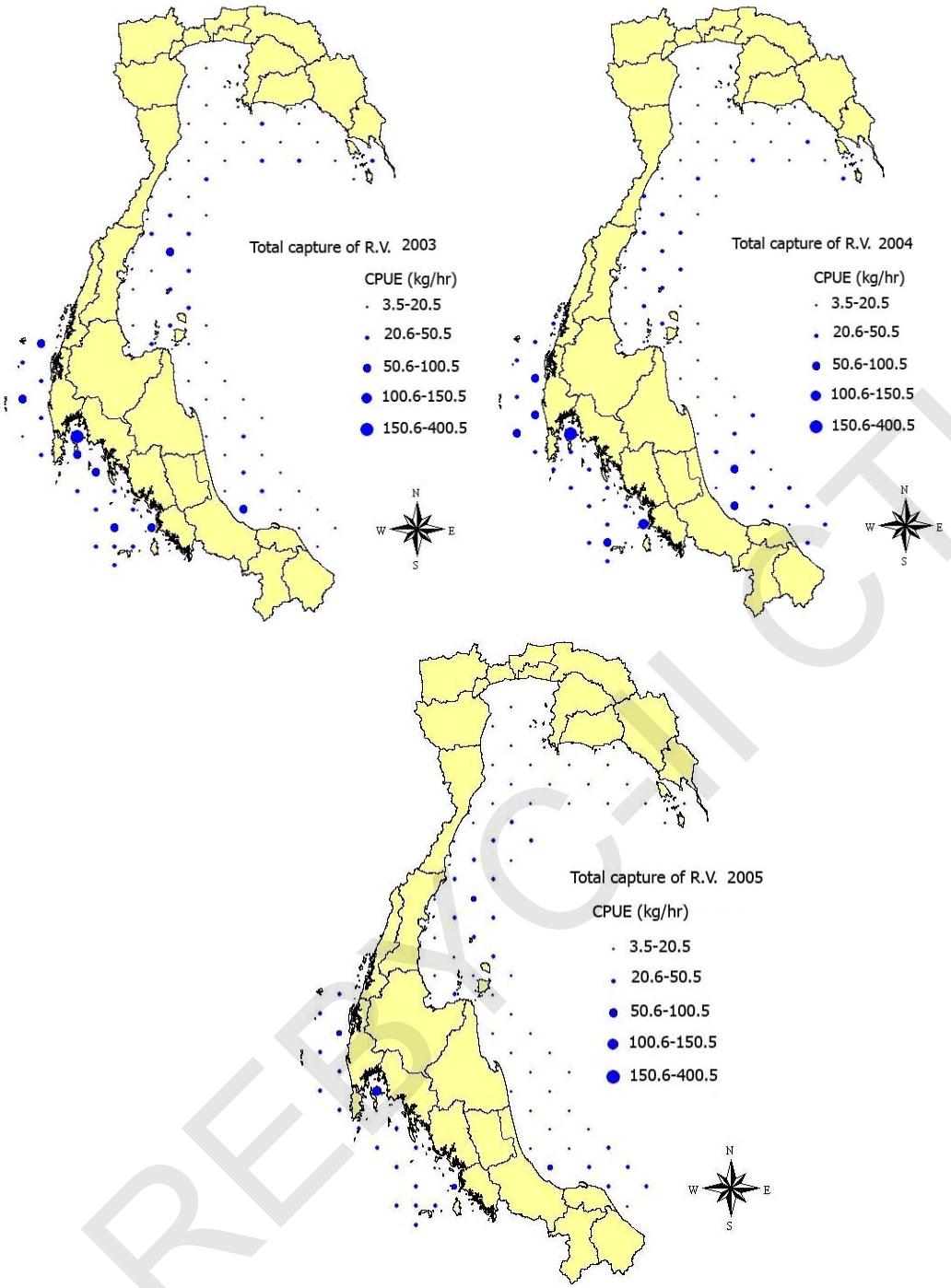


Figure 14. The comparison of the total capture by research vessels, 2003 to 2005 were distributed via grid stations.

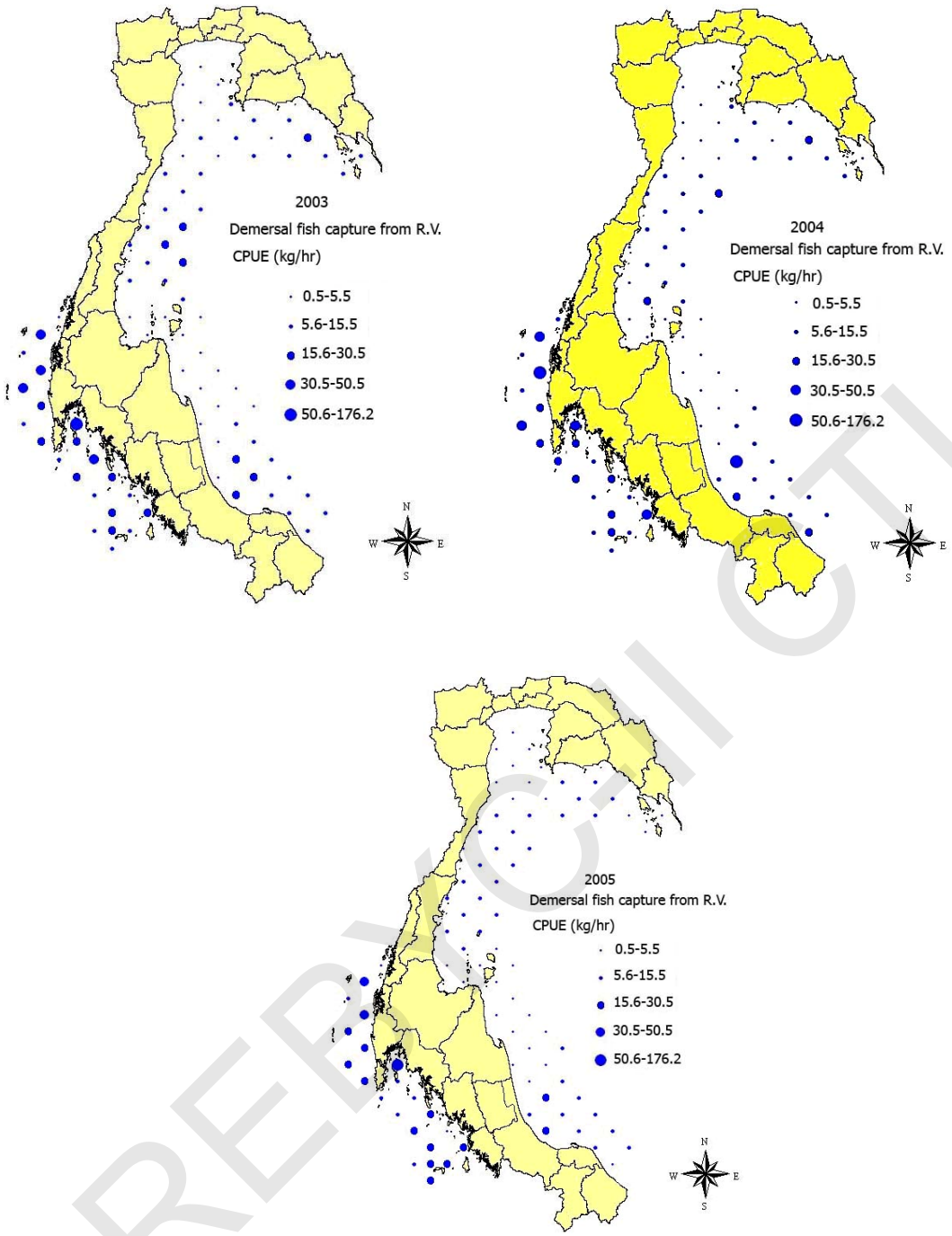


Figure 15. The comparison of the demersal fish group caught by research vessels, 2003 to 2005 were distributed via grid stations.

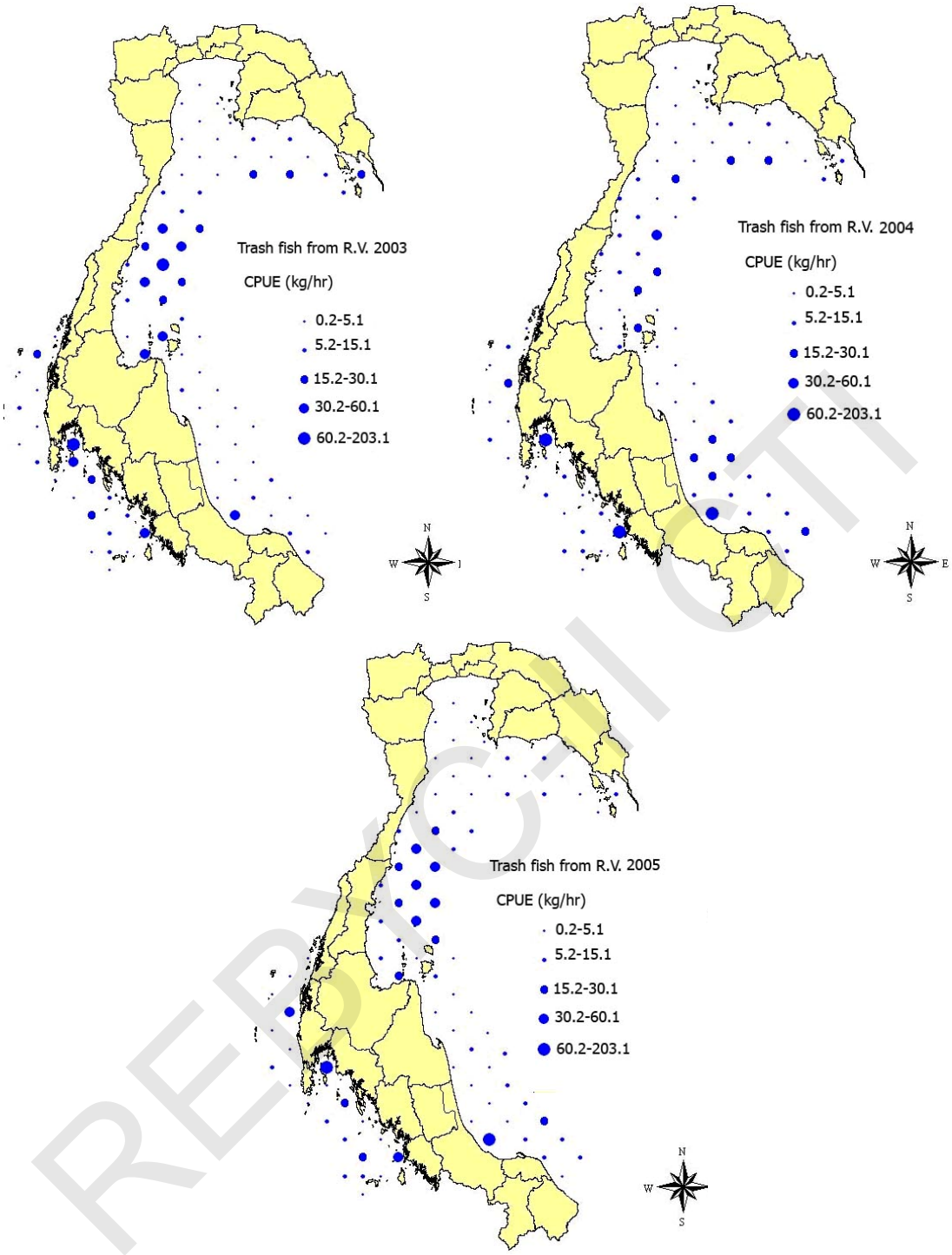


Figure 16. The comparison of the trash fish capture by research vessels, 2003 to 2005 were distributed via grid stations.

1.2.7 Production trend

In 2007, the total production of the country from marine capture accounted for 2.079 million metric ton which could be separated as capture from the Gulf of Thailand 1.448 mil mt (70%) and from Andaman Sea 0.631 mil mt (30%). In the Gulf of Thailand, capture by gear types were categorized into trawls (OBT, PT,BT) 814,826 mt (56%); purse seine 476,719 mt (33%); gillnet and encircling gill net 63,974 mt (4%); light luring fishing 25,747 mt (2%); movable gear 25,495 mt (2%); hook 1232 mt (0.1%); stationary gear 14,248 mt (1%) and miscellaneous 25,617 mt (2%). Among trawl gear, otter board trawler was the most important in terms of high number of boats and high capture production. The capture from trawl gear was shared by OBT 80%; PT 19% and BT 0.1%.

The production trend from 1990 to 2007 can be seen from Fig. 17. The total production in the Gulf of Thailand has two high peaks in 1992 with 2,081,528 mt and in 2000 with 2,020,876 mt. After the year 2000, the total production showed significantly down trend to present level of 1,447,898 mt in 2007. The trash fish group also showed decreasing trend since 1990 ranging 367,505-774,874 mt. The pelagic fish group has its production in the range of 551,765-700,149 mt during 1990 to 2007.The production of demersal fish was ranged 105,740-324,552 mt and downward to 247,313 in 2007.

The value of total marine capture from 1990–2007 ranged 16,978.200-34,732.645 million Baht. Trash fish was lowest value whereas the production was high (Fig.18).

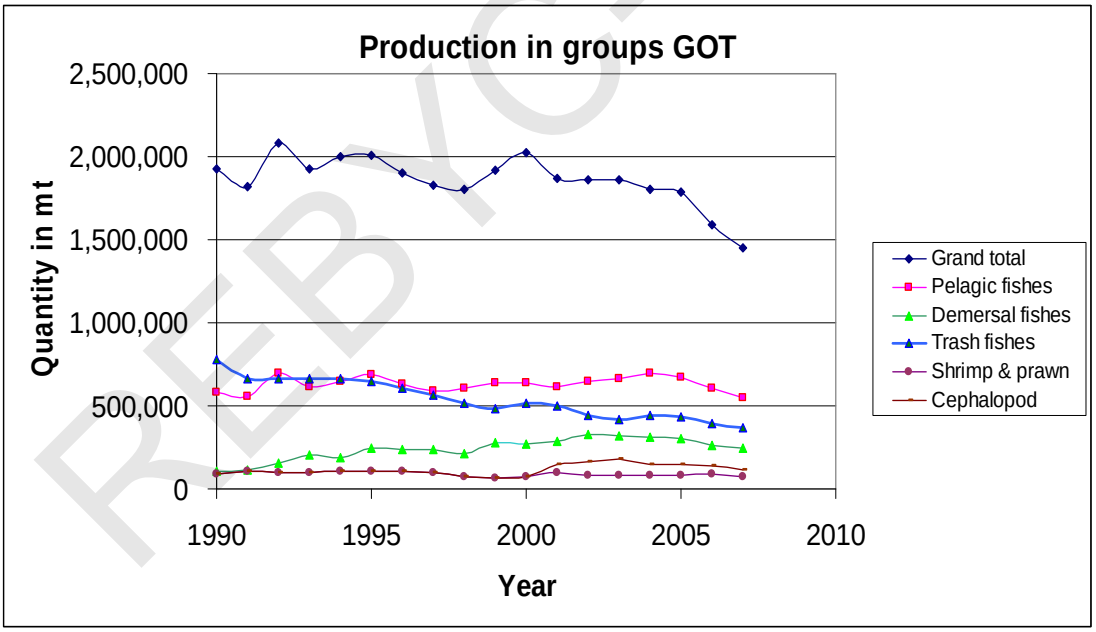


Figure 17. Production of marine capture in the Gulf of Thailand (GOT) caught by all types of gear divided into 6 groups, 1990-2007.

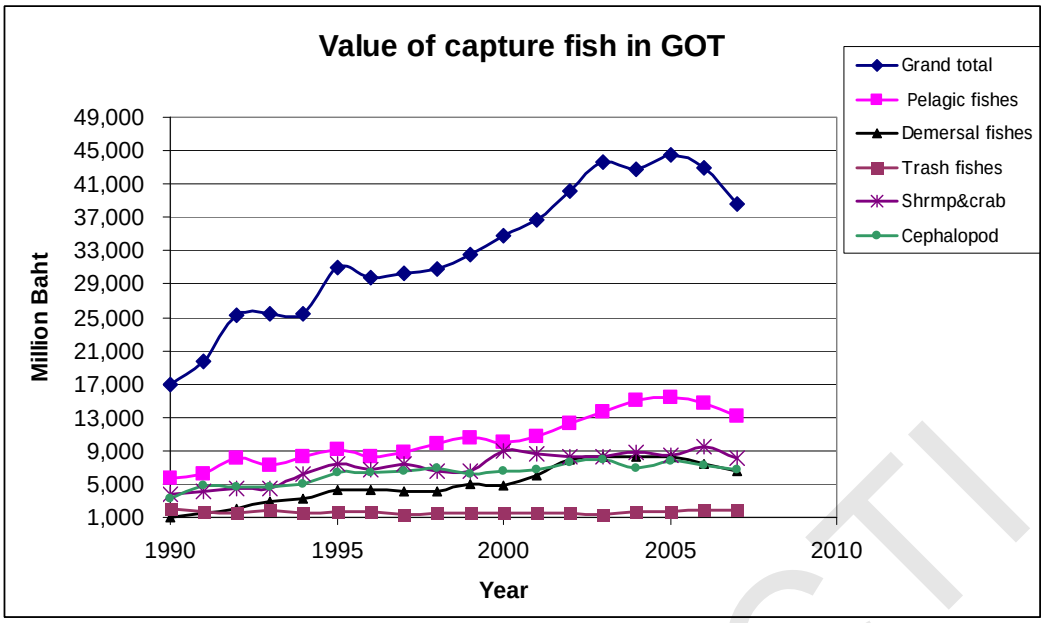


Figure 18. Value of marine capture in the Gulf of Thailand caught by all types of gear divided into six groups, 1990-2007.

2. Overview of employment in the trawl fisheries sub-sector

2.1 Estimated number of jobs onboard vessels

The 2000 inter-censal of Marine Fishery revealed that the total number of labor force in marine fisheries was 168,140 (National Statistic Office, 2000). They comprised of 50,312 households exclusively engaged in capture fishery; 27,388 households engaged in coastal aquaculture; 3,001 engaged in both marine capture fishery and coastal aquaculture; and 28,934 households were fishery employees. Finally, the population of marine fishery was 535,210 persons.

2.2 Estimated number of jobs in post harvest and other auxiliary activities

The marine fisheries sector supports substantial employment in the industries such as fish processing, cold storage, fish meal, boats construction, etc. The labor forces of these industries were estimated by those Associations at 330,000 in 2009.

2.3 Distribution/marketing of catch nationally and for export

2.3.1 National human consumption species

Over the period 1999 to 2008 the apparent per capita consumption of fish in Thailand fluctuated between 29.5 and 42.7 kg annually (Table 6)

Table 6. Fish meal, trade and fish consumption, 1999 – 2008.

year	Total	Fish used	Trade		Apparent Consumption		
	Production (mil.tons)	for fishmeal (mil.tons)	Imports (mil.tons)	Exports (mil.tons)	Total consumption (mil.tons)	Population (mil.)	Percapita (kg)
1999	3.63	0.77	0.91	1.95	1.82	61.80	29.52
2000	3.71	0.77	0.81	1.66	2.09	61.88	33.76
2001	3.65	0.74	0.84	1.71	2.04	62.31	32.74
2002	3.80	0.70	1.06	1.82	2.34	62.80	37.24
2003	3.91	0.70	1.16	2.09	2.29	63.08	36.30
2004	4.10	0.77	1.33	2.07	2.59	61.97	41.76
2005	4.12	0.76	1.56	2.26	2.66	62.42	42.67
2006	4.05	0.67	1.56	2.43	2.51	62.83	39.89
2007	3.68	0.58	1.47	2.30	2.27	63.04	35.96
2008	3.80	0.57	1.62	2.34	2.51	63.39	39.62

Source: Department of Fisheries (1999-2008).

2.4 Species (and/or size/quality considerations) for reduction or animal feed

Khemakorn *et.al.* 2005 reviewed fish species in trash fish component which consisted of juvenile economic fish and true trash fish as shown in Table 7. The economic juvenile fish appeared in the Table with high percentage were demersal fish (*Mullidae, Synodontidae*, *Nemipteridae, Pricanthidae, Sphyraenidae*); pelagic fish (*Engraulidae, Carrangidae, Scombridae*) and invertebrate group (Crab trash, *Penaeidae*, *Sepiidae* and *Loliginidae*) as an example. These species should be reduced from the trash fish capture.

Table 7. Some species groups composition of trash fish from marine fisheries capture in the Gulf of Thailand.

Family	% in Trash fish	Family	% in Trash fish
Leiognathidae	25.1	*Scombridae*	1.2
Misc. trash	7.4	Stomatopoda	1.1
Engraulidae	7.2	*Callionymidae*	0.9
Mullidae	5.7	*Scorpaenidae*	0.8
Synodontidae	5.0	*Gobiidae*	0.7
Apogonidae	4.5	*Soleidae*	0.3
Crab trash	4.4	*Blenniidae*	0.2
Bothidae	3.9	*Sphyraenidae*	0.2
Carrangidae	3.6	*Dasyatidae*	0.2
Balistidae	3.2	Misc. other	0.2
Tetraodontidae	3.1	*Lutjanidae*	0,1
Nemipteridae	2.7	*Fistulariidae*	0.9
Pricanthidae	2.6	*Clupeidae*	0,9
Penaeidae	1.7	*Muraenesocidae*	0.7
Platycephalidae	1.6	*Siganidae*	0.3
Miscellaneous demersal	1.4	*Misc. pelagic*	0.3
Sepiidae	1.3	*Octopodidae*	0.2
Loliginidae	1.3	mollusc	0.2
Sciaenidae	1.3	*Synanceiidae*	0.2
Cynoglossidae	1.2	*Psettodidae*	0.1
Trichiuridae	1.1		

Source: Khemakorn *et al*., 2005

2.5 Export species (Fish export)

The export of fish and fishery products during the decade beginning 1999 amounted to 1,663,427 metric tons a year, valued at THB 192,320 million. For 2008, the volume of the fish export was at 1,907,057 metric tons, valued THB 228,218 million. Comparing with the previous year, there was a reduction in the volume by 3%; however the value was 11% higher. By type of the products, the shrimp products (culturing and natural capture) earned 37% of the revenue; canned tuna 27%, frozen and chilled dressed fish 10% and cephalopods 6%.

The important destinations for the exported fish and fishery commodities are the United States, Japan, the European Union, Africa, Australia, and Canada. During the decade of 1999, the average annual revenues registered a constant increase in all these importing countries: the United States 3%, Japan 2%, the European Union 11%, Africa 32%, Australia 7%, and Canada 4%. Of the total volume of the exports in 2008, the United States took 29% share, while Japan took 20%, the European Union 16%, Africa 6%, Australia 5%, and Canada 4% (Figs. 19 and 20).

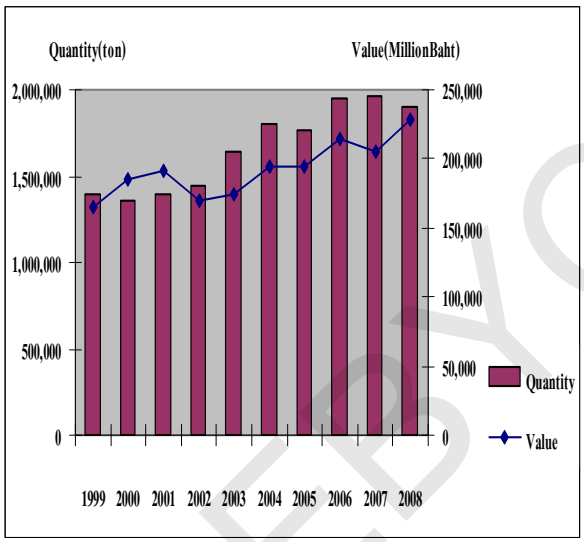


Figure 19: The volumes and values of all fish and fish product exports.

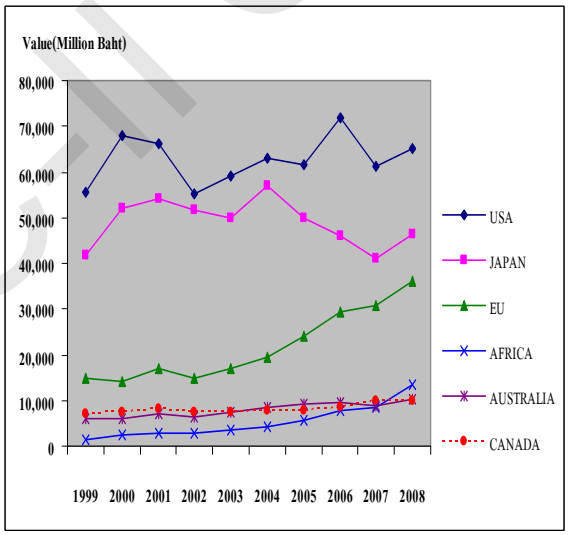


Figure 20: The values of the fish and fishery product exports by importing countries.

The fish, fish products and value exports of Thailand can be summarized as follows (Figs. 21 and 22):

a. *Shrimp.* An average volume of the annual export of shrimp was at 271,262 metric tons, valued THB 82,081 million, showing an annual increase of 5% in volume, and of 0.2% in value. In 2008, the volume of export was at 343,130 metric tons, valued THB 81,098 million, an increase of 1% in volume, and of 3.8% in value over the previous year.

b. *Canned tuna.* The average volume of the annual export of canned tuna was at 343,715 metric tons, valued THB 33,543 million, an annual increase of 8% in volume, and of

14% in value. In 2008, the volume of export was at 494,486 metric tons, valued THB 62,517 million, an increase of 10% in volume, and of 36% in value over the previous year.

c. *Surimi.* The average volume of the annual export of surimi was at 113,414 metric tons, valued THB 8,757 million, an annual increase of 8% in volume, and of 28% in value over those of 2007. In 2008, the volume of export was at 21,704 metric tons, valued THB 2,246 million, showing an increase of 17% in volume, and of 29% in value over the previous year.

d. *Crab.* The average volume of the annual export of crab was at 13,487 metric tons, valued THB 4,505 million, an annual increase of 1% in volume, and of 4% in value over those of 2007. In 2008, the volume of export was at 11,746 metric tons, valued THB 3,450 million, showing a reduction of 24% in volume, and of 21% in value over the previous year.

e. *Sardine.* The average volume of the annual export of sardine was at 47,789 metric tons, valued THB 2,355 million, an annual increase of 6% in volume, and of 14% in value over those of 2007. In 2008, the volume of export was at 74,949 metric tons, valued THB 4,702 million, showing an increase of 42% in volume, and of 60% in value over the previous year.

f. *Frozen and chilled cephalopods.* The average volume of the annual export of frozen and chilled cephalopods was at 88,640 metric tons, valued THB 13,267 million, an annual reduction of 0.6% in volume, and an annual increase of 2% in value over those of 2007. In 2008, the volume of export was at 77,982 metric tons, valued THB 12,532 million, showing a reduction of 12% in volume, and of 13% in value over the previous year.

