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# COUNTRY STATUS REPORT

# THAILAND

## PELAGIC FISHERIES AND RESOURCES IN THAI WATERS

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## ABSTRACT

*The study on fisheries status, the resources of important economical pelagic species in the Thai Waters and their management, are the consequence of the regional workshop on shared stocks in the South China Sea Area. The objectives of this paper are to analyses and review technical reports pertaining to pelagic fisheries and resources both in the Gulf of Thailand and Andaman Sea. In the Gulf of Thailand, the average catches during the last ten years (1984-1994) of Indo-Pacific mackerel; Indian mackerel; round scads; small tunas; anchovies; sardines; king mackerel; hardtail scad; bigeye scad and total pelagic are 83,022; 30,223; 28,258; 114,630; 93,570; 101,346; 9,154; 15,258; 19,988 and 543,549 metric tons, respectively. The Maximum Sustainable Yields of Indo-Pacific mackerel; Indian mackerel; round scads; small tunas; anchovies; sardines; king mackerel; hardtail scad and bigeye scad estimated using Schaefer's model are 94,791; 34,282; 29,280; 86,000; 106,118; 110,457; 14,599; 18,433 and 18,500 metric tons, respectively. In the Andaman Sea, the average catches of Indo-Pacific mackerel; round scads; small tunas; sardines and total pelagic are 29,021; 12,470; 16,507; 29,651 and 108,346 metric tons, respectively and the Maximum Sustainable Yields of Indo-pacific mackerel; small tunas; sardines and total pelagic are 24,453; 8,383; 36,228 and 144,848 metric tons, respectively. The further objective is also to establish the pelagic fisheries resources and management which the resources are shared with neighbouring countries.*

*It express that many stocks of important economical pelagic species in Thai's Waters have been fully exploited and there is a sign of stock depletion of the round scad resources in the Gulf of Thailand. Therefore, the fishermen have change their fisheries to fish the fishery industrial target species. Some pelagic stocks, as a result, have been neglected for a while and could be rehabilited within a short time.*


## 1. INTRODUCTION

Marine capture fisheries, both demersal and pelagic fisheries, play an important role on the Economic Development of Thailand. It is also a major source of animal protein for Thai people. Prior to 1950's, Thai marine fisheries was coastal fisheries, using traditional types of fishing gear. Those marine resources were consumed largely by people inhabiting coastal areas. Since early 1960's, the marine fisheries has been rapidly developed, resulted from the introduction of new fishing gears and technologies, venture of fishing fleets into new fishing grounds, improvement of fishing and restructuring of both supporting facilities and infrastructure. These development, resulted in a spectacular increase in total marine capture. It exceeds 1 and 2 million metric tons in 1968 and 1977 respectively (DOF, 1982a). In 1994, the total marine fisheries production reach 3.15 million metric tons, of which consist of 73% from the Gulf of Thailand and 27% from the Andaman Sea (DOF, 1996a). Due to rapid development without appropriate management measures, especially trawl fisheries, have resulted in the decline of stock abundances. In the Gulf of Thailand, the significant increase in number of otter board trawlers from 99 units in 1960 to some 13,000 units in 1990 including small trawl nets, has resulted in drastic decrease in the catch rate as express by the information obtain through the research

trawler of the Department of Fisheries. The rates tend to decrease from 256kg/hr trawling in 1963 to 170kg/hr in 1980 and 20kg/hr in 1989. More than 65 percent of the trawl catches are trash fish comprising small non-edible species, edible species of low commercial value and juveniles of commercially important species. Among them, the juvenile species are estimated about 40 percent of the total trash fish (DOF, 1994a). According to the drastic reduction of catch rates, the occurrence of over fishing of demersal and invertebrate resources have been clearly observed.