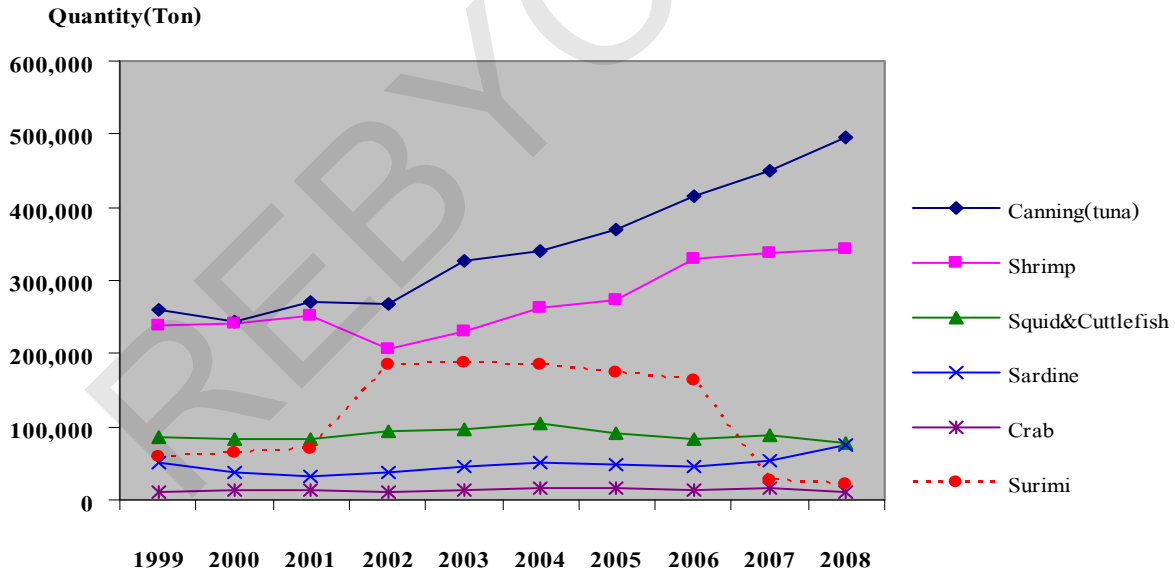


Figure 21: The volumes of fish export by types of commodities in 1999-2008.

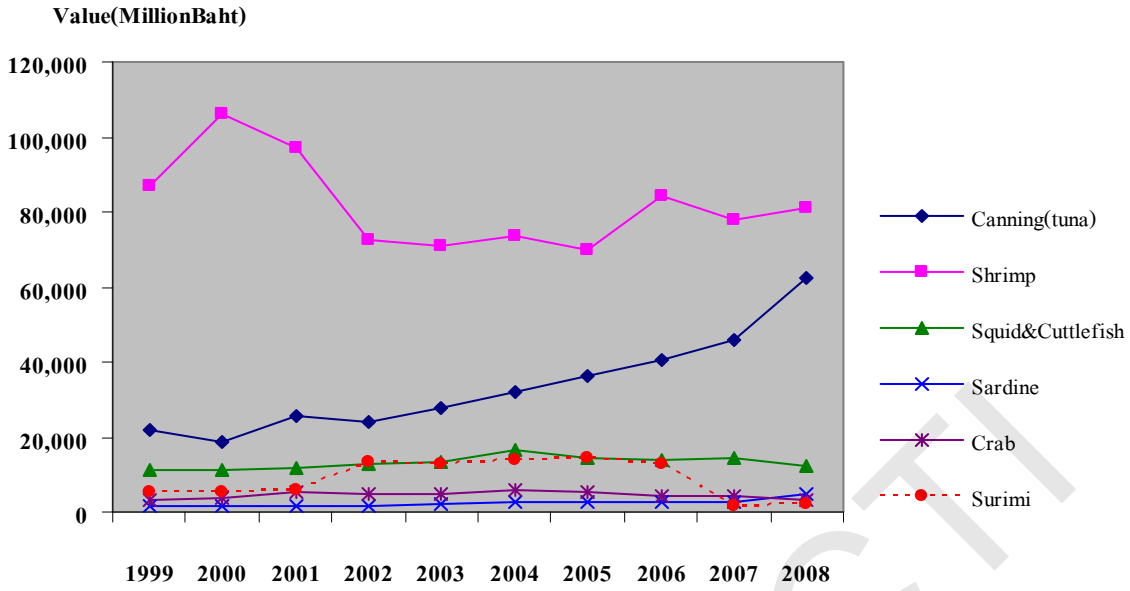


Figure 22. : The values of fish exports by type of commodities, 1999-2008.

3. General condition of coastal trawl resources

3.1 Status of stock of coastal trawl resources

Coastal trawl resources in the Gulf of Thailand are mainly considered on the demersal economical value fish e.g. lizard fish, threadfin bream, bigeye and low value trash fish of miscellaneous species both economical and non economical species with small sizes. The stock assessments are mostly done on the economic species in terms of species groups and individual species. In this connection, the demersal fish stocks have been assessed by several researchers, in several occasions and several options as indicated in Tables 8 and 9. All of assessments showed overexploitation.

Table 8. The marine cpture fisheries resources and the status of the stocks.

Marine Fisheries Resources	Present level, 1994 (tons)	Status of the Stocks	Area concerned	References
Total Pelagic Fish	**643,855**		**Gulf of Thailand**	
Rastrelliger brachysoma	82,021	MSY 79,651: F_{MSY} 339,755 days PS: Areas 2,3	Gulf of Thailand	Tantisawetrat et al, 1994
Rastrelliger brachysoma		MSY 72,693: F_{MSY} 95,327 days GPS :Areas 2,3	Gulf of Thailand	FAO, 1995
Rastrelliger kanagurta	50,898	MSY 32,836: F_{MSY} 130,644 days	Gulf of Thailand	Chutaget, 1997
Rastrelliger kanagurta		MSY 32,866: F_{MSY} at X-Factor 2.0:Areas 2,3	Gulf of Thailand	Tantisawetrat, 1996
Rastrelliger kanagurta		MSY 32,533: F_{MSY} 112,502 days:Areas 2,3	Gulf of Thailand	Tantisawetrat, 1996
Stolephorus spp	102,729	MSY 101,000: F_{MSY} 52,946 days	Gulf of Thailand	Vattanakul, 1994
Stolephorus spp		MSY 96,210: F_{MSY} 78,634 days	Gulf of Thailand	Patiyasevi, 1997
Stolephorus heterolobus		MSY 49,078	East Coast of Gulf of THA	Yoosuksawat, 1991
Total Demersal Fish	**191,348**	**MSY 136,300 :F_{MSY} 10,110,000 hrs RV trawlers**	**Gulf of Thailand**	**FAO, 1995**

Table 8. (Continue). The marine capture fisheries resources and the status of the stocks.

Marine Fisheries Resources	Present level, 1994 (tons)	Status of the Stocks	Area concerned	References
Nemipterus spp	55,850	MSY 20,900 :F_{MSY} 9,300,000 hrs RV (9 imp.gears)	Gulf of Thailand	FAO, 1995
Nemipterus hexodon		MSY 17,615 :F_{MSY} 14,429,754 hrs (OBT14-18m)	Gulf of Thailand	Isara, 1996
Nemipterus hexodon		MSY 21,697: F_{MSY} at X-Factor 0.54	Gulf of Thailand	FAO, 1995
Saurida spp	35,593	MSY 20,900: F_{MSY} 6,600,000 hrs RV (9 imp.gears)	Gulf of Thailand	FAO, 1995
Saurida undosquamis		MSY 21,303: F_{MSY} at X-Factor 0.36	Gulf of Thailand	FAO, 1995
Saurida elongata		MSY 2,250: F_{MSY} at X-Factor 0.46	Gulf of Thailand	FAO, 1995
Priacanthus spp	44,680	MSY 17,400: F_{MSY} 7,600,000 hrs RV (9 imp.gears)	Gulf of Thailand	FAO, 1995
Priacanthus tayenus		MSY 55,915: F_{MSY} at X-Factor 0.31	Gulf of Thailand	FAO, 1995
Trashfish	**661,080**	**MSY 615,800 :F_{MSY} 49,400,000 hrs RV**	**Gulf of Thailand (9 imp.gears)**	**FAO, 1995**
Squid		MSY 41,000 (1972-1981)	Gulf of Thailand	Supongpan and Kongmuag, 1981
Squid	55,762	MSY 6,7000 (1972-1991)	Gulf of Thailand	Supongpan, 1993
Loligo duvauceli male		MSY 30,400 X-factor 0.9	Gulf of Thailand	Supongpan, 1996
Loligo duvauceli female		MSY 21,600 X-factor 0.8	Gulf of Thailand	Supongpan, 1996
Cutttlefish		MSY 2,5000 (1972-1981)	Gulf of Thailand	Supongpan and Kongmuag, 1981
Cutttlefish	41,987	MSY 35,000 (1972-1991)	Gulf of Thailand	Supongpan, 1993
Octopus		MSY 4,900 (1972-1981)	Gulf of Thailand	Supongpan and Kongmuag, 1981
Octopus	11,282	MSY 8,500 (1972-1991)	Gulf of Thailand	Supongpan, 1993
Metapenaeus affinis		MSY 12,300; 14,700,000 hrs OBT<14m.	Gulf of Thailand	Vibhasiri,1995
Total Pelagic Fish	**309,814**	**MSY 136,602: F_{MSY} 79,591 days (9 imp.gears)**	**Andaman Sea**	**Patiyasevi, 1997**
Rastrelliger brachysoma		MSY 15,256: F_{MSY} 31,485 days PS	Southern Andaman Sea	Boonragsa and Chanasit, 1995
Rastrelliger brachysoma	65,499	MSY 23,765: F_{MSY} 70,059days PS (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Rastrelliger kanagurta	13,695	MSY 5,899: F_{MSY} 32,643 days	Andaman Sea	Patiyasevi, 1997
Small tunas	31,182	MSY 8,651 :F_{MSY} 71,104 days (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Spanish Mackerels	6,473	MSY 2,213:F_{MSY} 31,004 days (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Decapterus spp	35,994	MSY 15,728:F_{MSY} 74,680 days (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Sardines	29,455	MSY 31,641:F_{MSY} 42,119 days	Andaman Sea	Patiyasevi, 1997
Sardines	29,455	MSY 36,228	Andaman Sea	Saikliang and Boonragsa, 1997
Total Demersal Fish	**37,347**	**MSY 17,758 :F_{MSY} 357,646 days (9 imp.gears)**	**Andaman Sea**	**Patiyasevi, 1997**
Nemipterus spp	19,260	MSY 5,909 :F_{MSY} 268,803 (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Priacanthus spp	7,614	MSY 1,100: F_{MSY} 308,968 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Croakers	15,396	MSY 5,909: F_{MSY} 268,803 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Barracudas	5,487	MSY 2,407: F_{MSY} 380,659 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Trashfish	**269,466**	**MSY 179,861: F_{MSY} 290,481 hrs (9 imp.gears)**	**Andaman Sea**	**Patiyasevi, 1997**
Squid	16,464	MSY 6,579 :F_{MSY} 326,929 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Cutttlefish	14,333	MSY 6,497 :F_{MSY} 300,299 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997
Shrimp	8,912	MSY 9,073 :F_{MSY} 267,825 hrs (9 imp.gears)	Andaman Sea	Patiyasevi, 1997

Remarks: 9 important gear = Otter board trawl, pair trawl, beam trawl, purse seine, anchovy purse seine, King mackerel drift gill net, mackerel encircling gill net, push net and bamboo stake trap.

Table 9 . Summary of MSY and f_{MSY} estimates for the Gulf of Thailand (Kongprom *et.al*,2003).

Group	MSY (t)	fMSY* ($x10^6$hr)	Years	References
Total (All species groups and all types of gear; including small scale fisheries)	2 159 049	64.25	1971 - 95	Fox Model (Kongprom *et.al*., 2003).
Trash fish (including small scale fisheries)	818 722	61.76	1971 - 95	Fox Model (Kongprom *et.al*., 2003).
Pelagic fish (including small scale fisheries)	624 318	295.55	1971 - 95	Fox Model (Kongprom *et.al*., 2003).
Demersal fish (All types of gear, including small scale fisheries)	196 953	19.99	1971 - 95	Fox Model (Kongprom *et.al.,* 2003).
Demersal fish (11 major types of gear**, excluding small scale fisheries)	136 300	10.1	1971 - 91	Demersal Fish Working Group (DFWG), 1995.
Demersal group (Demersal fish and trashfish combined; including small scale fisheries)	970 905	35.65	1971 - 95	Fox Model (Kongprom *et.al*., 2003).
	944 632	23.3***	1973 - 97	Fox Model (Boonchuwong and Dechboon, 2003.
	1 036 428	23.9***	1973 - 97	Schaefer model (FAO, 2001).
Demersal group (Demersal fish, trash fish and invertebrates combined; excluding small scale fisheries)	884 202	28.6	1972 - 89	Fox Model (Boonvanich, 1993).

Note: * refers to standard research vessel units unless specified otherwise.
** refers to otter board trawl, pair trawl, beam trawl, push net, three purse seines (Light luring, Thai, green), anchovy purse seine, mackerel encircling gillnet, king mackerel gillnet, bamboo stake trap.
*** refers to standard commercial boat units**.**

Recently, Kongprom *et.al*., 2008 has assessed demersal fish caught by trawl fisheries in the Gulf of Thailand, the assessment gives the Maximum Sustainable Yield (MSY) of 277,027 metric ton at optimum fishing effort (f_{MSY}) of $31.4*10^6$ trawling hour. Demersal catches in 2005 amounted for 315,418 with the using effort of $49.3*10^6$ hr which means the catches of demersal fish was overexploited about 14% and effort was over used about 57% of the MSY and optimal levels, respectively. Trash fish was also over exploited it showed that trash fish catches were caught less about 43% from MSY with effort using less than optimal level 32%.

The estimations of the exploitation rates (E=F/Z) of 15 species of trash fish based on length frequency from 4 periods (1971, 1981, 1991 and 1995). It was shown that the exploitation rates of these 15 species increased from time to time and almost reached its exploitation rates at 83-98% except few species (*Scolopsis* and *Megalaspis*) that the exploitation rates were still low. From theoretical point of views, most fish stocks should have the exploitation rates less than 0.5, at this level the fish stock can reproduce itself to compensate for their capture. From the results almost fish stocks were severely over exploited, the stocks have been fished almost 100% and the stocks almost collapsed, especially for the juvenile fish in trash fish components (Kongprom *et. al*., 2003) (Table 10).

Table 10. Estimates of exploitation rates based on length frequency assessment for 15 species caught as trash fish (derived from Kongprom *et. al*., 2003).

Family	Species	1971	1981	1991	1995
Carangidae	*Atule mate*	0.14	0.53	0.74	0.83
	Megalaspis cordyla	0.07 (1975)	0.19	0.31	0.39
Lutjanidae	*Lutjanus lineolatus*	0.30	0.49	0.81	0.86
Nemipteridae	*Nemipterus nematophorus*	0.31	0.50	0.90	0.98
	Nemipterus hexodon	0.18	0.33	0.84	0.97
	Nemipterus mesoprion	0.22	0.38	0.87	0.96
	Nemipterus peronii	0.19	0.34	0.84	0.92
	Scolopsis taeniopterus	0.26	0.06	0.09	0.02
Priacanthidae	*Priacanthus tayenus*	0.19	0.20	0.63	0.95
Scombridae	*Rastrelliger brachysoma*	0.63	0.80	0.95	0.95
	Rastrelliger kanagurta	0.54 (1972)	0.60	0.92	0.94
	Scomberomorus commerson	0.62 (1975)	0.82	0.75	0.87
Synodontidae	*Saurida elongata*	0.31	0.28	0.58	0.87
	Saurida undosquamis	0.31	0.28	0.59	0.89
Trichiuridae	*Trichiurus lepturus*	0.44	0.82	0.73	0.95

Table 11. Growth and mortality estimates for demersal fish (Kongprom *et.al*., 2005).

Species	$L\infty$ (cm)	K (yr^{-1})	M (yr^{-1})	F (yr^{-1})	Z (yr^{-1})	E (yr^{-1})
Priacantus tayenus	30.0	1.2	2.1	4.3	6.3	0.7
Nemipterus hexodon	30.7	1.6	2.5	3.9	6.4	0.6
N. furcosus	28.8	1.6	2.5	2.6	5.1	0.5
Saurida elongata	44.1	1.6	2.2	3.7	6.0	0.6
S. undosquamis	39.3	1.3	2.0	5.2	7.2	0.7
Leiognathus bindus	10.0	0.9	2.3	3.1	5.4	0.6
L. spendens	12.3	1.0	2.3	2.8	5.1	0.5

Notes: $L\infty$ = Length at infinity, K = growth parameter, M = Natural Mortality rate, F = Fishing mortality rate, Z = Total mortality rate (=F+M), E = Exploitation rate (= F/Z).

Kongprom *et.al*, 2005 have assessed seven species of demersal fish based on length frequency, it was found that the exploitation rates of economic sizes of demersal fish caught were ranging 0.5 to 0.7. It means that the demersal fish stocks of several species showed recovery and having better states than previous estimations in 2003 (Tables 10 and 11).

3.2 Quantities of low value / trash fish captured

Figure 23 shows landing, value and price per kg of trash fish caught in Thailand during 1971 to 2003. The trash fish production was fluctuated and recently the production decreased due to over fishing states for both economic juvenile and true trash fish stocks. The value of trash fish were also fluctuated and showed a bit higher due to the price per kg was higher. Trash fish production from trawlers in GOT during 1971 to 2007 showed highest peak at 774,874 metric ton in 1990 then decline to 321,136 mt in 2007 (Fig. 24).

The decreasing trend of trash fish production might be affected by overexploitation of economic juvenile fish and true trash fish with a long time evidences. Further the fishers who catch less big fish trying to catch more trash fish to compensate their benefit by using smaller mesh and or twine mesh (double thread mesh for more strong and rigid mesh).

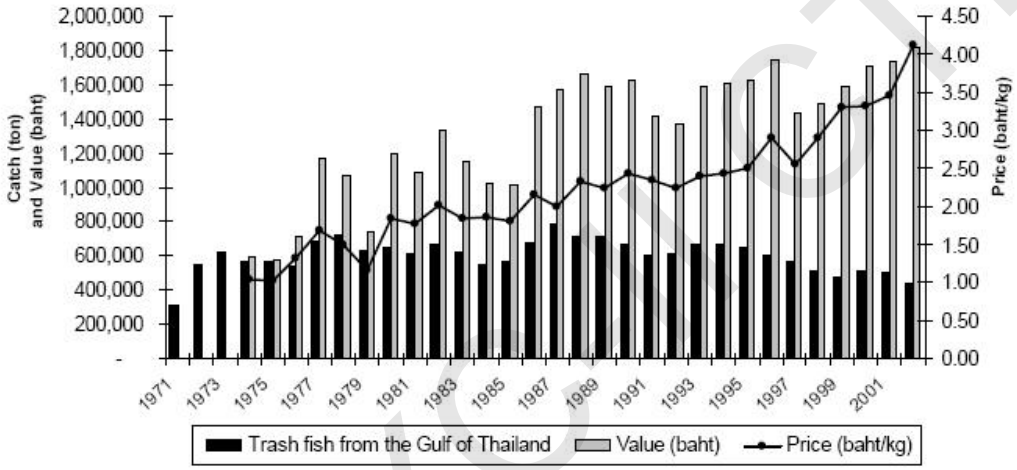


Figure 23. Landing and value of trash fish in the Gulf of Thailand, 1971-2003. (Khemakorn *et. al*., 2005).

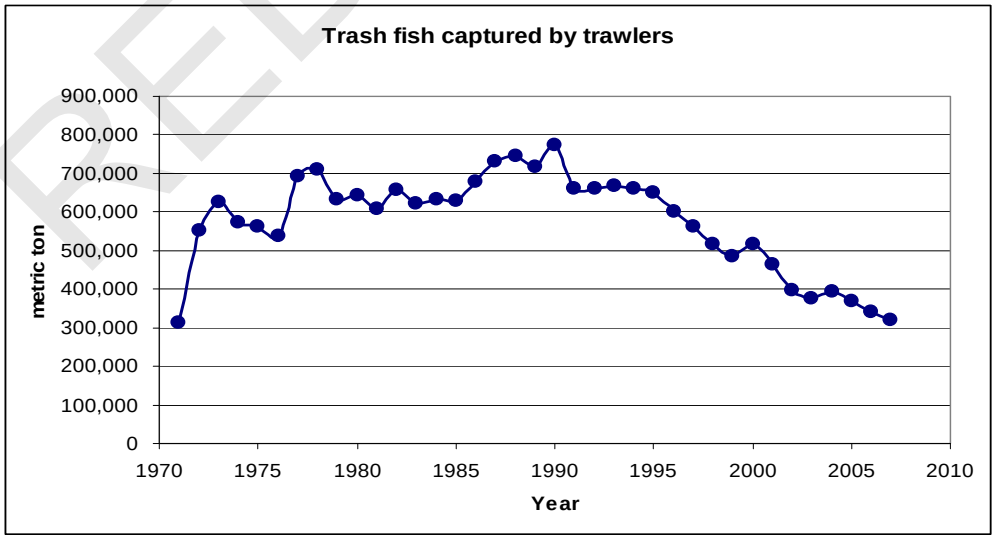


Figure 24. Trash fish production caught by trawlers in the Gulf of Thailand, 1971-2007.

Table 12. Trash fish used in fish meal production, whole country 1987-2004 (Lymer *et.al*., 2008). Unit in metric ton.

Year	Quantity used in fish meal production			Total	Total fish meal production	No. of plants
	Trash fish	Other food fish	Fish left over from processing			
1987	838 184	56 332	–	894 516	212 980	95
1988	888 774	55 006	–	943 780	236 892	96
1989	1 012 708	58 317	–	1 071 025	268 524	98
1990	1 022 106	64 919	–	1 087 025	285 042	104
1991	1 029 852	85 446	–	1 115 298	279 949	98
1992	1 295 104	94 417	–	1 389 521	348 624	106
1993	1 304 249	70 434	–	1 374 683	344 599	115
1994	1 473 138	82 083	–	1 555 221	389 885	118
1995	1 749 608	47 065	–	1 796 673	449 788	122
1996	1 652 688	45 230	–	1 697 918	425 075	118
1997	799 814	45 756	670 187	1 515 757	378 940	111
1998	758 465	53 841	511 581	1 323 887	342 438	97
1999	755 382	57 464	388 987	1 201 833	309 248	98
2000	725 489	62 675	358 927	1 147 091	299 073	96
2001	722 109	56 363	659 259	1 437 731	378 352	93
2002	679 640	59 908	768 096	1 507 644	391 583	93
2003	695 999	63 668	769 361	1 529 028	392 312	100
2004	771 723	112 586	671 641	1 555 950	423 866	95

Note: The quantity of trash fish before year 1997 included the fish left over from processing.

The quantity used in fish meal production comprised trash fish, other food fish (low value) and fish left from processing plants. Table 12 also shows the total fish meal production and number of fish meal plants from the years 1987 to 2004. In 2007 the fish meal plants have decreased to 71 plants.

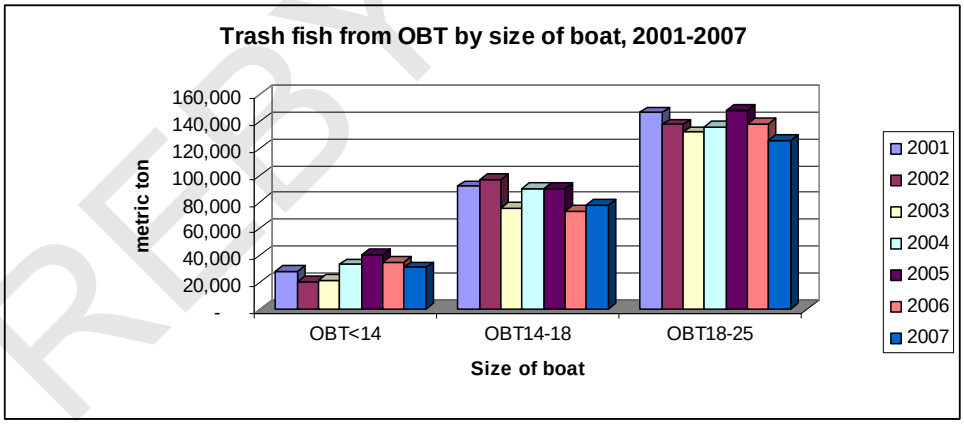


Figure 25. Trashfish caught by otter board trawlers categorized into size of boats.

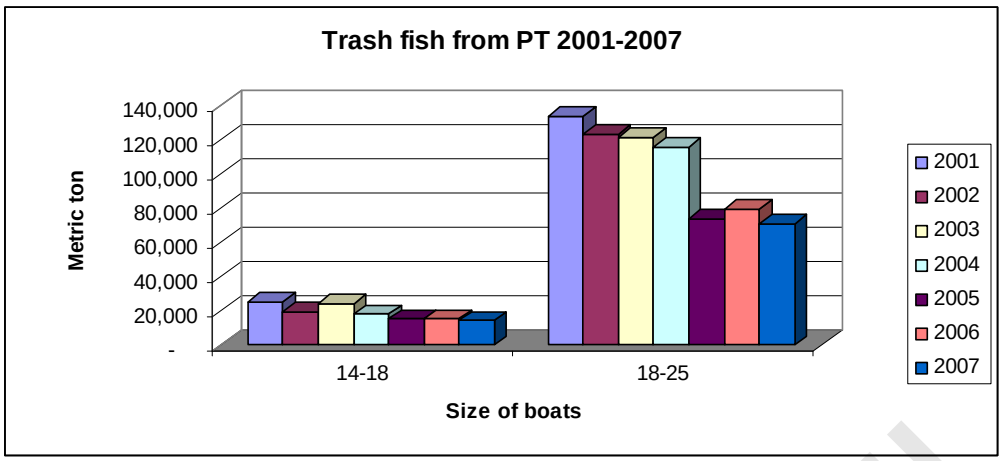


Figure 26. Trashfish caught by pair trawlers categorized into size of boats**.**

Table 13. Percentage of commercial economic fish and trash fish caught by trawlers in the Gulf of Thailand.

Trawlers	**1976-1981**	**1989-1993**	**2003-2005**
OBT<14 m			
%Economic fish	51.8	47.5	50.0
% Trashfish	48.2	52.2	50.0
OBT 14-18 m			
%Economic fish	41.6	33.9	50.9
% Trashfish	58.4	66.1	49.1
PT			
%Economic fish	42.3	55.0	63.9
% Trashfish	57.7	45.0	36.1
Sources	Supongpan and Kongmuag (1976-1981)	Isara (1996)	Kongprom *et.al*., 2008)

Figures 25 and 26 show trash fish caught by otter board and pair trawlers categorized by size of boats. It is shown that the bigger size boat can catch more trash fish both in otter board and pair trawlers. Table 13 shows the percentage of economic fish and trash fish caught by commercial trawlers in three periods. The first period (1976-1981), the percentage of trash fish caught ranging 48-58; the second period (1989-1993), the percentage of trash fish caught ranging 45-66; and the third period (2003-2005), the percentage of trash fish caught ranging 36-50. It was noticeable that the second period has more percentage of trash fish and the third period the percentage was down. For overall view, trawler caught economic fish in an average 49% and trashfish 51%. Table 14 shows economic juvenile fish in the trash fish component caught by trawlers was ranging 31-48%. Pair trawler could catch more percentage of economic juvenile fish than otter board trawl.

Table 14. CPUE and percentage of economic big size fish, economic juvenile fish in trash fish component and true trash fish caught by trawlers in the upper Gulf of Thailand, 1994- 1996.

	OBT<14m		**OBT 14-18 m**		**PT**	
Fish group	**kg/hr**	**%**	**kg/hr**	**%**	**kg/hr**	**%**
Demersal	3.9	20	3.0	12	27.7	14
Pelagic	0.4	2	0.3	1	66.7	34
Cephalopod	2.1	11	2.2	9	16.1	8
Shrimp	3.4	18	2.8	11	0.0	0
Crab	0.9	5	0.7	3	0.7	0
Other	0.2	0.9	0.0	0	0.3	0
Subtotal Economic big size fish	**10.9**	**56**	**9.1**	**37**	**111.6**	**57**
Small economic juvenile demersal fish	1.3	6		11		8
Small economic juvenile pelagic fish	0.2	1	0.4	2	35.6	18
Cephalopod	0.4	2	0.4	2	2.8	1
Shrimp	0.5	2	0.3	1	0.6	0
Crab	0.0	0	0.2	1	0.1	0
Other	1.2	6	0.7	3	0.8	0
Subtotal econ juvenile in trash fish	3.6	17	2.0	19	39.9	28
Subtotal True trash fish	5.0	26	10.7	44	29.3	15
Subtotal trash fish	**8.4**	**44**	**15.3**	**63**	**85.2**	**43**
Total	**19.3**	**100**	**24.3**	**100**	**196.8**	**100**

Source: Isara and Phoonsawat, 2002.

Sizes of juvenile fish in the component of trash fish are varied among sizes of trawlers e.g. pair trawlers and big sizes otter board trawlers which fished in deeper zones and farther, the dominant of fish species as well as method of fishing, which resulted to catch bigger sizes juvenile fish. These evidences may cause by area of fishing which is close to shallow areas or not. In shallow water, there are much more economic juvenile fish than in deeper zone. The sizes of fish are also smaller. From sampling surveys during 2003-2005 (Kongprom *et.al*.,2008), both in the Gulf of Thailand and in the Andaman Sea, the sizes of economic juvenile of demersal fish can be categorized into 3 species groups as follows:

1) Lizard fish, size ranged 6-19 cm;
2) Bigeye, size ranged 6-19 cm and
3) Threadfin bream, size ranged 4-21 cm.

4. Scope of project

4.1 Problems and Issues

- **Demersal resources caught by trawl fishery are over exploited;**

The demersal fish caught by trawl fisheries in the Gulf of Thailand were overexploited about 14% of it maximum sustainable level and the effort using was over 57% of its optimal level comparing to the year 2005 catches. Trash fish was also over exploited resulted trash fish catches were caught less about 43% from previous recorded.

The exploitation rates of 15 species of trash fish from trawl fisheries increased and almost reached its exploitation rates at 83-98% except few species. High exploitation rates indicated heavily exploitation and the stocks may finally collapse.

- **Excessive fishing effort in the present fisheries;**

The fishing effort of trawl fisheries was over its optimal level about 57% which basically estimated from registered number. The excess fishing effort is also causing from illegal fishing boats (no registered, no license). Free fishing of small scale fishing boats will be needed to register in near future.

By nature, effort and catch management have to span the whole fishery. Small sized resources might be managed on a local basis but the larger, more extensive, resources have to have their management agreed centrally.

- **Small sized economic and juvenile fish are used as low value fish for fish meal;**

High percentage of juvenile economic fish species was caught in trash fish component which used to make fish meal. If we left these economic juvenile fish grow for few months, they will give more weight and bigger sizes with valuable prices. These juvenile economic species comprise demersal fish group, pelagic fish group and invertebrate group.

- **Codend mesh sizes are too small in the trawl fisheries;**

Trawlers have been using small mesh size cod end to catch fish. Usually trawlers have used 2.5 cm mesh (stretch mesh) but in some places they have modified to use smaller mesh and double twine which could catch more small fish.

- **Illegal fishing is still occurred;**

Illegal fishing is still occurred by no registration and no licensing, some have different licenses from actual fishing. Monitoring and enforcement are expensive issues causing to not efficient to monitor and enforce.

- **Sea bottom is destructive by trawling activities;**

Sea bottom is destructive by trawling activities over the coastal zones of the Gulf. Benthic organisms are initial steps for food chain of the ecosystem which serve higher trophic level.

- **Introduction for Ecosystem-based management into the way fisheries are managed, and includes efforts to:**
  a). reduce fishing capacity to levels that marine ecosystems can sustain;
  b). reduce fishing pressure to allow over-exploited fish populations to recover and ensure the maintenance of healthy populations;
  c). strengthen fisheries policy;
  d). promote fairer Fisheries Partnership Agreements;
  e). reduce illegal fishing;

f). one key aspect of ecosystem based management (EBM) is that it recognizes the economic, social, and cultural interest of all stakeholders in a fishery and how these interests affect resource management. By managing human issues and impacts, the EBM approach to fisheries is more likely to succeed where many other initiatives have failed-leading to healthy, sustainable fisheries and restored marine ecosystems and

g) create MPAs, no-take zones, and seasonal closures around important spawning and nursery sites to help depleted local fisheries recover and reduce the impact of fisheries on marine life**.**

- **Taking people into account;**

Recently, people participated in policy and legal framework formulation is more important that the government can clearly solve local problems and issues. The people can involve, participate or cooperative in terms of attending in various meeting, workshop, conference at local, national and international levels. Next step, people can help to take care and heal natural resources for themselves.

- **Long-lasting improvements to fisheries management need to be underpinned by clear changes to fisheries policy;**

The Department of Fisheries has formulated Master Plan for Marine Fisheries Management and Action Plan for ten years which is divided into two five year periods. The clear policy will be a pin point to more effective management.

- **Acceptance from private sector and stakeholder**

Building acceptance from private sector and stakeholder would be better for management at local and central levels.

- **promote Fisheries Partnership Agreements that:**

  - respect sustainable fishing levels;
  - account for environmental costs;
  - protect local fishers;
  - include compliance with flag state laws;
  - are based on best practice fisheries management;
  - include cooperation on research and monitoring;
  - ensure adequate monitoring and enforcement capacity and
  - ensure fairer sharing of economic benefits between producer and extractor nations

4.2 Proposed scope of the project:

- **Location and types of fisheries**

The scope of the project will be covered the Gulf of Thailand and will be concentrated at some relevant local areas. Types of fisheries will cover otter board trawler and pair trawler including closed area and closed season. Using VPS for monitoring and enforce is also proposed.

- **Problems to be addressed**

  1). How to propose by catch management measures which are acceptance by stakeholder and can be practices by fishers? The management measures should be easily monitored and enforced.

  2). Acceptance for excessive number of fishing boat by fisher/stakeholder and it should be reduced in some numbers.

  3). Acceptance for loss in capturing juvenile fish at large and the fishers' loss in fitting some devices in trawl gear (MS enlargement, JTED fitting).

  4). Enlarge cod end mesh size, who is loss and who is gain? Acceptance from fisher/stakeholder is highly appreciated.

  5). Protected for sea bottom by artificial reef installation, and establish community based fishery management using MCS or VMS.

  6). More closed area and closed season to protect ecosystem, larvae and spawner.

  7). Initiate and promote VPS system in monitoring and enforcement.

- **Beneficiaries and stakeholders**

The beneficiaries and stakeholder will be trawler fishers, all fishers at large, local people around the site, fish agent, fish processing plant and fish meal plant that can have good quality fish and has more protein content in fish meal product.

4.3 Justification for the choice of project scope:

- How will it solve (part of) the stated problem:

  a) Reduce percentage of trash fish capture especially juvenile economic species;

  b) Demersal resource will be recovered;

  c) More closed area and closed season to alternate over the Gulf which more juvenile and spawners will be protected;

  d) Local community will cooperate in VPS system, and using VPS to strengthening the management system.

- How does it relate to country priorities/ national and regional policies and strategies:
  The project scope is already formulated in the Plan of Action of the Master Plan for Marine Fisheries Management of the Department of Fisheries.

- Representativeness – nationally and regionally:
  The proposed project is coincided to the national and regional policy to manage bycatch trawl fisheries and fishing capacity management including to serving as good ecosystem.

- Challenges and opportunities:

  The proposal project has collaboration from GEF/SEAFDEC/DOF/FAT which is good opportunity for implementation. The fisher/association collaboration in experiments and demonstrations of changing mesh size, install JTED and VPS are challenges.

SECTION 2: BASELINE DATA

I. Major fishing ports or landing sites.

The Fish Marketing Organization has constructed the fishing piers along the Gulf of Thailand and in the Andaman Sea sides. In the Gulf of Thailand there were 14 fishing piers in 1995 and 18 in 2000 to 2005 at various provinces (Table 15) from FMO. The private fishing piers were 657 in 1995; 524 in 2000 and decreased to 223 in 2005.

Table 15. Number of fishing piers of Fish Marketing Organization and private fishing piers.

	1995	**1995**	**2000**	**2000**	**2000**	**2005**
Provinces	**FMO[1]**	**Private[2]**	**FMO[1]**	**Private[3]**	**Other gov[4]**	**Private[3]**
Trad	1	45	1	27	15	10
Chantaburi		20		12	13	8
Rayong		13		60	6	32
Chonburi	1	19	1	30	8	13
Chachoengsao		7		5	2	3
Samutprakan	1	12	1	1		2
Bangkok			1			
Samutsakhon	1	5	1	9	9	2
Samuthsongklam		10		6	10	2
Petchaburi		8		5	10	6
Prachuab Kiri Khan	1	21	2	25	11	16
Chumporn	1	55	2	25	13	12
Surat Thani	1	32	1	40	10	7
Nakorn Sri Thammarat	1	93	1	70	7	24
Pattalung		3				
Songkhla	1	10	2	1	5	4
Pattani	1	9	1	35	3	
Narathivat		0	1	7		
Ranong	1	60	1	50	14	10
Phang-Nga		77		20	12	27
Phuket	1	25	1	13	3	7
Krabi		46		23	8	12
Trang	1	41		20	16	11
Satun		46	1	40	18	15
Grand total	**14**	**657**	**18**	**524**	**193**	**223**

[1] Fish Marketing Organization
[2] National Statistic Office
[3] Marine Department
[4] Small scale fishing piers provided by DOF and other relevant org.

The Department of Fisheries has launched the Small Scale Fisheries Development Project in the National Social and Economic Development Plan VI (1988-1992) and the project has been highlighted until 2003. The project has provided fishing facility by constructing local fishing pier as an example by requesting from fishers. During the projects, the overall fishing piers in total numbers were 193 piers in 2000. Recently all of the small scale fishing piers will be transferred to local authorities (Ao Bo To) to take care and facilitate for small scale fishers.

In 2006, there are a total of 850 fishing/landing ports scattered along the sea coasts in various coastal provinces in the Gulf of Thailand. Among these ports, 651 of them are used by small scale fishermen, while 199 ports cater to commercial fisheries. The Fish Marketing Organization (FMO) operates 9 of these landing ports. Landings at the 9 FMO fishing ports amount to 17.2% of all marine catch; they are sorted and recorded by species and types of the catch. The FMO also keeps the monthly records on the quantity of the catch landed by various types of fishing gear, no records on the fishing grounds are made. No record keeping has been found in any private-owned fishing piers, nonetheless information can be provided on request. Apart from these, five more ports that facilitate both cargo and fishing vessels, largely from overseas, are in operation.

In terms of quantities of fish landed, the following species are the most important: threadfin bream, Indo-Pacific mackerel, coastal tuna, bigeye snapper, squids, sardines, round scad and anchovies. In 2006, Songkhla, Pattani, Samut Sakorn, Nakorn Si Thammarat, and Trat were the largest ports in terms of both quantities and value of landings (Table 16).

Table 16 Fishing port by coastal provincein the Gulf of Thailand, 2006.

Province	**Total** (units)	**Small scale fishing port** (units)	**Commercial fishing port** (units)
*Bamgkok	1	-	1
Trat	112	101	11
Chantaburi	121	119	2
Rayong	94	53	41
Chulburi	36	26	10
Chachoengsao	5	5	-
*Samut Prakan	4	-	4
*Samut Sakhon	20	14	6
Samut Songkhram	3	1	2
Phetchaburi	16	10	6
*Prachuap Kiri Khan	28	8	20
*Chumporn	44	9	35
*Suratani	55	43	12
*Nakorn Si Thammarat	93	54	39
*Songkla	149	148	1
*Pattani	69	60	9
Total	**850**	**651**	**199**

Source: Information Technology Center, Department of Fisheries.
Note : * Including FMO fishing port.

II. Fishing grounds: areas of operation/fishing grounds, seabed types and depth ranges

The important and productive fishing grounds of Thailand are located within two Exclusive Economic Zones: the Gulf of Thailand and the Andaman Sea. The fishing grounds in the Gulf of Thailand have their southern boundary line extended to the line between Thailand and the Kingdom of Cambodia and that extends to the border line between Thailand and Malaysia. The total maritime area in the Gulf of Thailand north of this boundary line is 252,000 square kilometers. The majority of these fishing grounds are relatively shallow, their depths range between 20 to 30 meters. Their bottom soils are largely sandy loam, and dotted with areas of soft mud, fine sandy loam mixed with crushed mollusk shells. A rich supply of nutrients discharged into the Gulf is brought by various rivers, making the Gulf a rich body of water that supports plentitude of micro-organisms. The fishing grounds in the Gulf of Thailand and Andaman Sea are divided as statistical collection purposed into areas as follows (Fig. 27):

Area 1: Eastern Gulf of Thailand consists of the seas off the provinces of Trad, Chantaburi and Rayong.

Area 2: the Inner Gulf consists of the seas off the provinces of Chonburi, Chacheongsao, Samut Prakarn, Bangkok Metropolitan, Samut Sakorn, Samut Songkram, and Petchaburi.

Area 3: Upper western Gulf of Thailand consists of the seas off the provinces of Prachuab Kirikhan, Chumphon, and Surat Thani.

Area 4: Lower Western Gulf of Thailand consists of the seas off the provinces of Nakhon Sri Thammarat, Songkhla, Pattani and Narathiwas.

Area 5: Mid-Gulf of Thailand consists of the seas in the mid-Gulf that extend southward to the international boundary line between Thailand-Kingdom of Cambodia and Thailand-Malaysia.

The fishing grounds in the Andaman Sea span over an area of 126,000 square kilometers. They reach on their NW boundary line to the international boundary between Thailand and the Union of Myanmar and their southern boundary lines to the international boundary line between Thailand and Malaysia. The bottom of these fishing grounds is large slopes with a sharp declivity, featuring strong underwater currents that sweep through the relatively narrow continental shelves. The sea bottom is largely sandy loam. The fishing grounds in the Andaman Sea are subject to the influence of the SW monsoon rendering them less hospitable to fishing. Owing to hostile nature of the sea bottom and the prevailing strong winds from the monsoon, the Andaman fishing grounds can be divided into two major areas:

- ***Area 6:*** Upper Andaman Sea consists of the seas off the provinces of Ranong, Pang-nga, and Phuket.
- ***Area 7:*** Lower Andaman Sea consists of the seas off the provinces of Krabi, Trang, and Satun.

Areas A, B and C.D are fishing grounds beyond the EEZs of the country or in the high sea areas.

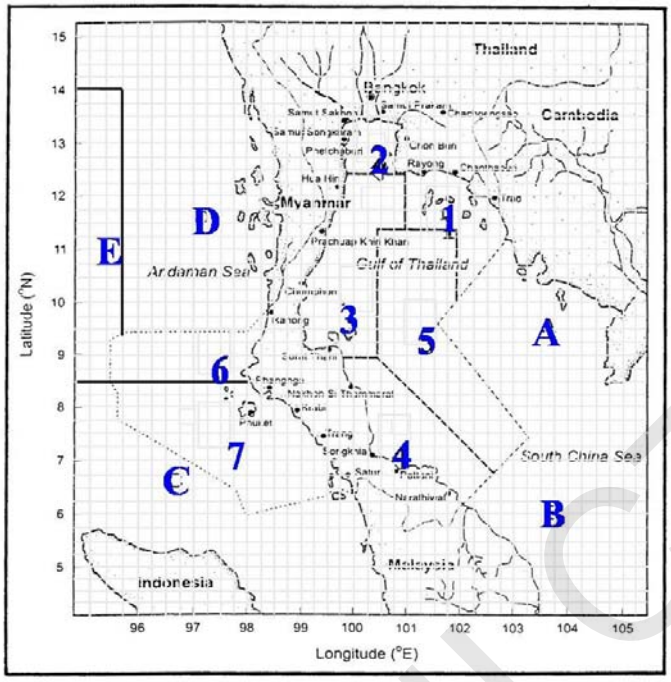


Figure 27. Fishing grounds in Thailand for fishery statistical purpose.

Owing to the problems facing Thailand stemming from the increasing degradation of aquatic resources, a number of Thai fishing fleets have been forced to venture farther outside the EEZ and to spend much longer time fishing. Thai fishing fleets are often sighted widely in the Southeast Asian and South Asian waters. It is known to Thai fishermen that fishing in the southern part of the South China Sea, in the Sunda continental shelf (southern part of the Socialist Republic of Vietnam), in the eastern part of Malaysia, Sarawak, Indonesian waters, Malacca Strait, Marid, Mohtama Bay, Arakan coast, southern Bangladesh, eastern coast of India, and Indian ocean. Since the 1970's, Thailand has been recognized as one of the distant water fishing nations.

III. Vessels: number of vessels and type and size of vessels

The 2000 inter-censal survey of the National Statistic Office found the overall number of marine fishing boats was 58,119, the majority of fishing boats was outboard engine or longtail engine boat 73% and inboard engine boat was 23% (Table 17). The remaining number was shared by non-motorized boat 4%. Most of inboard fishing vessels (11% of the total) were found to be small in size, their displacements were <10 gross metric tons. The medium size fishing vessels (with displacement between 10-49 gross metric tons) were found at 9% in number. Those with >50 gross metric tons displacement were scanty, their number made up to only 3% of the total. Comparing the number of fishing vessels between the two censuses (in 1995 and 2000), it was found that the total number of fishing vessels increased by 7%, it was found that while the outboard long-tail boats registered has increased during this period, the number of inboard engine boats went down by 13%. In terms of displacement, it can be said that while the small- and medium-sized fishing vessels reduced considerably in their numbers, the larger fishing vessels (with >50 gross metric tons displacement) increased by 9% over this period. As the number of non-motorized fishing vessels went down during the period between

the two censuses, it could be interpreted that progression was being made in improving the capacity of Thai fishing fleets. The trend showing a transformation of non-motorized boats to outboard long-tail engines, and small motorized boats were replaced by those with greater displacement. In reality, boat building yards appeared to put a greater number of larger fishing vessels into the fleets. Distant water fishing could be the factor influencing such the trend.

Table 17. Number of fishing boat by types of fishing gear and location, 1995 and 2000.

Location	The 1995 marine fisheries census						The 2000 marine fisheries Inter-censal					
	Total	Otter trawl	Pair trawl	Beam trawl	Push Net	Others	Total	Otter trawl	Pair trawl	Beam trawl	Push Net	Others
Total	54,538	4,880	1,318	1,028	3,591	43,721	58,119	4,162	1,001	403	3,791	48,762
Gulf of Thailand	37,665	3,881	1,187	999	2,471	29,127	36,968	3,609	836	372	2,046	30,105
Andaman Sea	16,873	999	131	29	1,120	14,594	21,151	553	165	31	1,745	18,657

Source: Information Technology Center, Department of Fisheries.

Most inboard engine fishing vessels were capable of fishing away from home ports. They were also equipped with efficient fishing gears, 39% were trawlers, 22% gillnetters, and 13% purse seiners or surrounding netters. It was found by the two censuses that the number of these inboard engine fishing vessels was decreasing in number.

The 2000 inter-censal survey found the total number of inboard motorized fishing vessels to be 13,263, among them 39% were trawlers, 22% gillnetters, 11% falling-netters, 8% purse-seiners, 7% push-netters, and the remaining 13% miscellaneous gears (Table 18). Comparing with the numbers of inboard motorized fishing vessels between the two censuses, it was found that a reduction of 13% in the total number was attributed to the reduction across the board of all types of fishing gear.

Table 18 Number of fishing boats by type and size, 2000.

	Total	Otter trawl	Pair trawl	Beam trawl	Push Net	Others
Total	**58,119**	**4,162**	**1,001**	**403**	**3,791**	**48,762**
Non-Motorized	2,639	-	-	-	-	2,639
Motorized	55,480	4,162	1,001	403	3,791	46,123
1) Out-board motorized	42,217	-	-	403	2,879	38,935
2) In-board motorized	13,263	4,162	1,001	0	912	7,188
< 10 gross metric tons	6,222	1,241	15	0	510	4,456
10 – 49 gross metric tons	5,064	1,873	502	0	393	2,296
> 50 gross metric tons	1,977	1,048	484	0	9	436

Source: Information Technology Center, Department of Fisheries.

In 2007, number fishing boat registered was of 13,056. The fishing gear registration in the Gulf of Thailand was 87% of the whole country. The fishing gear registration consist of otter trawl 23%, pair trawl 9%, beam trawl 0.3%, push net 4 % and others 64% (Table 19).

Table 19 Registration of fishing gear by size of boat in the Gulf of Thailand, 2007.

Size of fishing boat	No.of boat	No.of boat					
		Total	Otter trawl	Pair trawl	Beam trawl	Push Net	Others
Total	**13,056**	11,395	**2,580**	**1,062**	**37**	**430**	7,286
< 14 meters	6,118	5,463	770	8	19	305	4,361
14-18 meters	3,113	2,736	996	212	18	57	1,453
18-25 meters	3,697	3,087	795	833	0	67	1,392
> 25 meters	128	109	19	9	0	1	80

Source: Information Technology Center, Department of Fisheries.

Table 20. Number of fishing boats registered in the Gulf of Thailand 1970-2006.

Year	**OBT**	**PT**	**BT**	**PS**	**PN**	**OG**	**Total**
1970	2,210	442	430	53	354	850	4,339
1971	2,472	522	614	41	610	875	5,134
1972	3,185	702	599	66	1,327	916	6,795
1973	4,480	824	533	162	1,628	1,668	9,295
1974	4,074	854	343	192	1,213	1,454	8,130
1975	3,816	852	294	211	1,075	1,301	7,549
1976	4,088	832	284	317	844	2,614	8,979
1977	4,962	906	420	527	1,177	3,236	11,228
1978	5,110	854	489	593	1,426	3,897	12,369
1979	7,038	1,172	537	562	1,923	5,633	16,865
1980	8,131	1,230	1,060	632	2,262	6,047	19,362
1981	6,021	1,008	496	744	1,215	5,149	14,633
1982	9,358	1,406	711	734	1,899	5,542	19,650
1983	7,796	1,266	328	708	1,236	5,914	17,248
1984	7,769	1,166	196	337	960	4,954	15,382
1985	6,968	1,218	139	254	777	5,851	15,207
1986	6,226	1,084	97	285	664	6,849	15,205
1987	6,129	1,164	50	413	624	6,913	15,293
1988	5,766	1,132	50	519	531	6,613	14,611
1989	10,436	2,193	482	539	1,907	4,516	20,073
1990	10,256	2,193	456	405	1,879	5,134	20,323
1991	8,117	2,037	144	329	1,047	5,210	16,884
1992	7,538	1,876	51	270	818	5,085	15,638
1993	7,213	1,749	123	1,173	808	6,743	17,809
1994	6,482	1,708	156	1,163	651	7,149	17,309
1995	6,321	1,576	98	1,022	634	7,255	16,906
1996	6,840	1,843	285	905	776	6,929	17,578
1997	6,886	1,804	195	999	862	6,894	17,640
1998	7,050	1,820	291	966	861	7,128	18,116
1999	6,441	1,734	149	1,138	660	6,383	16,505
2000	6,154	1,682	172	990	638	7,145	16,781
2001	4,897	1,640	152	1,071	651	7,156	15,567
2002	4,952	1,544	179	1,260	632	6,931	15,498
2003	5,172	1,634	143	1,313	601	6,796	15,659
2004	4,896	1,410	133	1,355	545	7,749	16,088
2005	4,344	1,232	60	1,298	539	6,669	14,142
2006	3,306	1,257	42	1,171	438	4,762	10,976

Sources: Statistical record, Department of Fisheries, 1972-2009.
(OBT=otter board trawl, PT= pair trawl, BT=beam trawl, PS=purse seine,

PN=push net and OG=combination of all small scale fishing gear).

The number of all types of fishing boat registered in the Gulf of Thailand 1970 – 2006 are shown in Table 20. The registered number starting in 1970 was 4,399 for all sizes and types of fishing gear, the number gradually increased to be high number in 1980 with 19,362 then decreased with a fluctuated number until reached the highest number in 1990 with 20,323.

The number of fishing boats further decreased until 2006 having the number of 10,976. The biggest shared numbers were recognized to be otter board trawlers with numbers of 10,256 in 1990 and 10,436 in 1989. The smallest number was recognized to be beam trawl, the number were less than 60 in the recent year.

The Department of Fisheries has implemented the tenure system (or freezing number of fishing gear) since 1 November 1996. Owners of trawl gear (otter board trawl, otter boom trawl, pair trawl) have to continue their licenses every fishing year (1 April to 31 March of the following year). If there is no license fee payment and license continuation, that fishing gear is automatically quitted from trawl fishery. The license can be hereditable to the son only, no selling to other person. Only one type of gear on a motorized boat can be registered, (pair trawl can have two boats with one trawling gear). At the same time, the Minister of Agriculture and Cooperatives has issued a notification to limit entry of new trawl and push net boats. Resulted from the boat tenure system for trawlers, the registered numbers were stagnant and lower in the recent year. However there are some illegal trawling boats which the real number is unknown.

Number of registered trawlers in the Gulf of Thailand classified into OBT, PT, BT from 1967-2007 is shown in Fig. 28. The otter board trawlers have more number than others. The obviously peaks showed reopened for registration due to politic intervened. Anyhow the number has decline for the last three decades.

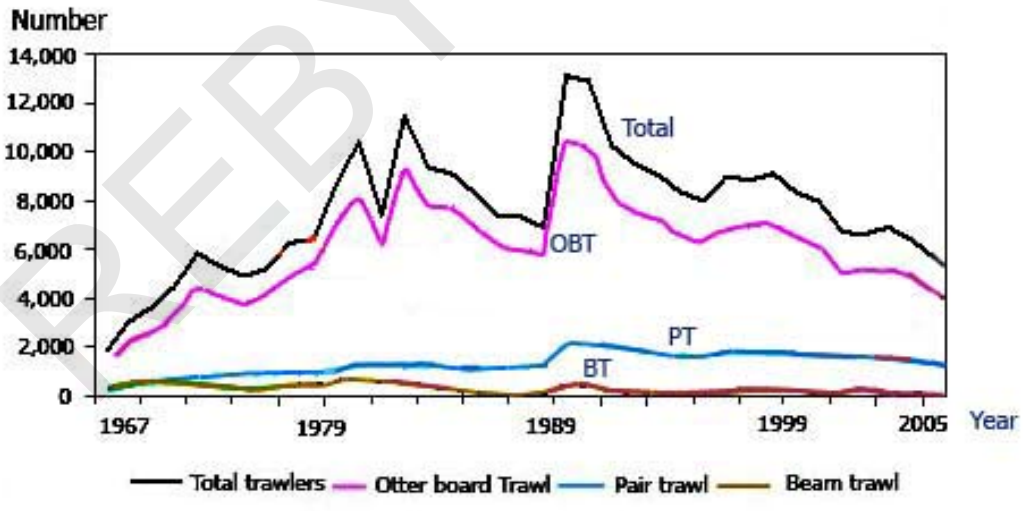


Figure 28. Number of registered trawlers in the Gulf of Thailand, 1967 to 2007.

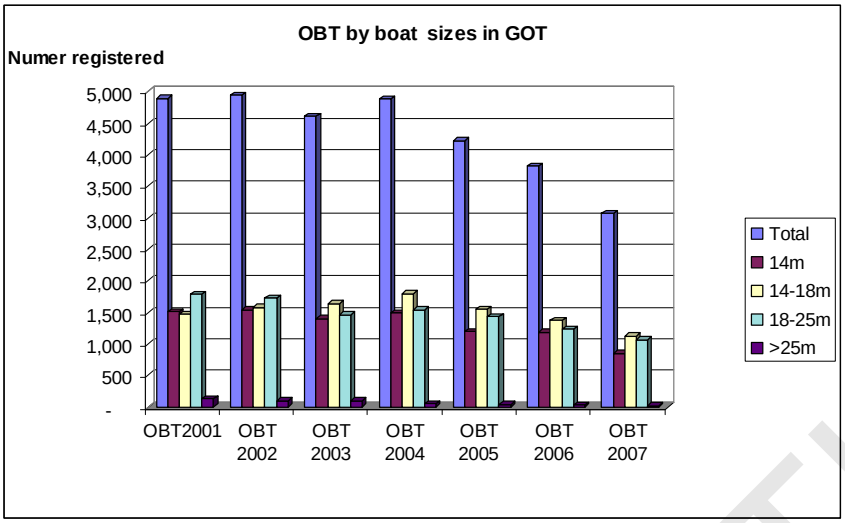


Figure 29. Registered otter board trawlers in the Gulf of Thailand, classified by sizes, 2001-2007.

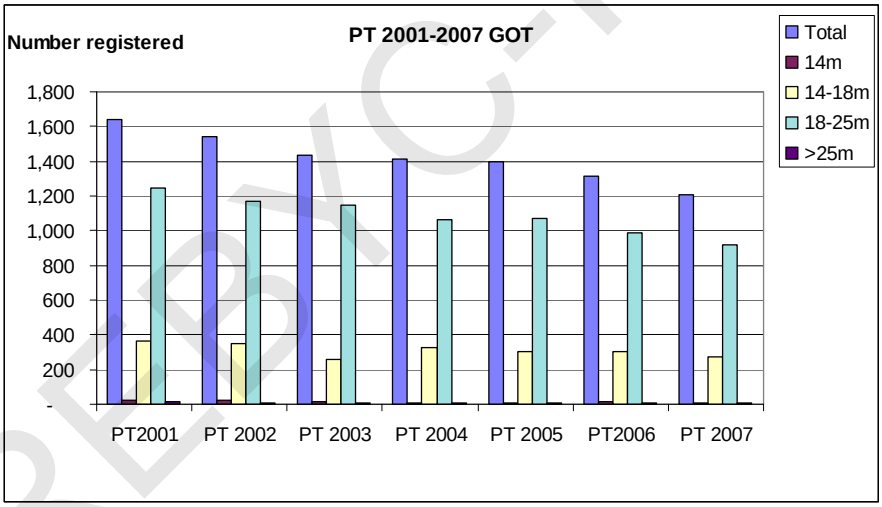


Figure 30. Registered pair trawlers in the Gulf of Thailand, classified by sizes, 2001-2007.

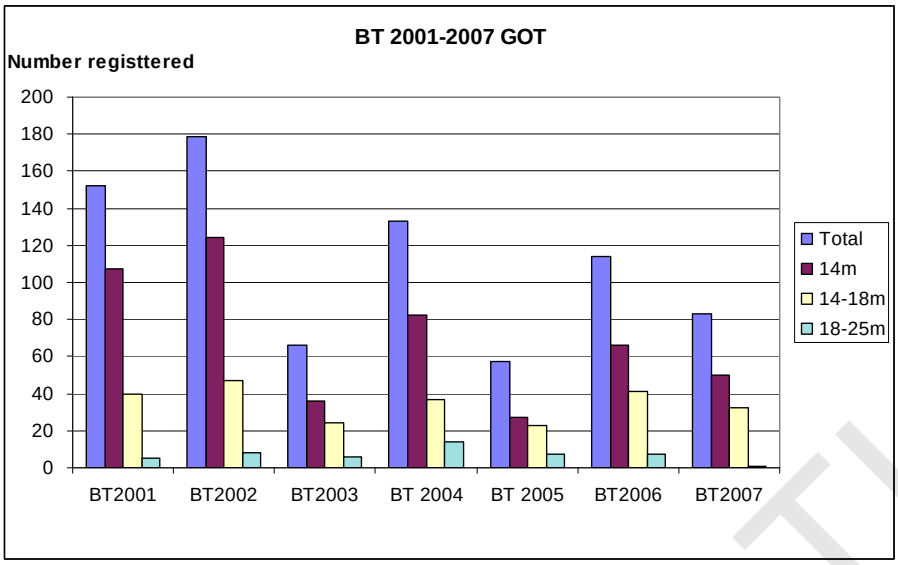


Figure 31. Registered beam trawler classified by sizes in the Gulf of Thailand, by size, 2001-2007.

When considering the size of fishing boats, the popular sizes of otter board trawlers were small (<14m), medium (14-18 m) and large (18-25 m) sizes whereas pair trawlers were large size. The beam trawlers were small size (Figs. 29, 30 and 31).

IV. Fishing gears and vessel arrangements

The registration of all kinds of vessels is responsible to the Marine Department whereas the fishing gear is responsible to the Department of Fisheries. In the Department of Fisheries case, the fishing vessel especially for trawl that has a tenure system to freeze the number of boats since then the registration of the trawling vessel is stagnant and has decreasing trend recently. From the statistical data of the Marine Department, the new boats registered as fishing boats were 819; 777 and 693 in 2006, 2007 and 2008 respectively. The total number of fishing boats for all kinds of fishing gear is 25,138 in 2009 which the small and medium sizes are more popular (Marine Department, 2009).

V. Ownership and crew structure (e.g. owner operated, hired crew or else)

Fisherman Occupation

From the study on social and economic of trawl and push net fisheries in the Gulf of Thailand (DOF, 2008), amount of 76% of the fishers did not have any other occupation than fishing. The rest 24% had other occupations, e.g. 10% had trading shop (food shop, groceries, coffee shop, fishing equipment, construction, room leasing, gasoline, fish meal plants and general trading). About 5% had aquaculture career, mostly shrimp followed by sea bass; 4% had agriculture careers (rubber plantation, oil palm plantation, integrated farming, pomelo orchard, and paddy field rice); 2% were hired workers; 1% was fish agent and other 1% was government official.

Otter board trawlers and pair trawlers are usually fished within the EEZ area and recognized as commercial fisheries which required full time in fishing activities. Beam trawlers have to find an additional non-fishing occupation. Most non-fishing occupations were general trading, agriculture, aquaculture, and fish processing careers. Beam trawlers and push netters

were also hired workers.

Constraint in non-fishing occupation is ability in conducting these fishermen. The other constraint was operating time and capital investment.

Experience in Non-fishing Occupation
From the study (DOF, 2008), an average of 25 years experiences trawl fishers have no experience on non fishing occupation before became to fisheries about 74%. Other 26% fishers have been worked in non fishing occupation (5% trader, 5% hired worker, 5% farmer, 2% fish farmer, 1% live stock keeper and 8% mechanic, carpenter, ship builder, ice plant owner, miner, fish processor employee of business and pharmacy). These fishers have experiences in non fishing occupation about 9 years before entering into fisheries.

Average share of fishing income in total income was 91%. Alternatives in non-fishing occupations as found were trading, farming, aquaculture and fish processing. Large vessel owners had more alternatives in non-fishing occupation and the small vessel owners heavily depended on fishing only. Even in farming the fishers still lack of land for agriculture.

From the study (DOF, 2008), about 12% of the fishers reported that they were attracted to fishing due to high fishing income; 8% reported that they became fishers since it was family business and 8% gave other reasons (fishing skill, increase income and utilizing the boat taken from the debtor). Most otter board trawl fishers reported they joined fishing due to the high fishing income, so did the pair trawlers. Beam trawlers reported other reasons beside the income. They lost from the previous occupation and turned to fishing by following the others in that location. Most of the push netters reported that they became fishers since it was family business.

Ownership and Family Members
The study (DOF, 2008) showed that almost all of the fishers run his individual business (97%) and with partnership was only 3%. On an average, family members were 5 persons per fishing household with only one member engaged in fishing. Number of family members could be varied among different types of gear and vessel size.

The fishers usually relied less on family labor, especially large vessels. They preferred hired workers working in the vessels. Usually only one family members engaged in fishing. The exception was in case of some pair trawlers and beam trawlers.

VI. Employment and fishing communities:

Worker/Crew
From the study (DOF, 2008), an average of each fisher had 19 workers; there was 8 workers/vessel, since some fishers owned more than one vessel. Among the 19 workers, one was family member. For hired workers, on an average there were 4 Thai workers and 14 non-Thai. The Thai worker would be the skillful one such as the skipper.

Otter board trawlers employed on an average 10 workers/vessel. There were few family labors going out for fishing. In some vessels there have no any family labor at all. There were 10 hired labors; 5 Thai, 5 non-Thai. Small vessel (<14 m) had 6 workers including 1 family labor, 3 Thai, 2 non-Thai. Medium otter trawl (14 -18 m) used 9 workers/fishers; 1

family labor, 4 Thai, 4 non-Thai. For boat size 18 - 25 m it had 13 workers, all were hired. The family member did not go out fishing. These hired workers consisted of 7 Thai, and 3 non-Thai. The large vessel (>25 m) used 16 workers/vessel; 6 Thais and 10 non-Thai.

Pair trawlers had 49 workers per vessel. This fishing gear used 2 vessels for fishing operation. In some cases there was one more vessel to transport the catch from fishing vessel back to landing port. Usually family member in this group did not go out fishing. Each hired, on average, 6 Thai, 43 non-Thai. By vessel size, the owners of small pair trawl (<14 m) used 9 worker/fisher hiring 8 non-Thai. The medium pair trawl (14-18 m) used 20 workers; 9 Thai and 11 non-Thai. Also, the medium pair trawl (18-25 m) used 32 workers/fisher; 6 Thai and 26 non-Thai. Finally, the large pair trawl (>25 m) used 137 workers/fisher; 10 Thai and 127 non-Thai.

On an average, beam trawlers used 8 workers per vessel. One of them was the family member as a skipper. Among these 7 hired workers, there were 3 Thai, 4 non-Thai. Small beam trawl (<14 m) used 5 workers/vessel; 1 family member and 4 Thai. Medium trawl (14 - 18 m) used 5 workers; 1 family labor, 2 Thai, and 2 non-Thai. The large beam trawl (18-25 m) used 12 workers/vessel; 1 family member, 2 Thai, and 9 non-Thai.

Family member who would be working onboard was often found in small vessel. In large vessel the owners would hire worker, not going out fishing themselves, especially large pair trawls. Beam trawlers and otter board trawlers (except those large vessel of >25 m) have hired their relatives more than Thai workers. Pair trawlers used mainly non-Thai fish workers.

The number of fish workers depended on by type of gear and vessel size. Pair trawlers used the most workers, mostly hired. Number of fish worker increased with vessel size. Otter board trawlers and pair trawlers relatively used more non-Thai workers. Beam trawlers of <14 m and 14 -18 m still used more Thai workers.

VII. Employment in post harvest activities (men / women; fulltime / part-time / seasonal employment)

Crew Wage

From the study (DOF, 2008), wage of fishing workers in trawl and push net was monthly payment basis but some payments were paid by catch revenue and bonus was variable paid by fishing conditions. On the average, skippers earned 10,393 – 62,385 baht/month, lowest in small pair trawls (<14 m) and highest in large pair trawls (>25 m). Skipper salary for otter board trawls were 11,391 – 18,344 baht/month. Also, salary for beam trawl skipper was 10,958 – 12,271 baht. Assistant skippers received 3,750 – 7,950 baht salary, lowest in small beam trawls (<14 m) and highest in medium pair trawls (14 – 18 m). Some sizes of pair trawls did not hire assistant skipper. Steersman salary ranged from 5,500 – 13,453 baht, lowest in small otter board trawls 14 m).

Total number of crew and per vessel (men / women; fulltime / part-time / seasonal employment)

Number of fishers

From the 1995 marine fishery census, there were 161,667 fishers in the peak period. Those fishers in the Gulf of Thailand accounted for 72% and could be divided into 45% of household member and 45% of workers. In 2000 the number of fishers increased by 4% from the year 1995. Fishers from Thai gulf increased by 4%, worker by 9% while household members decreased by 2% (Tables 21 and 22).

Table 21 The number of fishers in the peak period, the year 1995 and 2000.

Unit: person

Items	The 1995 Marine Fisheries Census					The 2000 Marine Fisheries intercensal				
	Grand total	HH Member	workers			Grand total	HH Member	workers		
			total	Thai	Non-Thai			total	Thai	Non-Thai
Whole country	161,667	76,722	84,945	72,195	12,750	168,140	80,857	87,283	58,067	29,216
Gulf of Thailand	116,059	52,165	63,894	58,717	5,177	120,603	51,037	69,566	47,362	22,204
Andaman Sea	45,608	24,557	21,051	13,478	7,573	47,537	29,820	17,717	10,705	7,012

Source: NSO, 2001

Table 22 The number of household members and workers, 2000. (Unit : person)

Items	Total	Male	Female
Whole country	558,414	286,439	271,975
Household members	429,894	218,171	211,723
Workers	128,520	68,268	60,252
Andaman Sea	153,883	79,749	74,134
Household members	116,298	60,020	56,278
Workers	37,585	19,729	17,856
Gulf of Thailand	404,531	206,690	197,841
Household members	313,596	158,151	155,445
Workers	90,935	48,539	42,396

Source: NSO, 2001

Economic Performance of Trawl Fisheries

a). Initial Investment

From the study (DOF, 2008), initial investment included investment on hull, engine and fishing equipment. The investment varied by type of gear and size of vessel as follow:

Otter board trawl

On an average, total initial investment of small otter trawl (<14 m) was 0.57 million baht per vessel. For medium otter trawl (14 -18 m), medium trawl (18 - 25 m) and large otter trawl (>25 m), the average initial investments were 1.1; 3.4 and 5.9 million baht respectively.

Pair trawls

Average initial investment in hull, engine, and equipment was 2.4 million baht for small pair trawl, 3.5 million baht for medium trawl (14-18 m), 9.1 million baht for medium trawl (18-25 m) and 12.8 million baht for large pair trawl, accordingly.

Beam trawl

Beam trawl with 3 size of vessel, small size (<14 m), medium size (14 - 18 m), and large size (>18 - 25 m) with had an average initial investment of 0.6, 1.0 and 2.1 million baht respectively.

b). Cost and Return of Trawl Fishing Operation (Figure 23).

Fixed and Variable Fishing Cost

From the study (DOF, 2008), average monthly fishing costs could be divided into:

(1) Fixed cost including monthly average depreciation on vessel, engine and equipment which were non-cash costs

(2) Variable costs including expenses on fish workers, fuel, ice, maintenance and fee which were either cash non-cash. Non-cash variable cost was opportunity cost of family labor. Details on these monthly averages fixed and variable costs in 2004 are given in Table 24.

Otter board trawl

The large otter trawl (>25 m) had the highest monthly total cost per vessel, 0.35 million baht. Fuel cost which was 0.17 million baht/month or 49% of the total costs. Most often found in this gear type was medium otter trawl (14-18 m). The total monthly costs was 0.20 million baht dividing into 0.01 million baht non-cash cost and 0.19 million baht cash cost. Fuel cost was 0.10 million baht/month, 50% of the total costs.

Pair trawls

The large pair trawl (>25 m) had the highest total costs per pair, 1.71 million baht/month. Highest cost item was fuel cost, 1.06 million baht or 62% of the total costs. Most often found in this gear type was medium pair trawl (18 - 25 m). Fuel cost was 0.50 million baht/month, 63% of the total costs.

Beam trawl

The medium beam trawl (18- 25 m) had the highest total costs per pair, 0.34 million baht/month. Highest cost item was fuel cost, 0.18 million baht or 51.71% of the total costs. Most often found in this gear type was medium beam trawl (14 -18 m). Fuel cost was 0.08 million baht/month, 55% of the total costs. Most often found in this gear type was small beam trawl (>14 m) which had the lowest cost among all fishing gears and vessel sizes. The total monthly costs was 0.08 million baht. Fuel cost was 0.045 million baht/month, 58% of the total costs.

Table 23. Average monthly cost of fishing operation by type and size of vessel, 2004 (in Baht).

Type of gear and Vessel size	Number (vessels)	Fixed cost	Variable costs						Total variable costs (TVC)	Total costs		
		Non-cash	Cash					Non-cash				
		Depreciation	Wage	Fuel	Lubricate	Ice	Maintenance and others	Family labor		Cash	Non-cash	Total costs (TC)
Otter board trawl												
< 14 m	48	3,714	19,562	57,964	1,903	4,809	19,820	6,441	110,499	104,058	10,155	114,213
14 - 18 m	61	6,595	30,500	99,221	3,024	13,905	42,021	3,904	192,576	188,672	10,499	199,171
>18 - 25 m	32	12,972	48,382	140,533	3,979	33,239	55,082	2,278	283,493	281,215	15,250	296,465
> 25 m	3	29,458	46,500	173,500	3,000	27,500	70,587	3,000	324,087	321,087	32,458	353,546
Pair trawls												
< 14 m	1	10,169	60,000	240,000	1,575	13,200	78,636	6,000	399,411	393,411	16,169	409,580
14 - 18 m	13	11,829	71,207	289,938	3,449	23,911	81,705	1,929	472,139	470,210	13,757	483,968
>18 - 25 m	36	21,624	112,492	496,215	4,932	34,547	118,634	429	767,249	766,820	22,052	788,872
> 25 m	2	37,498	283,635	1,058,520	12,500	63,000	258,571	na	1,676,226	1,676,226	37,498	1,713,723
Beam trawl												
< 14 m	9	3,071	7,298	44,133	3,391	2,177	12,749	5,133	74,882	69,748	8,204	77,952
14 - 18 m	28	3,954	24,614	84,162	3,125	6,116	27,398	4,038	149,454	145,416	7,992	153,408
>18 - 25 m	6	6,639	75,125	181,517	5,253	10,800	58,997	6,000	337,692	331,692	12,639	344,332
> 25 m	-	-	-	-	-	-	-	-	-	-	-	-

Net Income and Profit (Tables 24 and 25). Return from fishing included:
(1) net income which is total revenue less variable cost;
(2) profit which is total revenue less total cost and
(3) return over cash cost which is total revenue less total cash cost.
From the study (DOF, 2008) showed as follow;

Table 24 Average monthly catch and value of fishing operation by type and size of vessel, 2004. (Source: DOF, 2008).

Type of gear and Vessel size	Total catch volume (kg.)	Total catch value (baht)	Catch value (baht)					
			Food fish	Trash fish	Shrimp	Sergistid	Squid	Others (other fish, swimming crab, scallop)
Otter board trawl								
< 14 m	7,746	117,183	23,529	17,283	50,554	0	20,883	4,934
14 - 18 m	16,067	276,811	38,243	34,266	101,941	0	73,170	29,190
>18 - 25 m	38,086	407,080	53,829	82,448	52,789	0	185,503	32,511
> 25 m	n/a	472,400	n/a	n/a	n/a	n/a	n/a	n/a
Pair trawls								
< 14 m	19,437	403,650	34,000	43,500	0	0	323,750	2,400
14 - 18 m	25,308	569,812	51,036	50,643	17,375	0	421,416	29,343
>18 - 25 m	55,237	870,933	188,130	186,893	20,603	0	419,342	55,966
> 25 m	n/a	3,020,000	n/a	n/a	n/a	n/a	n/a	n/a
Beam trawl								
< 14 m	2,718	90,312	4,783	5,500	44,562	0	18,800	16,667
14 - 18 m	3,843	176,499	6,200	6,594	129,417	0	2,330	31,958
>18 - 25 m	3,111	346,680	22,000	50,167	83,917	0	5,000	185,597
> 25 m	-	-	-	-	-	-	-	-

Table 25 Average net income and profit of fishing operation, 2004 (in Baht, monthly).

Type of gear and Vessel size	Total fishing income	Return over cash costs	Net income	Profit
Otter board trawl (baht/vessel)				
< 14 m	117,183	13,125	6,683	2,970
14 - 18 m	276,811	88,139	84,235	77,639
>18 - 25 m	407,080	125,865	123,587	110,615
> 25 m	472,400	151,313	148,313	118,855
Pair trawls (baht/pair)				
< 14 m	403,650	10,239	4,239	-5,930
14 - 18 m	569,812	99,602	97,674	85,845
>18 - 25 m	870,933	104,113	103,684	82,061
> 25 m	3,020,000	1,343,774	1,343,774	1,306,277
Beam trawl (baht/vessel)				
< 14 m	90,312	20,563	15,430	12,359
14 - 18 m	176,499	31,084	27,045	23,092
>18 - 25 m	346,680	14,988	8,988	2,348
> 25 m	-	-	-	-

Otter board trawl

The largest otter trawls (> 25 m) had higher return over cash cost, higher net income and profit than other sizes. Return over cash cost was 0.15 million baht/month. Net income was 0.15 million baht. Profit was 0.12 million baht. The next was large otter trawl (18 – 25 m) which some of them fished outside Thai water. The small otter trawl (<14 m) still earned some profits but relatively low at 0.003 million baht, net income was 0.007 million baht and return over cash cost was 0.013 million baht/month/vessel.

Pair trawls

The medium pair trawls (14 - 18 m) and large pair trawl (18 - 25 m) had almost similar profit i.e. 0.09 and 0.08 million baht/month while the largest pair trawl (> 25 m) had a high profit of 1.31 million baht/month/pair. The small pair trawl (<14 m) lost 0.006 baht/month but still had a small net income of 0.004 million baht per pair and the return over cash coat was 0.01 million baht.

Beam trawl

In 2004, medium beam trawl (14 -18 m) had highest profit 0.023 million baht/month with 0.031 million baht return over cash cost and 0.027 million baht net income. Next most profitable was small beam trawl (<14 m) earning monthly 0.012 million baht profit. Least profitable was large beam trawl (>18 - 25 m), with monthly profit of only 0.002 million baht.

Most of trawls are still profitable. The profit was relatively low for small vessels fishing in the Gulf of Thailand. Large vessels had an alternative fishing outside the Gulf of Thailand were capable earning higher profit. Further, the study (DOF, 2008) showed costs and returns by type of gear and vessel size. In each type of gear the profitable one was relatively largest sized vessel which was fishing outside of the Gulf of Thailand. Small vessels were mostly limited to fish in the Gulf. Total gross revenue was highest for largest trawl (>25 m) at an average of 3.02 million baht/month and lowest for small beam trawl (<14 m), 90,312 baht/vessel/month. When deducting the costs, small pair trawl (<14 m) lost 5,930 baht/month. This fisher still fished since fishing was family business for generations. The large pair trawl (>25 m) enjoyed the highest profit 1.31 million baht/month. The least profitable was large beam trawls (18 – 25 m) which is considered large vessel for this gear group. By type of gear, for otter board trawl and pair trawls, the larger vessel earned more profit, but for beam trawl, though the revenue increased with the vessel size, the profit was least for large beam trawl (18-25 m). Most beam trawl was recognized as small scale fishing gear. The past high profit lured investment in larger vessel among these beam trawls.

c). Rate of Return from Fishing

From the study (DOF, 2008) showed the rate of return from fishing (R1 to R3) classified by type of gear and vessel size. R1 is the rate of return over cash cost, R2 is the rate of return over variable cost and R3 is the rate of return over total costs. Only some fishers paid their attentions on non-cash costs, but most of them focused on variable cost rather than total cost. Once the return from fishing can cover variable cost, they will go out fishing.

Not much of the fishing variable costs were non-cash costs. Most of non-cash cost was opportunity cost from family labor. Nowadays large vessel used less family labor. Recently, return over cash costs were closed to return over variable costs. When take into account on depreciation costs then the rate of return was lower.

VIII. Profile of fishing community livelihood strategies: other jobs fishers and fish workers engage in if not fulltime fishers, and other economic activities of concerned households

Number of fishing households

There were 53,112 fishing households in the entire country in 1995. In coastal of the Gulf of Thailand has 36,266 fishing households and can be divided into 8% of otter trawls and 1% of pair trawls. Comparison to the survey year 1995, entire fishing households in the year 2000 increased by 9% or 57,801 households. Fishery households increased by 3% from other types of fishery. While otter trawls and pair trawls declined by 12% and 32% respectively (Table 26). Table 27 shows the number of fishing households and workers households categorized by income from fishing and/or coastal aquaculture in the year 2000.

Table 26. The number of fishing households in of Thailand in the year 1995 and 2000.

Unit: households

Items	The 1995 Marine Fisheries Census					The 2000 Marine Fisheries intercensal				
	total	Otter trawls	Pair trawls	Beam Trawls	others	total	Otter trawls	Pair trawls	Beam Trawls	others
Whole country	53,112	3,294	452	986	48,380	57,801	2,855	310	403	54,233
Gulf of Thailand	36,266	2,909	423	958	31,976	37,098	2,552	288	372	33,886
Andaman Sea	16,846	385	29	28	16,404	20,703	303	22	31	20,347

Source: NSO (1999) and NSO (2001)

Table 27. The number of fishing households and workers households categorized by income from fishing and/or Coastal aquaculture in the year 2000.

Unit: households

Items	Total	All income	Most of the income	Partial of the income
Whole country	122,540	78,762	32,391	11,387
Fishing households	93,418	60,083	24,540	8,795
Workers households	29,122	18,679	7,851	2,592
Andaman Sea	33,463	21,072	8,953	3,438
Fishing households	24,969	15,819	6,735	2,415
Workers households	8,494	5,253	2,218	1,023
Gulf of Thailand	89,077	57,690	23,438	7,949
Fishing households	68,449	44,264	17,805	6,380
Workers households	20,628	13,426	5,633	1,569

Source: NSO, 2001

Small Scale Fisheries and Fishing Community Profile

The Department of Fisheries has developed and promoted small scale fisheries through the project of the Development of Coastal Small Scale Fisheries during 1987 to 1996 under the National Economic and Social Development Plans 6 and 7 and further extended to the Rehabilitation of the Thai Sea project in the eighth plan 1997-2001. The project was extensively implemented along the coastal areas both in the Gulf of Thailand and in the Andaman Sea.

(a) The main objectives were

- To strengthen small scale fishing community in coastal fisheries management
- To conserve marine resources and environment
- To lift up economic and social welfares of small scale fishers

(b) Strategy for small scale fisheries development

- To establish fisher groups and initiate them to participate in management issues
- To extend and promote alternative jobs to increase income
- To supply/improve basic facility for better livelihood
- To develop the coastal resource to be more fruitful

Since then the community-based management projects have been started in 1996. Two fishing communities in Bang Saphan Bay (part of Prachuab Kiri Khan province, covering nine villages) and Phang-Nga Bay (area covered parts of Phang Nga and Krabi provinces) were assigned as the pilot projects. The initial implementation of the projects were to give the fishers' knowledge of the objectives, concept of the fishing right, the fishing quota by zoning, the resources conservation, the system of community-based management and etc by training and learning. The project plan covered all coastal provinces both in the Gulf of Thailand and Andaman Sea. The requests of the appropriate fishing villages settled as the community-based management have been done by the fisher groups through the provincial fisheries officers, the Marine Fisheries Research and Development Bureau and the Administrative and Management Bureau then go to the Department of Fisheries. The outlook for the future is to let the fishers conserved and rehabilitation of their fisheries resources and marine environment by themselves, increase income via value added product, settlement of local central market, cheaper essential product store as well as to minimize the fishery conflicts between commercial and small scale fisheries including help to monitoring illegal fishing. Since the fisheries resources are limited and almost overexploited, the project is seemed to be suitable for the recent fisheries situation.

At present, the local fishers have gathering themselves as fisher groups and fisher communities which fishing boats during operation can be acting liked patrol boats and can inform government officials for illegal fishing boats, some may participate on arresting operation. Sometime the fishers participated with local officials in monitoring and enforcing for illegal one. As for the fisher groups or communities, the groups can manage for their own finance as revolving fund to help each other. Further they can have a coop shop for cheaper essential goods, cheaper gasoline, engine repairing, net repairing, releasing seed fry and enhance fishery resources, crab bank project to enhance swimming crab production, replant mangrove trees and making value added fishery products or agricultural products. Further the Department of Fisheries and the Ministry of Agriculture and Cooperatives provide rewards for winner in the contests of various issues for small scale fishers annually; e.g. best management, best value added product (OTOP), best aquaculture practice, best processing product etc.

IX. Catches: Catch composition (retained catch and discarded catch, share of economically valuable catch / trash fish)

Retained catches in cod end cover net

Table 28 shows the results of the experiments on enlargement of the cod end mesh sizes in fisher's shrimp trawls in Prachuab Kiri Khan province. The sizes of shrimp trawler using was less than 14 m, operated with cod end mesh sizes 2.0 and 2.5 cm covered by cover net with 1.5 cm meshes.

Table 28. Catch rate, percentage and rate of escape of marine fauna caught by fisher's shrimp trawlers using cod-end mesh size 2.0 and 2.5 cm and both were using cover net mesh size 1.5 cm in all experiments.

Effort used (hr/day)	10.15					10.32				
	Incodend 2.0 cm		In cover net			In cod end 2.5 cm		In Cover net		
	CPUE (kg/hr)	%	CPUE (kg/hr)	%	(%) Escape	CPUE (kg/hr)	%	CPUE (kg/hr)	%	(%) Escape
Total catch	37.30	100				28.87	100			
Total economic fish	10.89	29.2				12.49	43.26			
-Pelagic fish	0.00	0				0.00	0.005			
-Demersal fish	3.07	8.24				3.22	11.14			
-Cephalopod	0.81	2.17				0.90	3.11			
-Shrimp	4.95	13.26				6.49	22.49			
-Crab	2.03	5.43				1.85	6.39			
-Other	0.04	0.11				0.04	0.12			
Total trash fish	26.40	70.8	0.918	100	2.4	16.38	56.74	14.19	100	32.96
	In codend 2.0 cm		In cover net 1.5 cm			In codend 2.5 cm		In cover net 1.5 cm		
	CPUE (kg/hr)	%	CPUE (kg/hr)	%	(%) Escape	CPUE (kg/hr)	%	CPUE (kg/hr)	%	(%) Escape
Total trash fish	26.40	70.8	0.918	100	2.4	16.38	56.74	14.19	100	32.96
True trash fish	9.49	25.45	0.212	23.1	0.55	6.23	21.58	0.84	5.93	1.96
Total small size economic fish	16.91	45.35	0.706	76.9	1.85	10.15	35.16	13.35	94.07	31
Pelagic fish	0.25	0.67	0.045	4.94	0.12	0.17	0.6	0.07	0.46	0.15
Demersal fish	10.10	27.08	0.536	58.44	1.4	7.80	27	12.89	90.81	29.93
Cephalopod	0.69	1.84	0.043	4.64	0.11	0.79	2.72	0.27	1.92	0.63
Shrimp	5.76	15.44	0.081	8.82	0.21	1.36	4.7	0.12	0.88	0.29
Crab	0.00	0	0	0	0	0.00	0	0.00	0	0
Other	0.12	0.32	0.001	0.06	0.003	0.04	0.14	0.00	0	0

Source: Phoonsawat, 2005 (in Prachuab Kiri Khan)

The retained total catches from mesh sizes 2.0 and 2.5 cm were 37.3 kg/hr and 28.87 kg/hr respectively. For mesh size 2.0 cm the total catches was categorized into total economic fish (pelagic fish, demersal fish, cephalopod, shrimp, crab and other) 10.89 kg/hr (29 %) and trash

fish 26.4 kg/hr (71%). The trash fish comprised true trash fish 23 % and young or juvenile economic fish 77%. For mesh size 2.5 cm the results of the experiments could have much more economic fish with less trash fish and could reduce young and juvenile fish 94 % in the trash fish component.

Retained catches composition by species and size

Table 29 shows the CPUE (kg/hr) and percentage of economic fish, economic juvenile fish in trash fish component and trash fish (true trash fish) from various sizes of trawlers.

Table 29. Percentage of economic juvenile fish and true trash fish in the component of trash fish caught by trawlers in the Gulf of Thailand during 2003-2005 (Kongprom *et.al*., 2008).

	OBT <14 m	OBT 14-18 m	PT
% economic juvenile fish	33.6	30.6	47.8
% true trash fish	66.4	69.4	52.2

Table 30 shows size ranges of economic juvenile fish in trash fish component caught by various sizes of trawlers. It was noticeable that the small size of trawler could catch smaller sizes of juvenile fish than bigger size of trawler.

Table 30. Sizes of economic juvenile fish in the trash fish component caught by trawlers in the Gulf of Thailand, 2003-2005.

OBT<14 m		**OBT 14-18 m**		**PT**	
Species	**Length (cm)**	**Species**	**Length (cm)**	**Species**	**Length (cm)**
Cynoglossidae		*Cynoglossidae*	9.6-12.8	*Cynoglossidae*	8.1-12.5
Lutjanus lineolatus	5.7	*Lutjanus lineolatus*	8	*Lutjanus lineolatus*	6.6-8.3
Mullidae	5.9	*Mullidae*	6.6-7.3	*Mullidae*	7.0-7.4
Nemipterus hexodon	4.9-7.6	*Nemipterus hexodon*	5.7-21.0*	*Nemipterus hexodon*	6.9-13..9*
N. japonicus	7.2-7.4	*N. japonicus*		*N. japonicus*	7.6
N. mesoprion	5.7-6.7	*N. mesoprion*	6.5-9.6	*N. mesoprion*	7.5-11.2*
N. furcosus	7.2-8.2	*N. furcosus*	6.4-23.3*	*N. furcosus*	6.9-14.6*
Priacanthus tayenus	7.0-8.8	*Priacanthus tayenus*	9.1-19.9*	*Priacanthus tayenus*	7.4-19.1*
Platycephalidae	7.8-10.1	*Platycephalidae*	7.8-9.4	*Platycephalidae*	
Saurida elongata	8.3-12.1	*Saurida elongata*	9.6-15.8	*Saurida elongata*	10.3-19.1*
S. undosquamis	6.4-11.9	*S. undosquamis*	6.8-10.8	*S. undosquamis*	11.3-18.7*
S. isarankurai	7.6-8.3	*S. isarankurai*	8.8-10.6	*S. isarankurai*	8.8-9.9
Sepia aculeata		*Sepia aculeata*	11.5	*Sepia aculeata*	1.8-4.9
S. recurvirostra	3.5	*S. recurvirostra*		*S. recurvirostra*	3.8
Scianenidae	7.0-8.1	*Scianenidae*		*Scianenidae*	
Scolopsis taeniopterus	6.0-9.1	*Scolopsis taeniopterus*	6.0-8.3	*Scolopsis taeniopterus*	5.9-7.8
P. macracanthus		*P. macracanthus*	12.6	*P. macracanthus*	

* large sizes caught from central gulf area

Catch utilization and marketing:

Thailand utilizes marine fish catch largely for human consumption. In 2006, as much as 78% of the 3,311,666 metric tons of the annual catch (included marine culture and catches from outside Thai water) was traded in the local fish markets or processed into many fish products while the rest 22% was processed into fishmeal and animal feeds. The percentage of fish used directly for consumption has become greater year by year. Over the decade 1997, as much as 25% of the annual landing was processed into fishmeal and animal feeds. Those used for human consumption only 24% of fish which was immediately processed as iced and frozen products, 22% was sold as fresh fish, 19% went to canning, and the rest 10% was processed into salted, dried, fermented, steamed, smoked, grilled and other products.

Fish consumption patterns have been changed over years. In the decade 1997, the annual consumption of fresh fish increased on the average by 3% per annum, the processing into salted, dried, fermented, steamed, grilled, smoked and other types of processing products increased by 8% per annum, and the direct processing into iced and frozen product decreased by 1%, and the canned products decreased by 0.1%. Greater reduction (8%) was observed in the fish used for fishmeal and animal feed processing. (Figure 32)

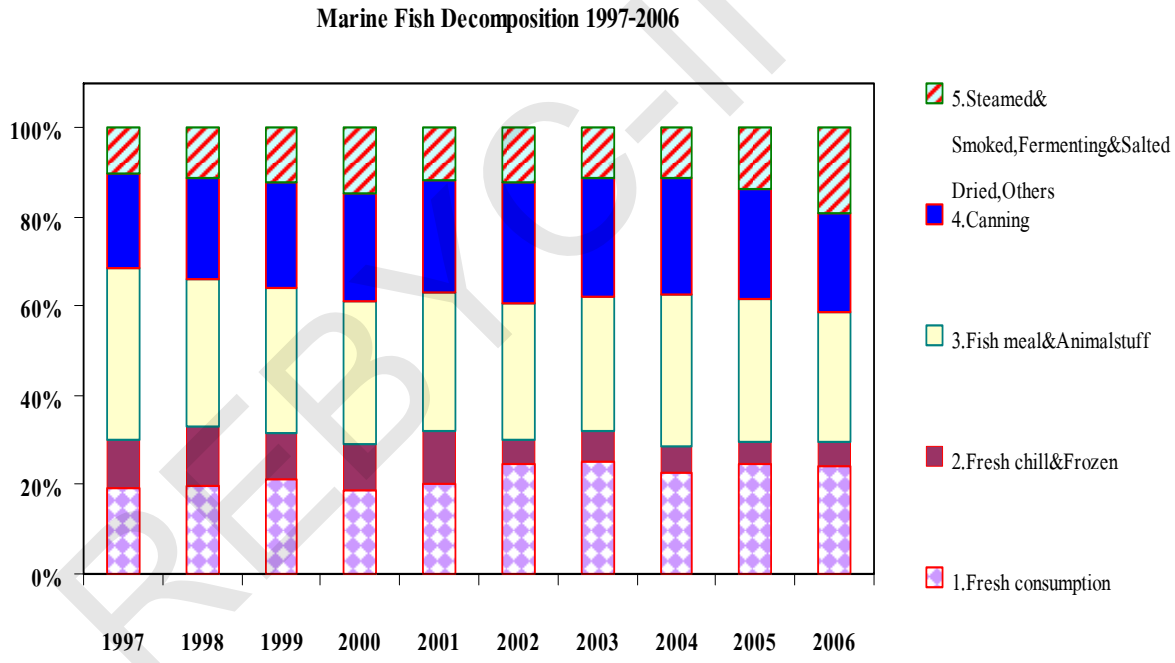


Figure 32. Different types of marine fish utilization in Thailand, 1997-2006

Value of catch / bycatch (including trash fish)

Value of fish production caught by trawl and push nets fishery along Thai Gulf coast line in the last 10 years (1998-2007) increased from 16,542 million baht in 1998 to 22,639 million baht in 2007. The value of marine animal for consumption was 93% of the total value, value of trash fish was 7%. This value ratio did not change a lot from time to time (Table 31). The value of marine fish from trawl fisheries and push net fishery were different by the boat gross tones capacity and sizes.

Table 31. Value of fish for consumption and trash fish, 1998-2007.

year	Fish for consumption		Trash fish		total
	Million baht	%	Million baht	%	Million baht
1998	15,098	91	1,445	9	16,542
1999	17,405	93	1,410	7	18,815
2000	19,577	93	1,503	7	21,079
2001	21,358	94	1,483	6	22,841
2002	24,066	94	1,457	6	25,523
2003	26,911	96	1,222	4	28,133
2004	24,660	94	1,508	6	26,167
2005	26,913	95	1,505	5	28,419
2006	24,375	94	1,666	6	26,040
2007	20,990	93	1,649	7	22,639

Source: Information Technology Center, Department of Fisheries.

X. Utilization of catch/bycatch – including trash fish (local human consumption/ reduction or animal feed/exports)

Fish processing

A great variety of fish processing methods have been used in Thailand. The majority of fish processors were favored in salted and dried fish and shellfish products. In 2007, it was found that 60% of the total 2,067 fish processors engaged themselves at the household level in these processing activities. The next popular type of fish processing among fish processors was fish ball and fish cake making. There was 13% of this type of fish processors reported at the same year. Fermentation as used by fish sauce factories and local fish sauce processors engaged as many as 11% of the processors, while steamed, baked, grilled, and smoked products involved only 2% of the fish processors. For industrial fish processing, which can hardly judged by their number, comprised 8% of cold storages, 2% of canning factories, and 4% of fishmeal factories.

The situation of economically important fish processing found in the decade 1997, can be summarized as follows:

Frozen product. The volume of the frozen fish and shellfish products varied only slightly from year to year; a drop down annual rate was a mere 0.1%. It is known that the majority of these frozen products (e.g. 51% of fish, 32% of shrimp and cephalopods, and 14% of crab, mollusc, and mantis shrimp) have been further processed as canned products.

Canned fish. An annual average of 1.120 mil metric tons of fresh fish was used for canning; the rate of annual increase was 4%. Imported raw materials were also used for canning such as 55% of Indo-Pacific mackerel, 12% of shrimp, 7% of Spanish mackerel and 6% of sardine as well as a small quantity of crab, cephalopod, and mollusk.

Fish sauce. The principal raw material for this product is anchovy. During this period, some of 100,360 metric tons per annum of this small pelagic were used by fish sauce factories. As

this product is very popular in the region and a must in oriental dishes, its annual increase during this period was as much as 5%.

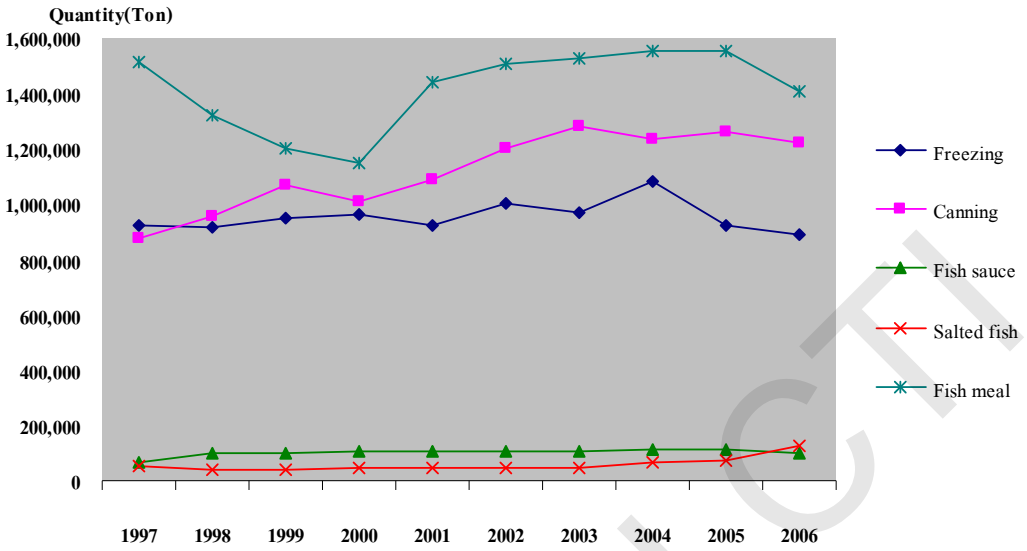


Figure 33. The quantities of fresh fish used in various types of processing during 1997-2006.

Table 32. Number of fish processing factories classified by types of fish processing in Thailand, 1988-1993.

Type of plants	1988	1989	1990	1991	1992	1993
Salted fish	748	830	750	632	621	702
Dried squid	671	772	712	642	605	604
Dried shellfish	646	646	646	523	456	484
Dried shrimp	195	213	205	168	188	192
Ice plants	175	177	182	191	199	207
Freezing	84	94	108	100	120	129
Fish meal	96	85	104	102	106	115
Fish, shrimp cracker	71	95	90	89	92	112
Streaming	65	65	55	62	71	107
Fish sauce	116	118	116	110	110	104
Fish ball	82	95	94	86	86	86
Budu sauce	23	29	29	27	27	81
Canning	45	43	42	42	49	52
Smoking	40	38	36	30	28	28
Total	3,057	3,300	3,169	2,804	2,758	3,003

Salted fish. Some 57,988 metric tons of fresh fish went into salted products during this period; their annual increase was impressively 13%.

Fishmeal. A huge quantity of 1,417,822 metric tons of small sized fish was processed into fishmeal each year during this period. Its quantity was gradually shrinking at the rate of 0.3% per annum due to overexploited situation of both small juvenile economic fish and true trash fish.

The fish processing plants also showed decreasing trend from the first period (1988 to 1993) to the second period (2001 to 2007). The favorable products were salted fish, dried squid, dried shellfish, dried shrimp. Fish and shrimp cracker and Budu sauce were noticeable more favorable in the second period than in the first period (Tables 32 and 33 and Figs. 33 and 34).

Table 33. Number of fish processing plants, 2001-2007

Types of fish processing plants	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Salted	692	641	624	664	792	793	742
Dried squid	290	306	284	299	316	283	277
Shrimp cracker	184	165	134	174	234	258	233
Dried shellfish	153	152	152	151	171	170	170
Frozen	126	133	142	153	155	148	149
Budu sauce	149	81	84	118	124	173	138
Fish sauce	81	82	85	84	86	78	77
Dried shrimp	79	80	63	60	66	77	77
Fish meal plants	69	69	74	73	73	71	71
Fish ball	71	69	62	56	56	42	42
Steamed	64	54	54	35	39	37	37
Canned	42	43	45	47	47	45	46
Smoked	10	10	11	8	8	8	8
Total	2,010	1,885	1,814	1,922	2,167	2,183	2,067

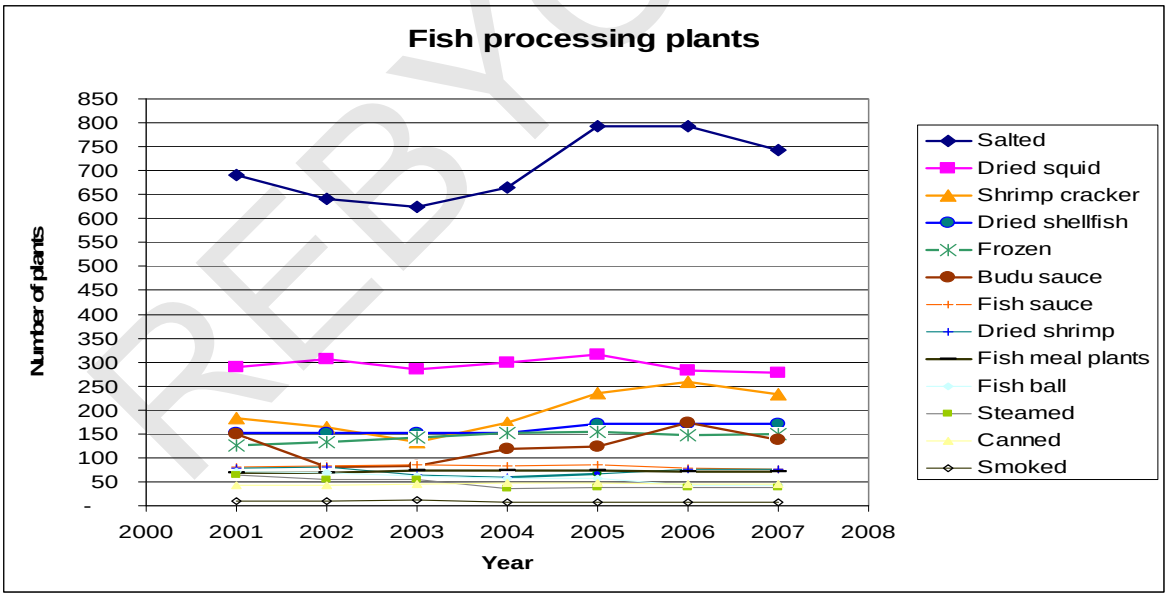


Figure 34. Fish processing plants in 2001 to 2007 in the coastal areas of Gulf Of Thailand.

Bycatch utilization (products / value chain / end consumers)

Sources of raw materials in fishmeal manufacturing are from trash fish, waste or residue from processing plants and other low value fish. In the last decade (1998-2007), the decline trend using trash fish for fish meal has been noticeable. In 1999 the ratio of raw material in fish meal plants was trash fish 63%, waste from processing 32% and other low value fish 5%. While in the year 2007, fish meal sources were 44% of trash fish, 51% of waste from processing plants and 4% from other low value fish (Figure 35).

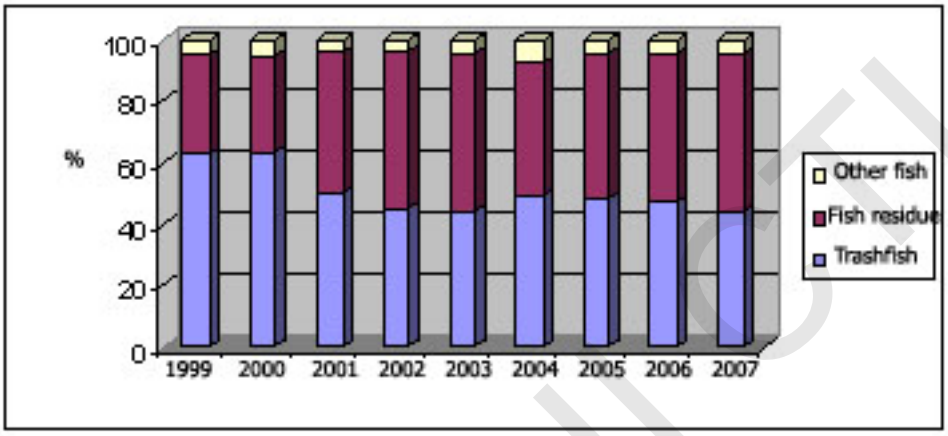


Figure 35. Percentage of raw material used for fishmeal processing, 1999-2007

Marketing and Supply chain (Figure 36 in attached file)

1). Supply Chain in the production process of demersal resources

Supply chain in the production process of demersal resources (including trash fish) comprises many stakeholders which are fish agent, collector, wholesaler, retailer, cold storage, exporter, importer and processing plant

1.1) Fish agent and collector

There are two major provinces e.g. Samuth Sakorn and Songkhla provinces which recognized as having big companies along the coast of the Gulf of Thailand. There are 55 Fish agents in Samuth Sakorn province who are at the same time the sail persons and owners of the vessels. In Songkla fishing port, there are agents and the collectors who purchase fish directly from fishers and fishing vessels. Fish agents will buy marine fish landed at major places with wholesale price and then further sail to middle men. Fish agents usually support in financing and fishing materials for fishers therefore fishers have to sell their products to their agents only and vice versa fish agents will buy fish from the fishers whom they are supported. In case of lacking fish production, they will also buy fish from other fishers.

1.2) Wholesalers

Wholesalers buy fish from fish agents and then sell to retailers or restaurants. In Songkla fishing port, wholesalers have their own sell places at port site.

1.3) Retailers

Retailers buy marine fish directly from wholesalers, collectors, fish agents and then sell to the consumers in fish market.

1.4) Cold storages and exporters

Cold storages and exporters purchase marine fish from fish agents and wholesalers and sell them to surimi processing plant for export.

1.5) Processing Plants

(*1) Processing Plants*

Processing plants buy fish from fish agents and inspect the quality of raw material before sending them to processing manufacture to make ground fish. Prepared fish would be cleaned before export and less of them are sold locally. Over 80% of processing plants in Samutsakorn produce only ground fish while in Songkla use ground fish as raw material to make value added products such as fish balls, fish tofu etc., processing plants in both provinces process ground fish for export. The major markets are Japan, Taiwan, Hong Kong and European countries. The less are sold domestically such as fish balls and fish tofu as said earlier.

(2) Fish meal plants

Fish meal plants buy tiny un-fresh fish to make fish meal, shrimp meal and food for other marine animals, fowl and other animals like pigs. Other leftovers like head and tails from processing plants are also used to make fish meal.

2). Aspect of supply chain

The distribution of trawl fishery production is varied by its purposes. For example, trash fish is supplied to fish meal plants while threadfin bream is supplied to processing plants to make surimi. For sea bass and other consumable fish are sold both domestic market and export. Marketing channel can be explained in two ways categorized by type of product and purpose.

2.1) Fish for processing plants

(1) Fish to produce surimi are threadfin breams, lizard fish, and big-eyes. At landing port, marine fish will be transferred from vessels then workers from fish agents will sort them out. Fish from vessels are varied depending on the fish gear used. After that some fish agents will primarily process fish by cutting head and removing guts before sending to processing plants. Some processing plants will come to receive raw material from fish agents by themselves.

(2) Fish used to produce fish meal are trash fish. Trash Fish from trawl fishery is not accepted as consumable fish because of its tiny size and un-freshness. In the past they are usually used as duck food so called duck fish. Fishers will sort trash fish from the other higher grade then sell them directly to fish meal plants.

2.2) Fish for human consumption

Market channel of fish for consumption are different from fish supplier to processing plants that there are more middle men.

(*1) Fish for domestic consumption*

Firstly wholesalers who have their own stalls at landing ports will send their workers to sorting fish into baskets and keep at their stalls. Secondly wholesalers living nearby or coming from other provinces will buy at the stalls and then sell to other retailers.

(*2) Fish exported for consumption*

Fish agents will send their workers to sort fish at landing port, then send to fish agent site to inspect species and weight. After that fish will be packed in plastic cages for transport companies to pick up at the port.

3). Marketing channels

Marine fish captured are distributed by 2 channels:

3.1) Fish agents/Collectors

After sorting ground fish for processing plants and for consumption, fish agents will send products to 3 channels.

(1) Processing plants at the upper part of Thai Gulf will only primarily process fish so they have to send some products to value-added processing plants and the other to export agents. Whereas processing plants at the lower part of Thai Gulf could add value to their products at their own plants and then sell to retailers, stores, restaurants and export agents.

(2) Fish meal plants buy trash fish from fish agents and from processing plants to produce fish meals and sell to farms and animal feed plants.

(3) Export; fish agents will select expensive and good quality fish for export to neighboring countries e.g. Malaysia, Singapore.

3.2) First wholesalers distribute into 3 channels

(1) Processing plants (Surimi products);
(.2) Second wholesalers in the region and other provinces will supply fish for processing plants and retailers and
(3) Consumers; some wholesalers have their own stores at local fresh markets.

4). Volume of trade

Marine fish products are naturally spoiled very soon due to hot weather, so most of business persons in this field will not keep the products too long but try to sell out quickly. Therefore buy and sale quantities are equal except for the processing plants and fish meal plants which buy raw material for further processing. From interviewing business persons, processing plants have 2,041 metric tons in trade volume per month (70%), fish meal plants 496.25 metric tons per months (17%), fish agents 195.47 metric tons (7%), Collectors 182.5 metric tons (6%), wholesalers and retailers, 1.2 metric tons (0.04%), fishers 0.87 metric tons (0.03%).

5). Export of marine fish caught by trawl fisheries

Marine fish from trawl fisheries are processed for exporting as surimi and fish ball. Processed fish are threadfin bream, lizard fish, big-eyes and croaker. In the past 3 years (2007-2008), export of those products was higher. In 2009, export value was around 7,000 million baht.

X. Fisheries policy and regulatory framework:

Relevant regional/national/local fisheries and marine environment policies and strategies

In summary, the Government of Thailand is moving steadily forward by updating its fishery legislation and implementing organizational changes to develop policies and mechanisms which are in line with international fisheries management, agreements and principles. The new Fisheries Act B.E. 2553 (2010) addresses internationally-accepted, responsible and sustainable fisheries management principles and practices and will modernize the Kingdom of Thailand's fisheries policies and management schemes.

Acts

Primary fisheries legislation includes the following acts:

- Act Governing the Right to Fish within Thai Waters B.E., 2482 (1939);
- Fisheries Act B.E. 2490 (1947), which has been focused on increased fisheries production for food security and not in the area of conservation or sustainable management of the resources. Poverty alleviation and food security for its growing population still remain priorities;
- Act Organizing the Activities of the Fish Market B.E. 2496; and
- New Fisheries Act B. E. 2553 (2010) (currently waiting for approving from House of Representatives).
- The act forming the Department of Coastal and Marine Fisheries is also a key piece of legislation that will impact on fisheries management in the future.

- The enhanced liaison between the DOF and the marine schools and departments of universities will also have a significant impact and provide advice for the Government on fisheries management in the future.

- It is to be noted that implementation of fisheries legislation is the responsibility of the DOF, DCMR, Marine Police, Royal Thailand Navy and the Office of Immigration.

- Law enforcement remains a central authority not yet delegated to regional or local levels. It would appear that the inter-agency mechanisms established under an earlier National Economic and Development Plan needs to be revisited and enhanced to resolve concerns of overlapping mandates.

Recently, the Department of Fisheries has formulated the Master Plan for Marine Fisheries Management. This Master Plan will remain active over the period of 10 years (2009-2018). It is divided into two 5-year periods: the first period from 2009-2013, and the second period from 2014-2018. The Action Plan is waiting for the House of Representatives for approval before implemented.

Specific objectives for these fisheries have been highlighted by the Government as follows:

Trawl fishery

- Protection of spawning stock;
- Protection of juveniles; and
- Sustainability of the fishery and environment.

Purse seine fishery

- Limit size of fish caught through minimum mesh size 2.5 cm; and
- Control fishing areas by zone (special case of anchovy fishery).

Encircling gillnets

- Protection of spawners especially for Indo-Pacific mackerel.

Management measures and activities that the Kingdom of Thailand has in her regulation included:

- Prohibiting trawlers and push netters from fishing within 3 km of the coast and requiring shrimp trawler to be fitted with turtle exclusion devices (TEDs-now no need to have TEDs for shrimp trawls));

- Establishing closed seasons and areas for rehabilitation of marine stocks;
- preserved areas for full protection as fish sanctuaries;
- leased areas for fixed or stationary gear;
- reserved areas for special purposes, e.g. coral reefs, sea grass beds and mangroves; and public fishing areas.

Further, DOF is carrying out other conservation measures, *inter alia:*

- Establishing artificial reefs for spawning grounds, fish shelter;
- Reduction of mesh sizes to reduce by-catches;
- Promoting community-based in fishery management;

Zoning for Conflict Resolution (will be done in near future)
Measures:

1. Zoning: Three major areas have been identified:

- Fishing grounds from 0 to 3.0 nautical miles (5 556 meters) from shore to be managed by Tambon Administrative Office;
- Fishing grounds from 3.0 to 6.0 nautical miles (11 112 meters) from shore to be managed by the Provincial Administrative Office;
- Fishing grounds 6.0 nautical miles or more from shore to be managed by Fisheries Department.

Owing to the different continental shelf's characteristics, the above zoning criterion may be applicable only to shallow seas. Where the continental shelf is steep, smaller distance from shore will be determined.

2. Fishing entitlements:

- All fishing boats must be registered where they are intended to operate.
- All types of fishing gears must also be registered in the fishing ground they are intended to be used.
- Vessel markings will be imposed so that fishing boats are easily identifiable at distance.
- Commercial fishing boats may be required to install a tracking device that is GPS traceable. The role of coastal radio stations to monitor and assist fishing boats may emerge again.

3. Provincial Fishery Management Committee:

- The meeting foresaw the needs for a Provincial Fishery Management Committee comprising Provincial fishery officers, academic expert, representatives of small-scale and large-scale fishermen, and Fisheries association.
- As this larger zoning may also face the lateral demarcation lines as that of TAOs, a bay-wide committee may be a possibility.
- MCS measures will find their niches

Recently, the small scale fisheries or artisanal fisheries are being "open access" fisheries. Although more species-specific through the use of selective types of fishing gear, and with similar management measures in place, these fisheries are becoming more expansion. At present the DOF has a measure to register the number of fishers and fishing boats to address the small scale fisheries.

4. Costs and revenues of fishery management

Costs of fisheries management are shouldered solely by the central government with no legislated cost recovery mechanisms in place, aside from minimal fisheries licensing fees. Costs for management have increased significantly over the past ten years due to increased consultation, monitoring, enforcement, litigation, and conflict resolution requirements. These costs have not yet been passed in total, or in part, on to stakeholders. The priorities of government for fisheries need to run on parallel tracks of implementing responsible sustainable fisheries and marine sector management, as well as seeking ways to obtain stakeholders ownership and cost sharing.

5. Implement of global fisheries mandates and initiatives

Thailand is reported to be a participant of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), United Nations Convention on Law of the Sea (UNCLOS), and is a signatory to the Convention on Biodiversity. Thailand has taken action to address the International Plans of Action (IPOA) for conservation and management of sharks through the implementation of statistics collection, biological studies, and development of a national plan of action. Further Thailand has commenced work on the IPOA for management of fishing capacity, but is limited by its lack of funding and may not complete the measure and assessment prior to 2005. Regarding the IPOA to eliminate IUU fishing, the new Fisheries Act improves vessel licensing and registration controls, and places an obligation and responsibility on the fishing vessel owner to comply with third party legislation when fishing in their waters, e.g., Thailand vessels fishing for Indonesian companies. Commitment for action in these and other IPOAs via national action plans and funding are another challenge facing the Government.

6. Participation in regional and international fishery bodies.

Thailand has bilateral, multiple agreements, arrangements and technical collaboration as follows:

Bilateral arrangements

Thailand has engaged in fishery collaboration arrangements with several foreign countries, mainly her neighboring countries. These permitted fishing vessels were operating in the waters of Indonesia, Cambodia, Malaysia, Bangladesh, Somalia, Madagascar, and Myanmar. Fishery production derived from these arrangements has been brought back to Thailand in order to support fishery processing plants and domestic consumption.

Multiple or Multilateral Arrangements

Apart from negotiating for fishery access, Thailand has also involved with regional economic groups such as Asia-Pacific Economic Cooperation (APEC); Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC); Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT); Indian Ocean Rim Association for Regional Cooperation (IOR-ARC,); Indian Ocean Tuna Commission (IOTC); Southeast Asian Fishery Development Centre (SEAFDEC); Food and Agriculture Organization of the United Nations (FAO); Bay of Bengal Large Marine Ecosystem (BOBLME); and Association of South East Asian Nations (ASEAN).

It is noteworthy that the Kingdom of Thailand hosts several regional offices including the regional offices for FAO/RAP fisheries, NACA and SEAFDEC

Technical International Cooperation
Moreover, under technical cooperation program both bilateral and multilateral, Thailand has cooperated with various international organizations such as Food and Agriculture Organization (FAO), Southeast Asian Fisheries Development Center (SEAFDEC), Network of Aquaculture of Asia (NACA), Codex, European Commission, German Technical Cooperation (GTZ), Japanese International Cooperation Agency (JICA), Norwegian Development Agency (NORAD), USAID, etc. Many technical bilateral arrangements on fisheries are such as Cooperation on Thai-French, Thai-Norway, Thai-US, Thai-Korea, Thai-China, Thai-South-Africa, Thai-Canada, Thai-Vietnam, Thai-Malaysia, Thai-Myanmar, Multilateral ECOST project (Ecosystems, Societies, Consilience, Precautionary principle: Development of an assessment method of the societal cost for best fishing practices and efficient public policies; Project co-funded by the European Commission within the Sixth Framework Programme), FAO/GEF project: Bycatch management and reducing discard from trawl fisheries in the coral triangle and Southeast Asian waters, etc.

7. Relevant regional/national/local policies and strategies on poverty reduction and food security (*description of relevant parts*)

Food security
At regional policies, Thailand is members of RAP/FAO, ASEAN and SEAFDEC, the Department of Fisheries has implemented the national fisheries coincided with regional legal framework for fishery sustainability, responsible fisheries and management of fishing capacity for food security at large.

At local level, the Department of Fisheries has developed and promoted small scale fisheries since 1987. Small scale fisheries contribute directly to food and livelihood security, balanced nutrition, poverty reduction and wealth creation, foreign exchange earnings and rural development. At national level various areas were identified for priority action including the adoption of a human rights framework for social development; the empowerment of community organizations, giving more decision-making power to women; support to adaptive co-management that accounts for traditional knowledge and customary rights; protection and legislation of the rights of small-scale fishing communities to fishery resources and land; promotion of market access through improved post harvest handling and marketing and better access to credit; support to diversified if not alternative sustainable livelihoods; access to basic social services; and overarching capacity building and networking.

Sustainable Development Initiatives
Various initiatives have been developed to help sustainable fisheries for food security and the protection for environment in marine fisheries programs appear as follows:

- Sea turtle, marine mammal, sea grass and coral reef protection program;
- Program to maintain biodiversity;
- Initiative program to produce fish meal using plant protein to replace animal protein (trash fish);
- Habitat and fishing ground improvement program to rehabilitate fisheries resource;
- Promotion of fisheries and environment sustainability and responsible fisheries program;
- Fishing capacity reduction program for trawl and push net;
- Promotion of non-destructive fishing gear program;
- Monitoring program for seawater quality on heavy metal residues in fishing grounds;

- Promotion of community based fishery management in coastal areas; and
- Promotion of mangrove re-plantation in coastal areas.

Social assistance

Social assistance for fisheries sector refers to the promotion of Community-based fisheries management program for small-scale fishers within the initiative program that the Department of Fisheries promote to the fisher groups as follows:

- Small business for local fishery products, ready to eat product and promote One Tombol One Product (OTOP);
- Program for alternative job training in practice and on the site visit;
- Promote the fisher group co-op shop for cheaper essential daily needs; and
- Promote fisher wives gathering as house wife groups to do small business on fishery or agriculture products

Structural adjustment:

- Balance fishing capacity of commercial and small scale fisheries;
- Settle down and develop the program for fishing capacity reduction for trawl and push net;
- Promote fishers to establish crab bank project for sustainable fisheries and secure their incomes;
- Promote Community-based fisheries management for small-scale fisheries;
- Promote right-based fisheries; and
- Promote stakeholder involvement in monitoring, control and enforcement.

Voluntary Program for Labeling

The Ministry of Agriculture and Cooperatives (MOAC) has recently launched a quality label called "Q-mark" for certified agricultural commodities including fishery products. The Q-mark logo represents high quality agricultural commodities and ensures safety for consumption. This national logo is awarded on a voluntary basis. Both production systems and agricultural products can apply for the label providing that they are in compliance with the standards established by MOAC. The Q-mark is being promoted internationally. Consumers can be assured of premium quality agricultural products and exported from Thailand. Q-mark is another tool to assist Thailand in competing in the world market and in achieving the national goal of being the "Kitchen of the World".

8. International and regional commitment relevant to bycatch management and discards reduction (*description of relevant parts*)

Thailand has begun to work on the implementation of the Fishing Capacity Reduction in collaborated with FAO/RAP and collaboration in trash fish project with World Fish Center and FOA/RAP.

9. Relevant government institutional structure (ministries, departments, coordination arrangements)

Organization of the Department of Fisheries, Ministry of Agriculture and Cooperatives

The organization of the Department of Fisheries comprises 10 Divisions and 5 Bureaus categorized as follows:

- Administrative Offices
  - Office of the Director-General and Deputy Director General

- Office of senior fisheries advisors and experts
- Office of senior fisheries inspectors
- Office of internal audit
- Office of central administration.

- Administrative Divisions
  There are four administrative divisions responsible for Policy and Planning, Finance, and Personnel.

- Technical Bureaus and Divisions
  The Bureaus and divisions involved in various technical fisheries activities appear as follows:

1). Fisheries Administration and Management Bureau
The Bureau has its main responsibilities on conducting research in the area of marine and inland fisheries; issuing fisheries conservation measures; monitor and inspect aquatic animal trade; update and revise fisheries related regulation law, announcements and other commands, disseminate knowledge concerning fishery and other related laws, Jurassic Act, Civil Liability of Government officers, Criminal and Administrative case and other related cases, supporting Community participation for sustainable fishery resources and other duties to be assigned.

2). Fishery Technology Development and Transfer Bureau
The Bureau has its main responsibilities in carrying out research and extension on fisheries for development of better businesses and occupations in aquaculture, fishing and fish processing. The goal has been pursuing through: Researching for appropriated methods of fisheries technology transfer; Providing assistance and financial support to fish farmers to increase their production potential; Implementing curriculum development and fisheries training to strengthen fish farmers' commercial competitiveness; Conducting research and development in the area of fisheries engineering; Dissemination of useful fisheries information; Implementing royal-initiated fisheries projects and special activities; Other duties to be assigned.

3). Coastal Aquaculture Research and Development Bureau
The Bureau is responsible to study and research of coastal aquaculture technologies by using highly applied science; Using high technology for increasing efficiency and quality of seed production to commercial scale for export and local demand; Exploration, research and restoration of fisheries resources and environment in coastal aquaculture area; Farm accreditation and quality monitoring of coastal aquaculture production and production process to reach the safety standard for consumers and environmental aspects; Production of seed from improved broodstocks, rare species and endangered species; Development of disease diagnostic techniques and disease prevention and issue health certification; Study and research on nutritional needs of coastal aquatic animal; and co-operation or support work to other involve organization and other duties to be assigned by the Department of Fisheries.

4). Marine Fisheries Research and Development Bureau
The Bureau is responsible for research of the restoration of fishery resources and fisheries environment on the area of Thai waters, disputed areas, foreign waters increasing fishing capacity to be more effective fisheries, the effective improvement of fishing gears technology and fishing technique and method, monitor, control and surveillance fishing ground to meet the safety standard for consumers and environment, providing the knowledge and technical

service on Taxonomy of marine floras and fauna, the marine aquatic management and other duties to be assigned.

5). Inland Fisheries Research and Development Bureau
The Bureau is responsible for research and a development of high technology in Aquaculture; Rehabilitation in fisheries resources and environment; Controlling the hazardous chemical to aquaculture; Setting up and inspection on farm, production and safety standard for consumer and environment; Providing the knowledge in propagation and culturing the improved strain aquatic animal for conservation and economic; Diagnosis and prevention on the aquatic diseases and issuing of aquatic animal health certification for export, controlling of aquatic animal disease epizootic and drug used; controlling the feed quality and issuing of feed certification for export and management on the inland aquatic museum.

6). Fish Inspection and Quality Control Division
The Bureau is responsible for inspection of processing plants' hygiene and sanitation, ensuring implementation of HACCP and improvement of quality of fish and fishery products to meet international standards. FOQD also provides services on laboratory analyses and certification for export.

7). Fisheries Foreign Affairs Division
The Division is responsible for foreign fisheries negotiation, regulation of the fishing vessels and execution to prevent and manage overseas fisheries, cooperating with foreign countries in technical, commitments on bilateral multilateral and international organizations, research and analysis overseas fisheries economic and other duties to be assigned.

8). Fishery Technological Development Division
The Division is responsible for research of post-harvest technology, maximize utilization of fishery resources, improve and quality control of fish fishery products.

9). Fishery Information Technology Center
The Center is responsible for developing and maintaining computer networking, geographical information system management information system and fisheries data collection and statistics reports to digitally provide the fishery information of the nation to the end users.

10). Aquatic Animal Genetics Research and Development Institute
The Institute is responsible to study and research of biotechnological applications to development of molecular markers and genetic mapping, genetic improvement, genetic inspection and maintenance, and gene bank of aquatic animals, plants and the brood stocks. The production and expansion of good quality seeds by the Institute are desirable. The Institute serves the superior policy on other duties to be assigned by the DOF.

For regional administration, there are 76 provincial administrations in fisheries provincial offices located in each province of Thailand. Each office is responsible for research, analysis and evaluation of fisheries technology for supporting fishery business, issuing of the certificate in accordance with fishery laws and other related laws and measures, the surveillance of aquatic animals breeding and fishery, providing of related knowledge and services to fishery employee or aquatic animals breeder, and other duties to be assigned. Moreover, there are 76 Inland Fisheries Research and Development Stations or Centers as well as 22 Coastal Aquaculture Centers. (Annex DOF structure). Research and Development Stations and Centers located in each province and each coastal province, respectively.

DOF is the major organization responsible for management and development of fisheries industry of Thailand. DOF works closely with various organizations both government and private sectors to ensure efficient management both for fisheries management and development and fisheries products export development.

In term of fisheries management and development, DOF involves with various agencies such as National Economic and Social Development Board, Thailand; Board of Investment; Ministry of Natural Resources and Environment; Department of Trade Negotiation; Department of Coastal and Marine Resources; Navy Civil Affairs Department; National Fisheries Association Thailand; The Thai Oversea Fisheries Association; and other related fisheries associations.

In term of fishery product export development, DOF works closely with Ministry of Commerce (Department of Foreign Trade and Department of Export Promotion); Ministry of Finance (Department of Customs); Ministry of Public Health (Department of Medical and Food and Drug Administration). Besides, DOF cooperates with Ministry of Industry (Department of Industrial Works) for fisheries import aspect. Various private organizations working involved with DOF for production and fisheries products export are Thai Frozen Foods Association; Food Processors Association of Thailand; Thai Shrimp Association; and Ornamental Fish Association.

10. Review of legal definitions and terms related to bycatch

Legal definitions and terms related to bycatch

Thailand has no legal definition for bycatch but fishers are familiar with the word trashfish rather than bycatch. Trashfish is a combination of true trashfish and small juveniles of economic fish. There is also no discard from marine capture in Thailand, all landing products can be utilized into various processes.

Bycatch

Bycatch in the sense of scientific works are fish caught unintentionally in a fishery while intending to catch other fish. Bycatch are either of a different species or juveniles of the target species. The OECD (1997) defines bycatch as "total fishing mortality excluding that accounted directly by the retained catch of target species". There are at least four different ways the word *bycatch* is used in fisheries:

- Catch which is retained and sold but which is not the target species for the fishery;
- Species/sizes/sexes of fish which fishermen discard;
- Non-target fish whether retained and sold or discarded and
- Unwanted invertebrate species such as echinoderms and non-commercial crustaceans.

Discard

Discarding impacts on the environment in two ways; firstly, through increased mortality to target and non-target species, particularly at juvenile life-history stages, and secondly, through alteration of food webs by supplying increased levels of food to scavenging organisms on the sea floor, and to sea birds. The survival of discarded fish and invertebrates is variable and depends on species and fishing gear used.

Alverson *et al* (1994) and other workers associated with shrimp trawling identified the discard as the incidental catch of non target species. The use of selection technology in reducing the incidental catch of non-shrimp in temperature waters does, however, seem to be affecting the amount of bycatch discarded and recent evidence suggests that in many parts of the world tropical shrimp bycatch which was once discarded is now being utilized.

Trashfish

In Thailand, the word trashfish has been defined by Hyase and Meemeskul (1987) that trashfish are used mainly for fish meal products or as food for cultured fish or for ducks. The word trashfish generally refers to fish not used for human consumption, that is, primarily for aquaculture and livestock feeds. The word low value fish refers to fish of low commercial value (although of higher value than trash fish), some of which are used in aquaculture feeds and some of which go to human consumption. In this report the word trash fish is used to refer to both groups. Trash fish comprised a considerable number of juvenile and young fish of economical important species; it should be noted that an increase in fishing capacity for trashfish capture in shallow waters and using smaller cod-end mesh size in capturing, it has resulted in a reduction of young economic fish in the trashfish component and further fish stocks could not recover by nature as well.

Trashfish from commercial landing in the Gulf of Thailand has been grouped into 3 groups (Hyase and Meemeskul, 1987) as follow:

1. **Unfavorable group** consists of
   a. Bad taste or inedible fish, no commercial value (Apogonidae, Balistidae, Lagocephalidae, Labridae, Tetraodontidae etc.
   b. Small sized economic species (Leiognathidae, Apogonidae, Bohidae, Pleuronectidae, Balistidae, Fistulariidae, *Pentaprion* spp.
   c. Juvenile of economic fish (Synodontidae, Nemiptidae, Mullidae, Priacanthidae, Lutjanidae,Scolopsidae, Trichiuridae, other demersal and pelagic fish.
   d. Too small quantity in catch (almost economic species)
   e. Low price (not fresh fish- pelagic fish)
2. **Favorable group,** this group has market value

   Economic group, the group comprised unsold fish and local or private consumption**.**

11. Legislation and regulations (e.g. executive orders, decrees etc) – current and proposed – related to trawl fisheries and bycatch management

Under the Thai Fisheries Act B.E. 2490 (1947), Section 32, The Minister or provincial governor in his jurisdiction and with the approval of the Minister is empowered to issue a notification determining:

(1) the size of mesh and dimension of every kind of fishing implement, and size, kind, number and parts of fishing implement, which is permitted in fisheries;
(2) any kind of fishing implement which is absolutely forbidden to be used in fisheries;
(3) the distance between each stationary gear;
(4) the methods of using every kind of fishing implement;

(5) the spawning and breeding seasons, fishing implement and methods of fishing in any fisheries during the said season;
(6) the kind, size and maximum number of aquatic animals the fishing of which is permissible;
(7) certain kinds of aquatic animals the fishing of which is absolutely forbidden is absolutely prohibited.

Several Notifications for trawl and push net fisheries in the Gulf of Thailand have been issued under this Section (32) as follows:

a). trawl and push net with motor vessels are prohibited within 3,000 m from shore line in order to conserve young aquatic animals and their eggs from being caught and destroyed;
b). trawl, push net, La-wa, shrimp push net, Sergestid push net, and other similar nets of similar use with motor vessel or engine, absolutely in fishing throughout the Lake of Songkhla, including Talay Noi in the locality of Songkhla and Pattalung provinces;
c). any kind and any size of trawls, push nets, la-wa, zip, shrimp push net, Sergestid push net, and all kinds of bag nets with motor vessel or engine in fishing in the coastal areas of Cholburi province (as indicated in the map attached) of in any means as from September 1 to the end of February of every year are prohibited;
d). Prohibition of certain kind of fishing appliances in spawning and breeding seasons in the locality of Prachuab Kiri Khan-Chumporn-Surat Thani provinces;
e). Determination on fixing TED with shrimp trawl fishery (At present this issue is eliminated-May 2010). No person shall absolutely use a shrimp trawl with any kind of motor vessel for fishing in fisheries in the gulf or bay of any seaside provinces. Exemption shall be allowed to the fishing by using shrimp trawls that have already fixed with turtle excluder devices or other similar appliance of similar use as in the pictures annexed hereto;
f). Sea grass bed protection; and
g). Beam trawl is prohibited in locality area in Cholburi province.

12. Relevant national/local legislation with regard to decentralization of fisheries management, co-management arrangements and spatial management (e.g. fisheries refugia)

Implementation of the Fisheries Act is carried out primarily at the Provincial and District (sub-provincial) level. The 1994 Royal Decree on Administration, in combination with the 1992 Administration Act, sets out the authority of both the Provincial Fishery Officer (each province has a Provincial Fishery Officer) and the District Fishery Officers. The District Office and the officers therein report to the Provincial Officer. Because the authority of Provincial Fishery and District Fishery officers is derived simultaneously from the 1994 Royal Decree, the 1992 Administration Act and the 1947 Fisheries Act, the relationship between these officers and both the Provincial Governor and the Department of Fisheries are complicated. It appears that while the District and Provincial Officers have implementation responsibilities under the Fisheries Act, they report through the Provincial Governor to Department of Fisheries rather than directly to senior officials in Department of Fisheries. While the Provincial and District Officers do not answer to, nor are under the control of the Provincial Governor, the cooperation of the Provincial Governor is important if smooth relations are to exist between the fishery officers and Bangkok. Other aspects of the broader

Department of Fisheries mandate set out in the 1994 Royal Decree are implemented or carried out by the 30 divisions or institutions within the Department of Fisheries.

The provincial fishery officers and local authority can request for Provincial Notification to manage their own resources through the National Constitution: State is to promote and encourage public participation in the preservation and exploitation of natural resources and, more generally, in the maintenance and protection of the environment. That Notification should be well collaborated to the Fisheries Act. One good example is Bang Saphan Bay Community based Fishery Management that has demarcated their management zones.

Provincial Governors

Consistent with the 1947 Fisheries Act and with the decentralization of authority within Thailand, Provincial Governors can be given certain authorities by the Minister respecting the fishing activities that take place within their jurisdiction. While it is sometimes asserted that a Provincial Governor has jurisdiction and responsibility for all matters (including fisheries) which arise within the territory of a province, the jurisdiction and responsibility of a Provincial Governor arises from legislation, thus the authority of a Provincial Governor is not inherent but is delegated. Under the 1947 Fisheries Act, the Provincial Governor could be delegated authority regarding fisheries matters within his jurisdiction. This was done through administrative and governmental organization decrees, legislation, regulations and notifications.

Regarding to the Ao Bo To Act B. E 2537 (1994) and revision Act 2542 (1999) No. 3 concerning the natural resources and environment management in harmonize to the Constitution of the Kingdom of Thailand B.E. 2550 (2007) Section 66, 67 and 85 and the Fisheries Act B.E. 2490 (1947) Section 67 (subsection 7) and Section 71, the co-management or community based fishery management or fishery refugia can be settle through participatory approach.

13. Review of management measures applied to the concerned fleet

a. licensing scheme

The 1947 Fishery Act contains numerous provisions regarding the registration of vessels, fishers and fishing gear. Generally, the approach of the 1947 Fisheries Act was that, if an individual paid the required fee, then registration had taken place and fishing could occur. Registration of this type is important for determining the numbers of fishers, vessels and types of gear in use. The Department of Fisheries have the authority to manage the marine resources in Thai waters and the fishing activities of Thai flag fishing vessels have been accomplished with the use of licences, permits and written permissions from the bilateral arrangement. At the moment, the vessel registration is on the hand of Marine Department which responsible for all kinds of vessels whereas the fishing gear registration is responsible by the Department of Fisheries.

b. effort control

The effort control has been issued by the Department of Fisheries as follows:

- mesh size regulation for pelagic fish caught by purse seine with light using mesh not less than 2.5 cm; for anchovy with light using mesh size not less than 0.6 cm; for squid fishing with light the mesh using is not less than 3.2 cm and for short necked clam the sieve size not less than 1.2 cm and coincided with prohibit to posses dredge more than 3 number during operation and boat size less than 25 m LOA as well. At

present there is no mesh size regulation for trawler and the DOF is determining to regulate for mesh size use in the bottom part of crab trap;

- Number of boat, the DOF has implemented boat-tenure system for trawlers. To freezing the number by no transferring license to other person except for the son, licenses have to continue in every fishing year (1 April to 31 March of the following year) otherwise the license will be cancelled;
- Any size of fishing boat with engine or motor could not fish thoroughly within 3,000 m from shoreline;
- no entry for new building fishing boat except for fishing outside Thai water and having a permission document from the juristic country fishing ground.

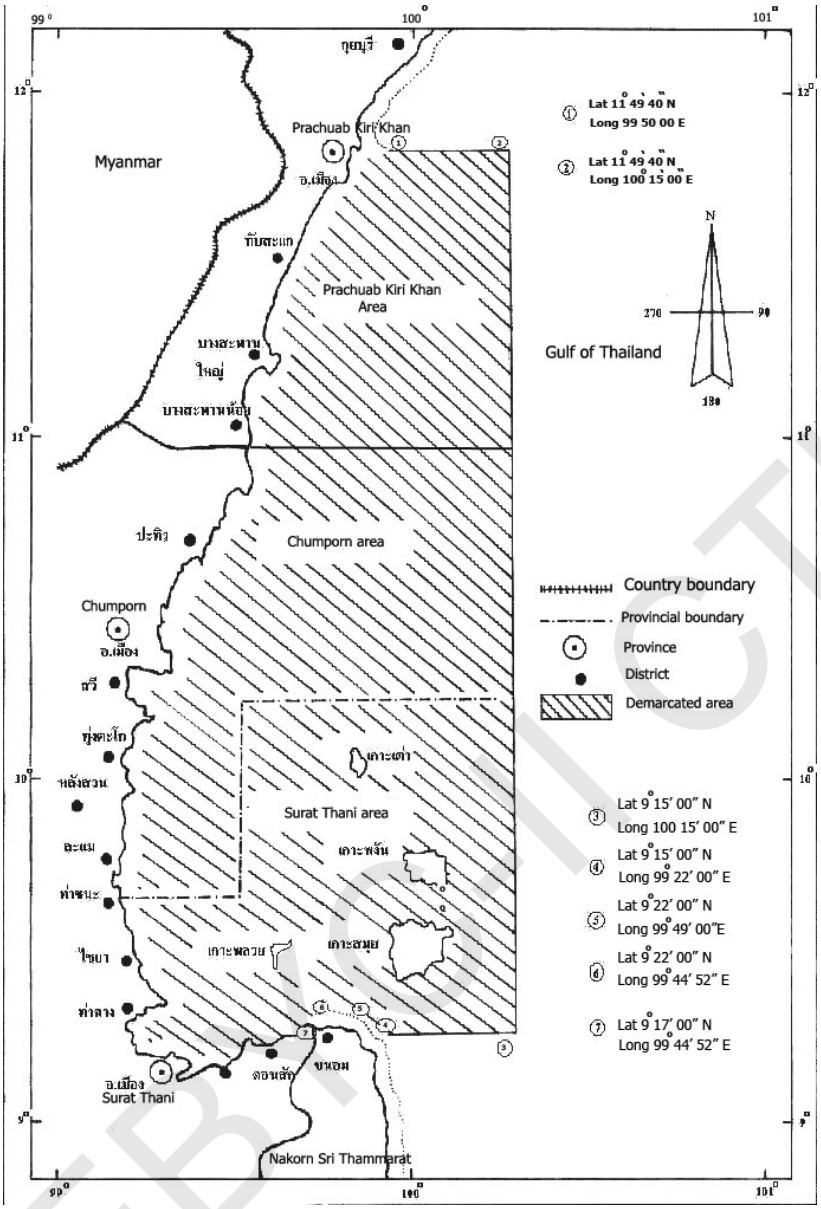
c. closures (by area and by season), MPAs

The Ministry of Agriculture and Cooperatives has issued several Notifications to protect nursing area and spawning season for marine animals in several areas both in the Gulf of Thailand and in the Andaman Sea, e.g. areas located in Trad, Cholburi, Prachuab-Chumporn-Surat Thani, Songkhla lake, Pattani provinces. An example is shown in Prachuab Kiri Khan-Chumporn-Surat Thani provinces, this Notification has been issued on 2 November 1984 and has been developed to cover the present fishery situation.

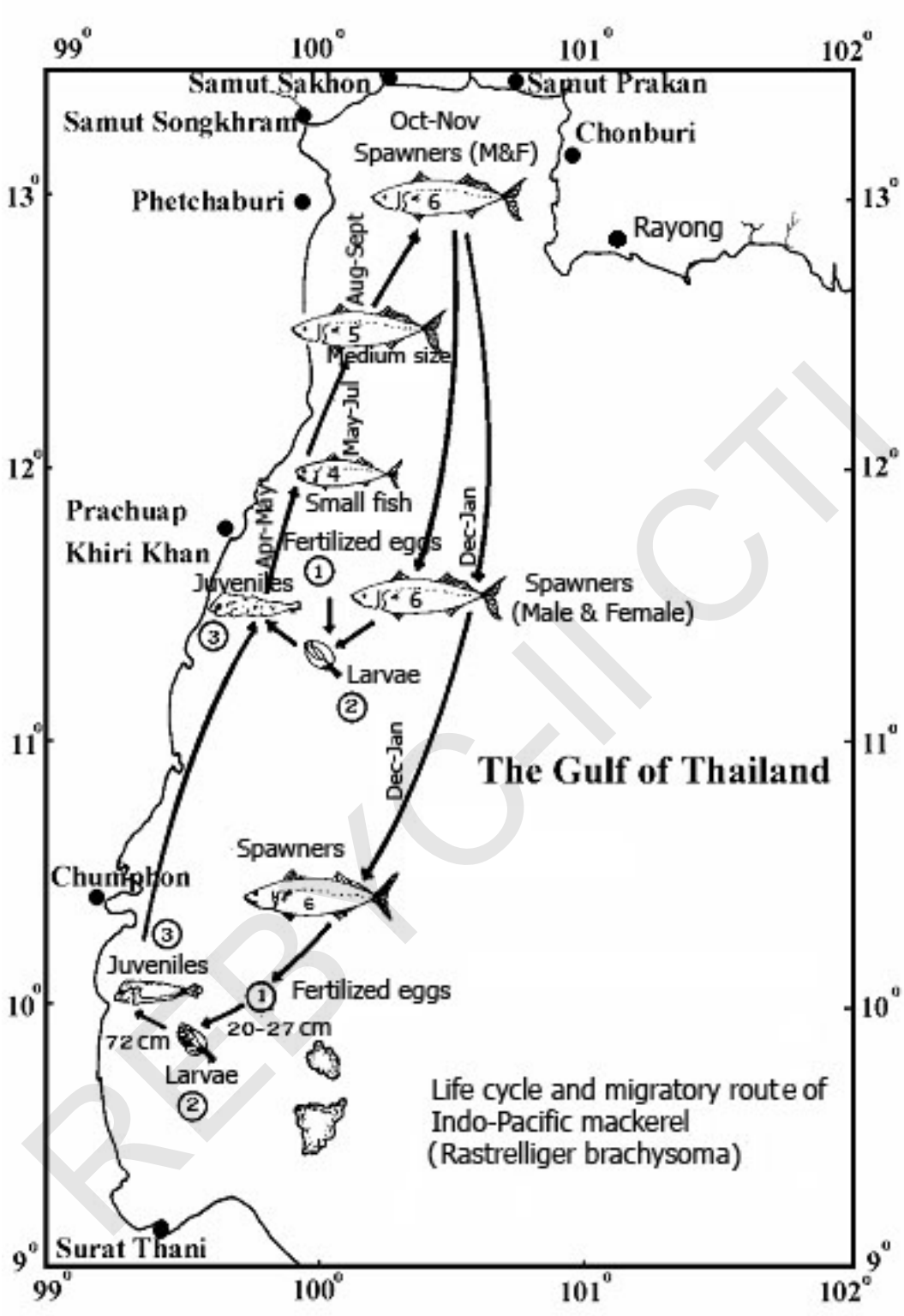
The prohibition of certain kind of fishing appliances in spawning and breeding seasons in the locality of Prachuab Kiri Khan-Chumporn-Surat Thani provinces; which detailed in:

1. area demarcated as indicated in the map attached (Map 1);
2. closed season during 15 February to 15 May annually; and
3. prohibited types of fishing gear:
   a). all types of trawling fishing boats which operating with engine, except one boat fishing at night time and LOA less than 16 m;
   b). motorized fishing boat using encircling gill net in operation or similar method;
   c). light luring purse seine with mesh size larger than 2.5 cm;
   d). all light luring anchovy purse seines are prohibited; and
   e). motorized push net with LOA more than 14 m is prohibited.

At first this closed area and season measure was covered only for Indo-Pacific mackerel, since from the intensive studies on the life history, fish larvae, the mortality and the migratory routes of this species that were clearly shown and documented via several research works (Map 2). The Department of Fisheries decided to protect the Indo-Pacific mackerel for sustainable used. This species is also well known and favorable for most Thai people. Later on there were several research work evidences that not only Indo-Pacific mackerel has its nursing area and spawning ground but also several demersal and invertebrate animals have spawning grown and nursing at this area. Further the closed area and closed season measures were revised to cover all important economic species as appeared in the above mention.



Map 1. Closed area and closed season with types of fishing gear prohibited. The closed area is covered 26,400 km^2.



Map 2. Life cycle and migratory route of Indo-Pacific mackerel *(Rastrelliger brachysoma*) in the Gulf of Thailand (Adapted from Menasveta, 1980).

d. gear regulations to improve species and size selectivity

At present there is no direct measures and regulation for trawl gear to improve species and size selectivity. Sizes and species selectivities are only issued for purse seine, anchovy purse seine, squid light luring fishing and short necked clam dredge. In near future DOF would have limited cod end mesh size for trawlers and for swimming crab trap.

e. bycatch reduction measures

In Thailand there is no direct measures for bycatch reduction; The DOF has reduced number of push net fishing boats for several years (started in 1997 to 2003) which could reduce some amounts of trash fish caught by push net. Next step, DOF will request the government budget to compensate for those trawlers whose want to quit or change to another more selective size and species to fish; environmental friendly fishing gear or aquaculture for plankton eater fish, e.g. oyster, mussel, blood clam etc.

f. other

1) initiate the local fish groups/community and local authorities to establish reserved area (closed area and season, MPA or refugia) for small scale fisheries at localities using local law and regulation coincident with DOF law and regulation;
2) revision of up to date license fees, one who destroys environment or catches more should have to pay more;
3) take action for some types of efficient fishing gear that did not yet included in the list of fishing in tool coordinates;
4) Initiate trawlers to fit JTED to reduce juvenile capture;
5) Initiate trawlers to change their mesh sizes codend for some times and then issue measures to control and regulate; and
6) Reduce or stop subsidize for trawlers (green and purple fuel).

14. Compliance with regulations

A review of MCS systems in place for trawl fisheries including use of VMS for monitoring trawl vessels

Monitoring, Control and Surveillance (MCS)

Along with the potential for enhanced economic benefits, the 1982 Convention on the Law of the Sea also brought with it responsibilities for coastal States in the utilization of resources in EEZs. It is this latter responsibility that, in many cases, has demonstrated the need for development and control over the use of a country's marine resources. Fisheries are central to this development, as fish and their habitats are key resources in the exclusive economic zone. Although the objectives of fisheries management and MCS are generally to take advantage of the economic opportunities of the extension of the EEZ, they also include the exercise of sovereign rights over the zone, conservation of marine resources, and collection of appropriate data on activities to ensure sound, rational oceans and fisheries management planning. Fisheries MCS needs to be defined in light of these points.

MCS has aspects distinct from ***fisheries management***, although there is overlap. According to the 2003 FAO paper on Recent Trends, fisheries management consists of:

- Data collection and analysis
- Participatory management planning
- Establishing a regulatory framework
    - Input controls
    - Operational and output controls
- Implementation

Management criteria include:

- Establishing designated fishing areas in which no fishing, fishing by vessels with permits, or open fishing is allowed.
- Restrictions on fishing gear, including the banning of certain types on vessels in given areas, or controls on such parameters as the mesh size of fishing nets. These restrictions can be enforced only by physical inspection at sea or at dockside.
- Catch and quota controls, by species or total take
    - Days at sea
    - Daily time at sea
    - Seasonal catch limits
    - Per-trip catch limits
    - Limits on catch within certain areas
    - Individual (vessel) transferable quotas
    - Minimum or maximum fish sizes
    - Bycatch

- Vessel movement controls
    - Into areas
    - Exiting areas
    - Sightings in areas

- Onboard observers
- Licensing
- Vessel inspection

While MCS, in the basic FAO definitions, does not include *enforcement*, that category will be included here as part of the means of implementing MCS operations. In MCS discussions, there is a strong emphasis that the success of MCS is not to be measured in number of arrests, but in the level of compliance with presumably reasonable frameworks (i.e., the "control" part of MCS). If a sense of participation in the development of controls, as well as peer pressure, leads to meeting the fisheries management controls without a single arrest, the MCS program is successful (Wikipedia.org, 2010**;** Flewwering, 1999).

Monitoring

A 1981 Conference of Experts defined **monitoring** as "*the continuous requirement for the measurement of fishing effort characteristics and resource yields*" This was expanded, in a 1993 workshop to include the measurement of:

- catch;
- species composition;
- fishing effort;

- bycatch (i.e., species other than the targeted one incidentally captured by the primary effort) and
- area of operation.

Control

According to the 1981 Conference of Experts, **control** is the "*regulatory conditions under which the exploitation of the resource may be conducted"* This is usually considered to consist of legislation, regulations, and international agreements. Each of these should describe the management measures required and the requirements that will be enforced. The actual enforcement mechanisms are not part of control.

Surveillance

Surveillance, according to the 1981 Conference of Experts, is "*the degree and types of observation required to maintain compliance with the regulatory controls imposed on fishing activities.*" The Ghana workshop termed it the "*regulation and supervision of fishing activity...*" This definition does not clearly include enforcement.

Many systems are involved in the technical process of surveillance. Radar, including coastal, airborne, and space borne systems, may be intended for national security or law enforcement, but can simultaneously provide information to fisheries management and environmental protection authorities.

Enforcement

Enforcement ranges from self-regulation to onboard observers to patrol platforms (vessels and aircraft) to law enforcement activity.

MCS implementation has sea (log book by fishers and catch reporting by onboard observers) land (Catch inspectors, electronic instrument), and aerospace (Low-flying aircraft can visually identify fishing vessels) aspects. Monitoring systems, such as Vessel monitoring system, may operate in all three of these regimes. These aspects also affect other maritime systems that can cooperate with VMS.

Also on the fishing vessel can be the shipboard components of vessel monitoring system (VMS). These can be independent systems involving navigational and time input, embedded and dedicated computer, and radio transmission of reports. The transmission is usually via satellite, but some countries are using coastal VHF repeater systems.

Vessel monitoring systems (VMS) are used in commercial fishing to allow environmental and fisheries regulatory organizations to monitor, minimally, the position, time at a position, and course and speed of fishing vessels. They are a key part of monitoring control and surveillance (MCS) programs at the national and international levels. VMS may be used to monitor vessels in the territorial waters of a country or a subdivision of a country, or in the Exclusive Economic Zones (EEZ) that extend 200 nautical miles (370.4 km) from the coasts of many countries.

Detail of VMS approved equipment and operational use will vary with the requirements of the nation of the vessel's registry, and the regional or national water in which the vessel is operating. Fisheries followed by VMS fall into two main categories:

- Local/regional fish

- Highly migratory species (HMS) such as tuna and billfish

In case of Thailand, the MCS system has been implemented for those fishing vessels that fishing in neighboring countries e.g. Malaysia. In the EEZ areas of the country, there is no establishment of this system for Thai fishers due to too expensive for them and has no well understanding situation. In some coastal areas funded by Coastal Habitat and Resource Management (CHARM EU funding) project, the small scale fishers in the Andaman Sea coast have VMS system using coastal VHF repeater system to report local authorities to arrest illegal fishing boats that poaching into reserved areas.

Vessel Positioning System (VPS)

VPS is functioned by using mobile phone, GPS (Global Position System) and satellite to communicate between on board at sea and on land at office. VPS will report where the fishing vessel is by using (Fig. 36):

a) the telecommunication like GSM (Global Service Mobile) for communication between the vessels at sea and the offices on land, and
b) GPS (Global Positioning System) for vessel position on Earth.

In 2008, the Department of Fisheries (DOF), National Electronics and Computer Technology Center (NECTEC) and Geo-informatics and Space Technology Development Agency (GISTDA) have initiated the pilot project of using the Vessel Positioning System and Satellite Imagery. The overall number of vessels to be equipped with VPS is 50 vessels. The main objective is to find out the possibility of implementing the vessel monitoring system in Thai waters in terms of

- the reliability of the VPS equipments,
- the willingness of fishing vessel owners, and
- role of satellite imagery, particularly THEOS (Thailand Earth Observation Satellite; the first Thailand Resource Satellite) assisting in mapping the vessel distribution at the appropriately available time.

However, Thailand has monitoring and sampling surveys for catch, species composition, fishing effort, trash fish (bycatch i.e., species other than the targeted one incidentally captured by the primary effort) and area of operation or fishing grounds. Law and regulation control through enforcement for closed area and closed season, reserved area within 3 km or 3nm in some proclaimed localities.

Although there is much written documents about MCS but there is no method directly to the fishery authority responsible for decision regarding the fisheries in the country with guidance and advice on how to introduce or strengthen the MCS. In Thailand there is no established system for monitoring, control and surveillance of maritime zones to conserve her marine

fisheries and associated habitats. In such situation the country needs assistance in addressing this issue.

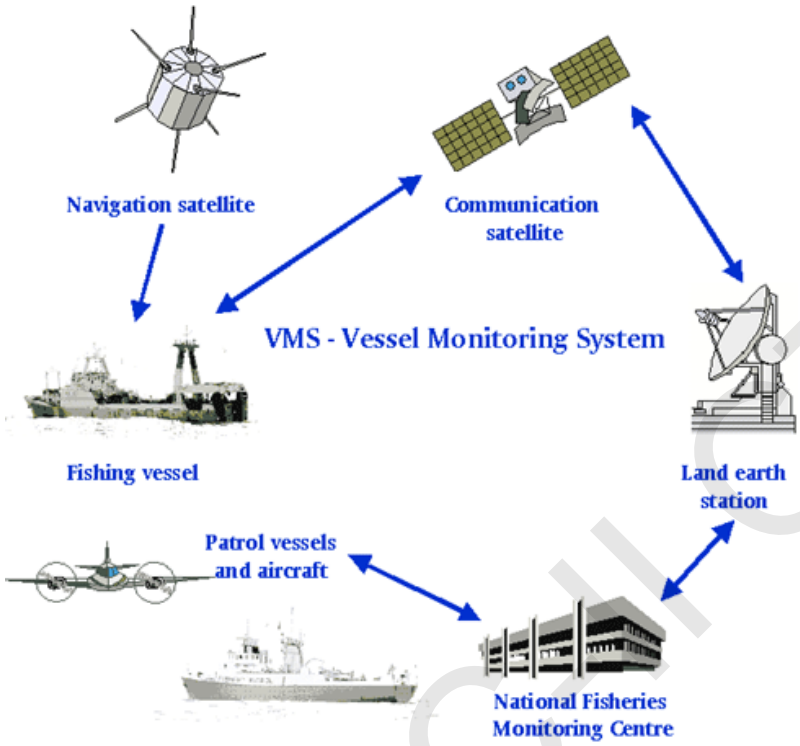


Figure 36. The Vessel Position System (VPS) function.

Level of compliance with regulations

The level of compliance with trawl fisheries regulation of the DOF regarding to the illegal fishing in reserve/conserved and other areas is limited only arresting the illegal fishing boats, gear and illegal seamen sending to police for judgments. These measures/regulations are also transferred to Marine Department, Marine Navy, the Department of Marine Coastal Resources and Fishery provincial offices for arresting illegal fishing.

Problems encountered with regard to bycatch/discards and management of concerned fleets

Capture of juveniles (name species and amounts), larger species (including turtles, sharks and rays)

1). Since the marine resources especially demersal fish are scarce, fishers try to use smaller mesh size to intending catch more small fish or trash fish to compensate the loosing benefit from big fish.

2). Area preservation for juvenile and spawners are usually invaded by commercial fishers who want to catch more fish without awareness of depletion of fish stocks.

3). Small scale fishers gathering to protect their areas of fishing against commercial fishers causing conflict problem for overlapping fishing grounds.

4). Illegal fishing boats are still fishing by using another fishing license permit, especially trawlers.

Thailand adopted the CCRF as one of its major tools for fisheries management throughout the State and has take action to implement the IPOA-SHARKs through the collection of statistics, the undertaking of biological studies and the development of a national plan of action. Thailand endorsed the IPOA-IUU and is in the process of establishing the IPOA-IUU through a national committee to supervise and provide guidance and policy to implement NPOA-IUU in order to ensure that Thailand is a responsible fishing nation.

Interactions of coastal trawl fisheries with other ecosystem components: with prohibited, protected and threatened species and with vulnerable bottom habitats

Fishers are accepted to have more areas closure, agree to have more installation of artificial reef (AR) to protect sea bottom and as fish shelter to protect threatened species and rehabilitation of the resource and habitats.

Conflicts between different fleet segments, fisheries and other resource users

Review of specific situations where conflicts occur between different resource users and stakeholder groups

The conflict between traditional or the coastal small scale fishers and the commercial or the large scale fishers has long been realized in many countries including Thailand. The word conflict implies the competition between these two groups of fishers both in the sea and on the land.

The advancement of fishing technologies especially the trawling fishery has given a great advantage for the commercial fishers over the traditional fishers. The encroachment of trawlers into the area three kilometers from the shoreline removed marine resources from the traditional fishers is an example of such conflict. The decreasing coastal fish species, and then worsen initial ecological condition are directly affected to the traditional fishers who use the stationary fishing gear such as squid trap, crab gillnet, shrimp trammel net or the simple movable gear such as push net. The conflicts on the fishing areas are usually occurred over the Gulf of Thailand and Andaman Sea; in the gulf the mostly occurred areas are in Trad, Chumporn and Surat Thani Provinces. Direct losses occurred to the small scale fishers when their fishing gear were damaged or towed away by the encroachment of commercial boats within three km. Shortnecked clam dredging versus small scale fisheries at near shore areas is usually occurred. The arrested trawlers which are fishing at trans-boundary areas of neighboring countries make political issues among neighboring countries.

The competition between the two fisher groups (LSF and SSF) also happens in the market level, both in the input and the output markets. Due to the scale of operation, the commercial fishers will have the better bargaining power to obtain the lower input and the higher output prices. Scale of economy also helps the commercial fishers to have more efficient use of input factor than the small scale. There is no fisheries policy directly employed to solve the problem between those fisher groups. Most of the government agencies and private organizations were also concentrated relatively more on the commercial fisheries. The voiceless coastal fishers which is in fact, the majority of the fishers (about 87 % in population but contributes only about 13 % of total marine production) have to struggle mostly by

themselves. The development of the fishery industry as well as the implementation of fishery regulations have not been sufficiently supported the major part of the small scale fisher population

Nature of conflict

Nature of conflict is dealing with the overlapping fishing area of the small scale and commercial fishers such as the shortnecked clam fishers come to fish in the near shore area and destroy the benthic habitat which is the fishing ground of the small scale fisher; anchovy light luring at near shore fishing that capture young and juvenile fish in high percentage apart from anchovy; trawlers fish in the area which the small scale fishers have placed their trap and their traps were destroyed.

How the conflict is addressed

The fishery conflicts have been addressed and solved in case by case, for example in the case of the anchovy fishery which using fishing zone to solve the problem in Songkhla province.

There has a long history for anchovy fishery that makes conflict to other types of fishing gear and the fishers frequently request DOF to except some fishery regulations for anchovy fishery. At present there are several Notifications of the Ministry of Agriculture and Cooperatives that directly regulate the anchovy fishery, e.g. a Notification issued on 1 February 2000, setting the program for the fishers who used anchovy nets to register and apply for fishing licenses and control mesh size (0.6 cm); a Notification issued on 23 March 2001, banning the anchovy lift net and falling net used with electric generator to catch anchovy. Until now the fishers are frequently request DOF to allow them to use smaller mesh size (0.5 cm).

Previously, the anchovy fishers operate their fishing activities more concentrate in the eastern and central Gulf of Thailand until 1996, the resources were scarce. They extended their fishing activities to southward. Conflicts occurred between the one who move in and that the local fishers. Usually, the fishery resources are considered as opened access that anyone can move to anywhere to fish. In this case the local fishers in Songkhla province did not allow outsiders to move in their areas. The seriousness conflicts continually increased. Consequently, the Board of National Policy agreed to set up Songkhla as an example area for case study of anchovy fishery using a zoning system with the following details:

i. Area within 5 nm would be used for local fishery
ii. Areas within 5–12 nm would be used for anchovy falling and lift nets
iii. Areas within 12–15 nm would be used as a buffer zone
iv. Areas more than 15 nm would be used for bigger size boat for anchovy falling and lift nets

It is note that there is no setting for suitable number of fishing boats in each zone that led to less catch in zone 5-12 nm in recent year.

Other problems related to fisheries management, e.g. with regard to:

1. Economic and/or biological overfishing

a). Fishers try to compensate from loosing big fish capture by using small mesh to catch more juvenile economical fish including true trash fish. These will cause recruitment over fishing of the fish stocks.

b). Fish handling should be improved for more fresh fish product during the line of preservation and transportation including clean containers.

c). Some fish families in trash fish component are currently being over fished. However, as many of these families are caught both as trash fish and for other commercial uses, the relative contribution of these needs to be understood. The role of the expansion of the fishing grounds over time also needs to be examined.

2. Fleet capacity and fishing effort

Excess number of fishing boats, especially the illegal fishing boats should be eliminated out of the fisheries for first step.

3. MCS / enforcement

- Nowadays, MCS system is still very expensive for Thai trawlers who fish in the EEZs areas.

- Enforcement from several governmental sectors is confused and using different standard in regulation and enforce.

4. Other

Some fishery management measures are not yet decentralized to local authority which can make people in the area trouble e.g. the local community has implemented their areas to conserve some fish species, no fishing in spawning season but the fishers come from outside to fish. There is no method to arrest due to fisheries are open accesses and no official boundary in the sea.

Importance of bycatch from a socio-economic point of view that could constitute a disincentive for reducing bycatch

Income for fishers and postharvest handlers

For social economic point of view to reducing by catch from trawl fisheries, it needs to collect intensively data on the economic and social cost and return for the complete market. Models should also look at how these economic and social benefits will change with changes in the market pathways.

Demand from aquaculture

Recently, the quantity of trash fish and low value food fish demand from aquaculture sector is not enough due to the quantity of aquaculture production has increased. Even though the very high demand of fishmeal that the local trash fish could not serve adequately, the fishmeal from abroad such as Peru has been imported as well as the feed pellets to complementary the need.. However the trends of commercial landings catch of trash fish and low value food fish are slightly decreasing continuously and so there might be the more obstacles for reaching the goals of increased aquaculture production. It is difficult to estimate on the amounts of imported feed and fishmeal in the country. This information would be critical in assessing the country level demand for local “trash feed” in aquaculture feeds.

SECTION 3: KEY ACTIVITIES, STRUCTURES AND PERCEPTIONS

Under the Master Plan for Marine Fisheries Management (2009-2013), there are activities and programs in support of by catch management and sustainable fisheries as follows:

1. Develop and promote fishing gear and fishing methods for sustainable fisheries

1.1 Prescribe measures for control of destructive fishing gear and methods, and overcapacity.
1.2 Promote research and improvement of fishing gear that are ecosystem and environmental friendly
1.3 Educate, train, and support the use of fishing gears, equipment, and fishing methods that ascertain sustainable fisheries.

2. Regulate the practices that are illegal and destructive to the fish stocks and their habitats

2.1 Recognize and promote the use of fishing gear and their ancillary equipment as prescribed by law;
2.2 Control the marketing of illegal catch;
2.3 Initiate legislative process for the control of illegal possession of certain species and/or sizes of aquatic animals;
2.4 Promote and support the fishing practices leading to the reduction of bycatch and trash fish;
2.5 Promote and support the fishing practices leading to the reduction of bycatch and trash fish and
2.6 Improve MCS measures including the measures of Port State control that is actively participated by local governments and fisher organizations.

3. Promote the utility of fish catch to its fullest potential

3.1 Initiate and promote the processes that effectively reduce the post-harvest loss, both at sea and at any point of the transport chain.
3.2 Promote a full use of fish catch for human consumption, and any value-added processing.
3.3 Improve basic infrastructure in fisheries and transportation to reduce the post-harvest loss
3.4 Apply effective post-harvest handling to preserve the maximum possible value of the catch.

4. Devise methods to make use of potential marine living resources that have not been fully used

4.1 Encourage any research/experiment, and resource exploration to discover unexploited or underexploited resources, e.g. living resources in deep sea and along continental shelves.
4.2 Promote/support designing of fishing gear and fishing methods commensurate with the living resources and are ecosystem and environmental friendly.
4.3 Conduct feasibility study to identify marketing feasibility, and to demonstrate/encourage their utility by fishers.

5. Activities and programs in support of bycatch management and sustainable fisheries (with regard to fishing or postharvest/marketing activities):

Description of current and planned activities

- **Government activities**

The Department of Fisheries has settle the Master Plan for Marine Fisheries Management for ten years period which has been approved by the cabinet, The Action Plan will be implemented which the plan is included the flowing activities concerning on bycatch issues as:

a) to reduce number of boats especially for trawlers in the Thai EEZ fishing zone within 5 years and to initiate some bigger sized boats to change or adapt their fishing gear to use long line to fish in the high sea within 8 years using Agricultural revolving fund;

b) to improve post harvest and handling process to meet health standard level;

c) to establish 3 areas for fishery refugia in Trad (1) and Koh Sammui(2);

d) to alternate destructive fishing gear to environment friendly fishing gear from year 2012-2014; targeting to PN and trawlers;

e) to enlarge the MS codend of trawlers and propose management measures targeting to the registered boats; .

d) to improve/develop logistic facility for fish production, community central market and fishing piers.

- **Donor funded projects and activities**

The donor funded projects and activities are SEAFDEC which provides technical assistant in several research projects and meeting facilities; FAO provides technical assistant and funding in several research projects and meeting facilities; the Fisheries Association of Thailand is funding for some meals during some meetings and the Thai Oversea Fisheries Association is funding for some meals during some meetings.

- **Other activities carried out (by NGOs or other organizations)**

With regards to the fishery and coastal resource protection and conservation, the main NGOs working in Thailand are Volunteer for Society Fund, Lae Tai Project, Southern Small-Scale Fisheries Association, Yad Fon Association, and Wildlife Fund Thailand. These NGOs are acting as the supporting and facilitating organizations in various mechanisms e.g. financial and/or academic working, there are various activities from other NGOs working in collaboration with them. The project programs can be implemented as sub-projects in which the above major key NGOs are the executing agencies**.**

6. Planning and implementation processes

Which directorates are engaged in planning management measures?

The Administrative and Fisheries Management Bureau, Marine Fisheries Research and Development Bureau, Policy and Planning Division, Provincial officers from coastal areas

and the Fisheries Conservation Committee are engaged in the planning management measures which the representatives from fishers/stakeholders are participated in the processes.

7. What is the planning process for investigating and implementing management measures?

The Marine Fisheries Research and Development Bureau has synthesized the results from research works and proposed for conservation management measures then the Administrative and Fisheries Management Bureau and Policy and Planning Division frequently consult to the Marine Fisheries Research and Development Bureau and Provincial officers to formulate for management measures. Further, the management measures are put into consideration from the Fisheries Conservation and Management Committee which fishers or representatives of stakeholders are participated and adoption. After adoption, DOF will hold a Fisher and Stakeholder Meeting to closely investigate and consideration for acceptance. If there is some problems the measures will be reconsidered and revisited again until having higher level for acceptance from the meeting. Then the management measures will be approved and announced to public before implement about 0ne month. The consideration of management measures is taking long time for some measures which some measures will never come out to implement due to some pressures from political and social issues.

- **What level of private sector participation is being planned?**

Usually the private sectors will participate in some local meetings, bilateral arrangement meetings between Thailand and neighboring countries at local, national, regional and international levels. The private sectors will volunteer to implement some issues e.g. Good quality product (Q-Mark) HAACP, VMS from local community and VPS.

8. Earlier activities and research conducted to minimize impacts of fishing

Reviews of bycatch and discards studies and list of references

Experimental on optimum mesh size used in trawl fisheries

There were several research works on the enlargement of the cod end mesh size of trawlers in the Gulf of Thailand and South China Sea (Meemeskul, 1979; Sinoda, Supongpan and Supongpan, 1987). The optimum cod end mesh size of trawlers for 68 economic species was ranging 4.5 – 5.5 cm and the trash fish caught being bigger when using larger mesh (Figs. 37 and 38). Figure 38 shows the yield and value were varied by mesh sizes used (Demersal Fisheries Working Group, 1995;.Boonwanich, 2008) has also reported his experiments on the retained catch using codend mesh sizes 4.0 and 6.0 cm of trawler as well as estimated gain and loss within 6 months when enlarge mesh size.

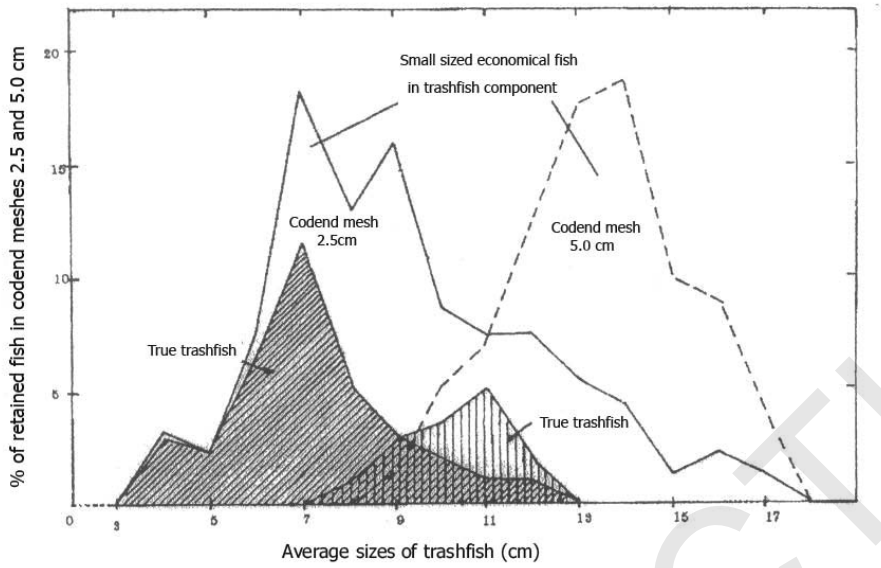


Figure 37. Size composition of trash fish caught by codend meshes 2.5 and 5.o cm.
(Sinoda, Supongpan and Supongpan, 1987).

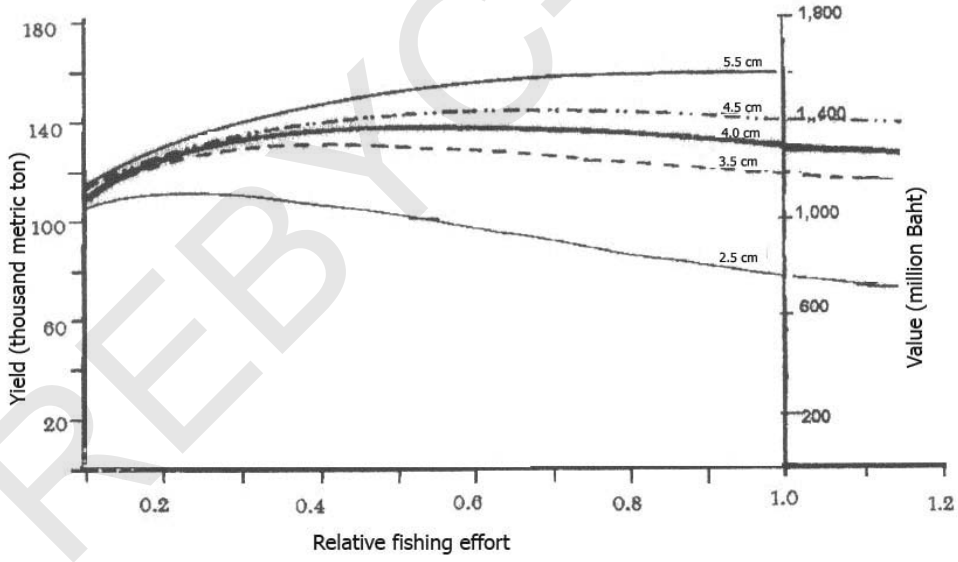


Figure 38. Yield and value of fish caught were varied by cod end mesh sizes used in trawl fisheries in the Gulf of Thailand.
(Demersal Fisheries Working Group, 1995).

Reviews of technologies introduced to reduce bycatch and discards

Juvenile and Trash Excluder Devices (JTEDs).

Over years the Training Department of the Southeast Asian Fisheries Development Center has completed a wide range of experimental fishing trials on the use of Juvenile and Trash Excluder Devices (JTEDs). These trials have been investigated the effectiveness of the rigid

sorting grid, rectangular window and semi-curved window types of JTEDs in releasing juveniles of commercially important fish species and trash fish from demersal fish trawling operations. Experiments began in Thai waters adjacent to the Provinces of Chumphon and Prachuap Kirikhan in 1998. This initial work led to the identification of the rigid sorting grid device as an effective tool in removing juvenile and trash fish from trawl capture.

In Thailand, experiments on the use of Juvenile and Trash Excluder Devices was on a cooperative basis with the Thai Department of Fisheries. A series of experiments on JTEDs in fish trawling operations were completed during two separate cruises. The first cruise took place from 1st to 12th June 1998 in the waters off Chumphon province, and the second cruise was conducted in the waters off Prachub Kirikan province from 28th September to 9th October 1998. The vessel, M.V. PRAMONG 1, was used for both cruises and series of experiments. Two JTED types (rectangular shaped window and semi curved window) were used in these experiments. The escapement and species composition were investigated. The trials took place in water depths of 15 to 25 m, the percentage of release levels of commercial species, cephalopod and trash fish were recorded.

It is note that there is no study on the loss and gain as well as social economic issues for using JTED in the fisheries. How is the perception from the fishers and stakeholder in these issues? There is a need to further study and experiment for using JTED in trawl fisheries in Thailand.

Reviews of success / failure with bycatch management and discard reduction measures

Turtle Excluding Devices (TEDs)

Turtle Excluding Devices were used to fit with shrimp nets when they operated and its have mouth openings to release bycatch or unwanted animals. Sea turtles are animal which are captured incidentally by shrimp trawlers in Mexico. USA has used Turtles Conservation issue as a trade barrier for shrimp imported from several exporting countries, e.g. in Asian countries included Thailand. Several trials have been made in collaboration with SEAFDEC and Kasetsart University to modify and fit TEDs with small sized shrimp trawlers in Thailand. Fishers could not bear for more fuel consumed and loosed incomes. The installations of TEDs were not favor by the Thai fishers. Even though, the Department of Fisheries has given TEDS for free of charge to them. Thailand has announced for the shrimp trawler to fit TED when fishing since 1996. The announcement was affected by the USA regulation (1 May 1996) that the shrimp exporting countries have to install TEDs to conserve sea turtle. In Thailand sea turtle may be caught some but few and was released after captured. Thai people believe to release turtle then they will have long lives. The Department of Fisheries and the Navy Department have preserved egg laying places and rearing sea turtle for several decades.

Thailand, Malaysia, India and Pakistan are main shrimp exporting countries in Asia to USA. The USA regulation makes these countries feel unfair trade barrier using sea turtle as an instrument. Then these countries were cooperated to request the Appellate Body of WTO to consider this serious issue in 1996. Several arguments (GATT, WTO regulation) have been considered and at last these countries have won. The USA has announced to allow Thailand, Malaysia, India, Bangladesh and other 38 stakeholder countries can export their shrimps into USA since 1 May 1998.

Reviews of studies of the impact of trawling on seabed habitats

Experiments were made by using research vessel for beam trawling in Cholburi province. The beam trawling of fishers has modified to have two boat-shaped concretes to drag upon surface of sea bottom which it can destroy everything on the way passing. Marine benthic organism, sea grass, coral and artificial reef were destroyed. The results of the experiment led to DOF issuing special management measure for this area.

Reviews of studies of the techno-economic impacts of changes in management measures to the commercial fleet

Similar to many marine fish stocks in Asia and elsewhere in the world, the demersal resources in the Gulf of Thailand have been subjected to excessive levels of fishing effort since perhaps as long as two to three decades. This has resulted in a change in catch composition with a higher share of short-lived species in the catch. The influence on the value of the catch is not unambiguously negative because several short-lived species including certain cephalopods and crustaceans fetch good prices in the market. In general, fish prices showed real increases over the last decade including so-called 'trash-fish", i.e. by-catches of small fishes that are converted into fishmeal. The rapid growth in feed-intensive livestock and shrimp culture production has resulted in a rapidly growing fishmeal market. However, there is certainly concern about the impact on the Gulf of Thailand ecosystem and on bio-diversity of a continuation of the very high levels of mostly indiscriminate fishing effort, especially bottom trawling. While the immediate effect of a reduction of fishing effort could cause a decline in the quantity and value of the catch, the long-term benefit is likely to be very large. This is indicated by the findings of all three types of modelling approaches applied, namely surplus production model (Gordon-Schaefer and Gordon-Fox), age-structured Thompson & Bell model (BEAM 5) and mass-balance eco-system model (ECOPATH) (FAO/FISHCODE, 2000).

The immediate economic benefits arise from a reduction of harvesting costs. These are comparatively much larger in the trawl and pushnet fisheries because of both higher capital cost and higher operating costs, especially fuel costs. A reduction of fishing effort in the order of forty to fifty percent would be required to realize the full resource rent potential of the Thai demersal fisheries in the Gulf of Thailand. This would necessitate a major structural adjustment in terms of creating incentives for voluntary exit from the fishery as well as in terms of putting in place a management regime that would avoid a re-occurrence of excessive fleet capacity and fishing effort. This could only be achieved in close partnership with the fishing industry and by making available considerable financial and technical assistance for the adjustment process, especially in its early stages, to compensate owners of decommissioned fishing vessels and displaced crew and to strengthen management capabilities and capacities at all levels including central and local government agencies and community organizations.

9. What is the relationship between fishers and researchers / managers regarding bycatch management:

Private sector adoption of bycatch management technologies

From the results of the workshop held by the Department of Fisheries during 17-19 February 2010 at Bangkok: By catch management in trawl fisheries, the private sector has conceptual

adoption for cod end mesh size enlargement, fitting the JTED to reduce juvenile fish and introduction to use other sources of protein for making fish meal. Alternate area and season closure is also proposed from the meeting.

Private sector participation in bycatch projects

Some experiments have been made by the Department of Fisheries for cod end mesh size enlargement of trawlers which participated by fishers and boat owner, consultation meeting to reduce number of trawlers and using indicator for fishery management, it was apparent that the private sector has good collaboration and understanding with researchers and the Department of Fisheries.

Private sector perspective of by catch management

Since then there still has no by catch management in Thailand. Anyhow, there is a plan for reducing by catch about 20% from trash fish component.

Public awareness of by catch management

Public awareness of by catch management will be made through all kinds of media (TV, Radio, newspaper, leaflet, brochure, poster, sticker and VDO or VCD).

10. Market drivers:

Market / value-chain structure for catch and bycatch products from the concerned trawl fleet (processors, traders, companies, domestic and export markets)

The direct use of trash fish as feed for marine carnivorous finfish in Thailand is still practiced. This is due to the traditional habit of the farmer as well as their believing of the attractant qualities of trash fish a greater to cultured fish than that of formulated feed. Trash fish is required in high volume as a finfish feed. According to the recorded data from farmers, the average Food Converted Ratio (FCR) for sea bass and groupers were 7.5 and 5.5 respectively. Therefore it is possible to estimate the consumption of trash fish by finfish culture as 112,894 metric tons. The main source of those trash fish was obtained from small scale fisheries, which may not be included in the data of the total landed trash fish. The alternative to the use of trash fish is formulated feed for both fish species. However, before this is possible, it will be necessary to develop the pre-requisite infrastructures and relevant businesses such as weaned fry hatcheries and suitable finfish feeds. Fish fry was fed on trash fish for long time, fishers will not accept formulated feed and fry weaned, since then formulated feed are not yet available (Thongrod, 2005).

According to the survey and inspect the fisher activities by the DOF officers. It was reported that the low quality of by-catch product causing from improper handling. DOF is concerning to improve the quality of the by catch, including trash fish. In 2003, there was a pilot project aimed to improve packing methods and renew insulation of cold store room. As the results, the problem of trash fish quality and the advantage after improvement of on board cold room was reported below.

Problems concerned trash fish quality were:
- Packing methods
- Unsuitable ratio of ice and fish
- Over packing of both fish and ice in a tray
- Unhygienic practices

- Cold storage room too small
- Fish trays are not well organized
- Insufficient ice
- Lack of cold rooms, or not working well

Chart 1 is the pathways of the fishmeal industry in Thailand.

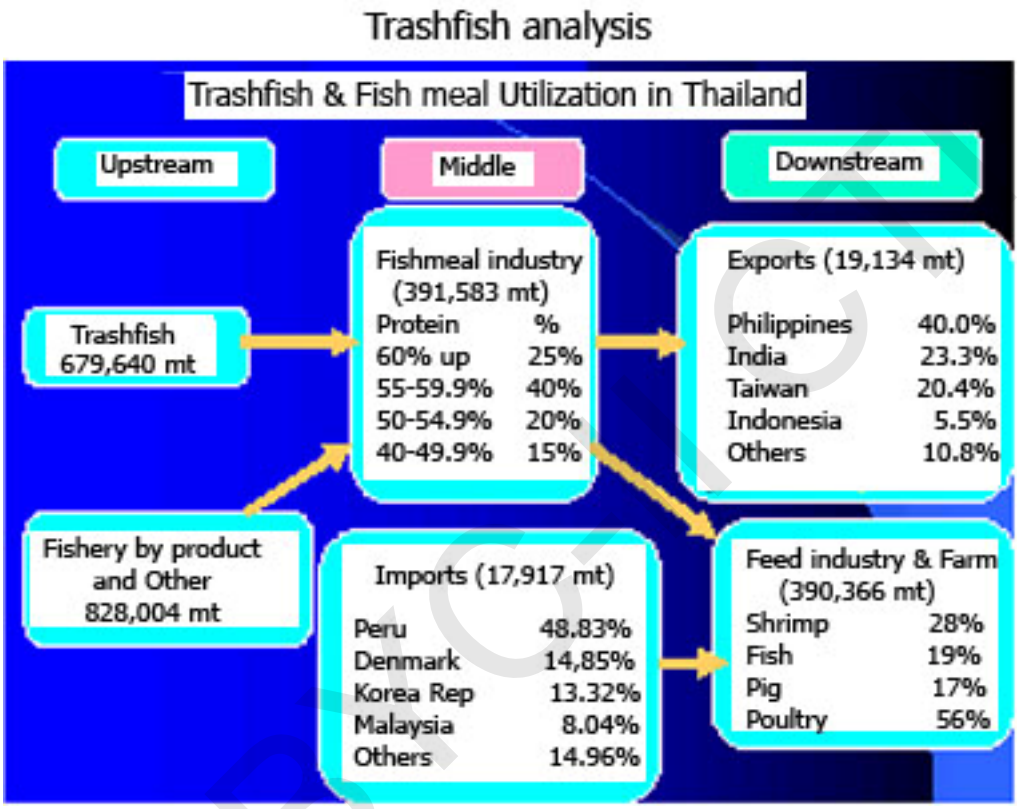


Chart 1. The pathways of the fishmeal industry in Thailand

(Adapted from Thongrod, 2005).

Existing eco-labeling and or certification schemes

- **For marine products – domestic or export markets**

SEAFDEC initiated member countries to prepare and research on ecolabel for Indo-Pacific mackerel (*Rastrelliger brachysoma*). DOF has also research for swimming crab caught by gillnet to have ecolabelling for domestic consumption. Several researches are ongoing. However, the Ministry of Agriculture and Cooperatives has a Q-Mark for good quality agriculture food to export.

1. **Existing or likely future price premiums for "eco-friendly" products**

   At present there is no price premium for eco-friendly product in Thailand.

2. **Domestic consumers' perception of "eco-friendly" products (awareness of the concept)**

   This is no evidence due to new issue for Thai fishers.

SECTION 4: PROJECT FORMULATION

1. What is the expected impact of the project?

- On fish catches – changes in volume and value of landed catches**;**
- Fishers may not accept for their loosing volume and value of landed catches at first. The government should have some incentives to compensate their lost benefit;
- On fishing capacity, employment and income of fishers in the concerned fleet segment(s) will be affected;
- Less fishing capacity, employment and income of fishers may cause social problems which have to find out how much and how to solve;
- On post-harvest sector – volumes and values treated, employment**;**
- Less trash fish capture may cause fishmeal factory find other source such as imported fishmeal or using other protein sources;
- Fish (bycatch) consumption, less capture of some economic small size species will affect to surimi processing product;
- Inputs into other economic activities (aquaculture)**,** in aquaculture, formulate food feed should mix more percentage of bean to substitute fish protein;
- Conflicts (between resource users and/or other stakeholders**),** less conflicts between trawlers and small scale fishers;
- Relevant marine habitats**,** relevant marine habitats will be the areas proposed by the fishers participated in the workshop at the meeting February 2010 in Bangkok and prescribed in the Plan of Action of the Master Plan for Marine Fisheries Management, DOF;
- Legal and institutional structures–government, private sector, social society; management measures for by catch management will be formulated and proposed;
- Regional cooperation on by catch management, regional cooperation on by catch management will be implemented under guidance of SEAFDEC, FAO/RAP;
- Awareness raising, people have more awareness through meetings, conferences and all kinds of media and
- Other, enhancement and rehabilitation (releasing seed fry and AR installation) and fishery tourism will be promoted and enhanced.

2. Who are the beneficiaries and stakeholders?

- Direct and indirect beneficiaries, fishers, processing plant and coastal fishers at large.
- Stakeholder analysis will be conduct during the project implement

3. What are the expected outcomes?

The overall expected outcome will be the fishery is sustainable which capture fishery production comprises 80% of fish for consumption and 20% of trash fish

4. What are the outputs?

The output of the project will be as follows:

a). Low percent capture of juvenile fish

b). Excess number of boats are reduced targeting at PN, OBT and PT

c). Good Quality products;

d). Healthy Ecosystem; and

e). No conflicts among types of fishing.

5. What are the main activities?

The main prioritizing activites will be covered 8 activities as follows:

Activity 1. Local Meetings among fishers and stakeholders before starting the project to announce and publicized, local workshops for preparing and work together and final meeting for result presentation and by catch management measure formulation. These activities will covered all projects before and after the project implementation.

Activity 2. Project 1: Enlargement of codend mesh size of trawlers in Prachuab Kiri Khan-Chumphon provinces, underwater VCD or DVD making for clear vision, escapement of healthy fish scene and good understood (Fishery biological data, fish species and size capture, fish price and analysis of loss and gain, social and economic issues will be collected and analised), finally to propose management measure for bycatch management.

Activity 3. Project 2: Establish new closed area and closed season in Trad province (one year, monthly research work on species, size, egg and larvae, spawning season, spawner size, fishing gear and methods, no of fishers concerned and social and economic of the fishery around the area concerned will be collected and analyzed), demarcated area, possibility to proposed closed area and season.

Activity 4. Project 3: The Management of Bycatch Utilization in the Gulf of Thailand. The project activities will cover amount of bycatch, location of landing, technology of bycatch utilization (processes/ products/ value chains/ end consumers), raw material supplier situation, how to reduce amount of bycatch for feed production by alternative protein, how to reduce amount of bycatch by improving fish handling via good hygiene and practice.

Activity 5. Project 4: JTEDs experiment and demonstration participated by fishers in Prachuab- Chumphon-Surat Thani Provinces, underwater VCD or DVD making for clear vision and good understood (Fishery biological data, fish species and size capture, fish price and analysis of loss and gain, social and economic issues will be collected and analised), finally to propose management measure for bycatch management.

Activity 6: Project 5: Initiate and promote VPS system (Vessel Position System) and Satellite Imagery at the closed area and closed season at Prachuab Kiri Khan – Chumphon-Surat Thani province to monitoring vessel, to prevent illegal fishing during area closure, mapping the vessel distribution and collect data on catch and effort, fishing ground and water property. The real time fishing activities can be accessed through world wide internet.

Activity 7: Regional Consultation Meeting will be held in five regions (eastern gulf, upper gulf, middle gulf, southern gulf and in the Andaman Sea). The meeting participated by fishers stakeholders will be discussed and brainstormed using all results from above five projects to formulate management framework for bycatch from trawl fisheries as well as perception and adoption from all stakeholders.

Activity 8: Project management: Enhancing and strengthening institutional capacity in terms of improved facilities in Chumphon province (Marine Fisheries Research and Development Center).

6. Monitoring and evaluation – what would be good SMART indicators?

Progress report for six month period to monitor the project will be made. The evaluation will be the percentage of stakeholder participation and perception in %. The good and SMART indicator will be the percentage of trashfish capture reduction in %.

7. What are the implementation and management arrangements?

7.1 Consultations and collaboration arrangement with private sector and stakeholders

Consultation and collaboration with private sectors and stakeholder will be made through meeting/workshop/conference and group discussion that will be held by DOF in collaboration with FAO/GEF and SEAFDEC, private sector and NGO.

The development of a strategy for reducing commercial fishing capacity in Thailand is one example. At the meeting, the participants recognized that it was essential to undertake certain preliminary actions be undertaken before it would be possible to actually reduce Thailand's fleet capacity. These included recording details of all vessels, whether fishing legally or not, and then clamping down on all unlicensed fishing. Preliminary actions have been undertaken by the Government of Thailand to reduce Thailand's fleet capacity. In June 2007, the regional workshop on managing fishing capacity and IUU fishing in Asia convened in Phuket, Thailand, organized by APFIC. It is another initiated step of examining and hearing from the stakeholders and related Government officers before developing national action plan to address the issue.

7.2 National project management arrangements

The national project management arrangement will be as follows:

a. DOF as a core agency: The national project will be implemented by The Department of Fisheries (through the Marine Fisheries Research and Development Bureau, Administrative and Management, Fishery Technology Information Development and Transfer Bureau, Fisheries Provincial Offices), in collaboration with private sectors (Fishery Associations, Fishery Society, SEAFDEC, fishers and related fishery agencies) and other relevant Ministry.

b. One national project consultant (expert on marine fisheries or related, retired or in working career) works for international communication, facilitate research work plan and activities, progress report, monitoring and evaluation the project implementation.

c. One national coordinator (DOF official) works to facilitate for official issues, facilitate working areas and support in official arrangement as well as financial report and driven the processes in working field and finalize of the project.

d. Researchers (**A Working Group)** from DOF (at project sites), SEAFDEC, fishery associations and relevant agencies will serve for field research works, data collection, analysis and reports in Thai language.

e. A Steering Committee will orient the policy and management framework for bycatch management and advice the working group to conduct research and activities in line with policy and management framework.

f. Experts on each subject (project) will recommend, comment for project implement and revisit the results and finalize for each subject and publicize. Translation Thai report into English version.

A Special Working Group for bycatch management from trawl fisheries in the Gulf of Thailand has been settle to organize the Workshop participated by stakeholders in Bangkok, 17-19 February 2010 to gathering comments and recommendation in management of the bycatch (trash fish) from trawl fisheries. The result output from the workshop will be considered to implement under UNEP/GEF upcoming project. Project proposal will be made through the Special Working Group and will be majority implemented by the Marine Fisheries Research and Development Bureau in collaboration with relevant government and private sector. The Special Working Group will revisit, comment and recommend the out put results of the project and management proposals. This Special Working Group will be reorganized to be Working Group and Steering Committee to support the approval project from FAO/GEF in the near future.

8. Risks:

- What are the main risks for not achieving the outputs and outcomes?
  The main risks for not achieving the output and outcome are the fishers not cooperate, participate and low perception.

- Are there potential undesirable effects?
  There are potential undesirable effects on very high price fuel, national economic downturn, disaster, Government cut off high percentage of annual budgetary.

9. Project budget: ***see also attached sample spread sheet***

The project budget covered all above 8 activities which will be requested from UNEP/GEF/FAO amounted at USD 701,461 (Seven hundred and one thousand, four hundred and sixty one). In-kind contributions from the Department of Fisheries will be amounted at USD 214,213 (two hundred fourteen thousand, two hundred thirteen) and from Fisheries Association of Thailand will be amounted at USD 474, 596 (four hundred seventy four thousand, five hundred and ninety six). Detailed budget break down is shown in attached file.

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