As the trawl fisheries weaken, the pelagic fisheries is lighted up. There has been developed in terms of fishing gear and technique. The main particularity is purse seine. From early seventies, the ordinary purse seine fisheries for capturing small and medium size of pelagic fish such as sardines, mackerels and scads, have been added up with new modern and larger purse seiner together with gill netters. In addition, the extension of fisheries into offshore waters from the early eighties to the deeper part of the Gulf of Thailand and distant-water fishing grounds are the relative important development of pelagic fisheries. It boosts the marine fishery production of Thailand, resulting the increase of pelagic fish production shared in the total marine production from 13% (197,235 tons) in 1973 to 30% (953,907 metric tons) in 1994, which lead pelagic fisheries to play more important role of marine fisheries in Thailand (DOF, 1977 and 1996a). Therefore, the perspective feature of pelagic fisheries in the Gulf of Thailand and the Andaman Sea are decribed using the marine fisheries statistics base on the sapling survey during 1980 to 1994.

## 2. DEVELOPMENT OF PELAGIC FISHERIES

Pelagic resources are mainly exploited by purse seines, which account for approximately 83% of total pelagic catches in 1994. The rest, 10%, 2% and 5% of total production are caught by trawlers, king mackerel drift gill netter and other gears respectively (Table 1). Pelagic fisheries had started when Chinese purse seines (CPS) targeting on school fish such as Indo-Pacific mackerel was introduced in 1925.

Table 1: Total pelagic fishes caught by type of fishing gears in Thailand, 1994

Unit: Metric tons

| Area | Purse seine | Trawlnets | Gillnets | Other | Total pelagic |
|---|---|---|---|---|---|
| Gulf of Thailand | 82% | 9% | 2% | 7% | 644,073 |
| Andaman Sea | 85% | 14% | 1% | 0% | 309,834 |
| Total | 83% | 10% | 2% | 5% | 953,907 |

Source: DOF, 1996a

Remark: Purse seine = Other purse seine (PS) + Anchovy purse seine (APS) + CPS
Trawlnets = Otter board trawl (OBT) + Pair trawl (PT) + Beam trawl (BET)
Gillnets = King mackerel drift gill net (KMN)
Other = Other gears

The remarkable development are recognized after the end of the second World war, CPS have been modified into Thai purse seine (TPS) in 1930, which operates by setting the net using one main boat instead of setting the net by 2 row boats as being used in CPS (Phasuk, 1978). In 1973 several kind

of luring techniques such as payao with coconut leaves and kerosene lamp are introduced. Until 1982 the luring techniques has been well developed by equipped electric generator on board which are called luring purse seine (LPS) become the popular fishing gear for mixed species. At the same time, tuna purse seine (TUNP) are developed by increasing the size of purse seine net and mesh size to catch small tunas in deeper waters together with and expansion to the offshore areas. Anchovies purse seine (APS) commonly used to catch anchovies in coastal areas have been developed as well, to operated with light luring for attracting the fish school at night time and move further offshore to fish.

## 3. FISHING GEAR

The purse seine net is the major fishing gear used to exploit the pelagic fish resources. It shows the increase in number year by year. The number of registered purse seine which classifies into Chinese purse seine (CPS), anchovy purse seine (APS) and other purse seines (TPS, LPS and TUNP) are shown in Figure 1. In the Gulf of Thailand, the registered number of purse seines increase from 585 unit in 1979 to 1,175 unit in 1994 which shows the great peak of 1,260 unit in 1991. In the Andaman Sea, the registered number of purse seines increase from 86 unit in 1979 to 273 unit in 1994 which shows the peak of 280 unit in 1989. Anyhow, it is obvious that the whole trend of purse seiners tend to increase in both fishing areas.

Normally, the mesh size of 2.5 centimeter is used for CPS, TPS and LPS, 1.0 centimeter for APS and the mesh size range from 7.5 to 9.4 centimeter are used for TUNP. However TPS may use the net with 3.8 centimeter mesh size when the Indo-Pacific mackerel of marketable size enter into the fishing ground. Most of the net are range from 300-1,600 meters in length and 50-150 meters in depth which depend on type of purse seines, size of boat and depth of fishing ground.

The production of Indo-Pacific mackerel, Indian mackerel, round scads, small tunas, anchovies and sardines caught by purse seine in the Gulf of Thailand are about 59%; 83%; 100%; 91%; 90% and 97% of the yield by all gears respectively. While the catch of those species in the Andaman sea are about 76%; 88%; 100%; 98%; 100% and 98% respectively (Table 2 and 3).

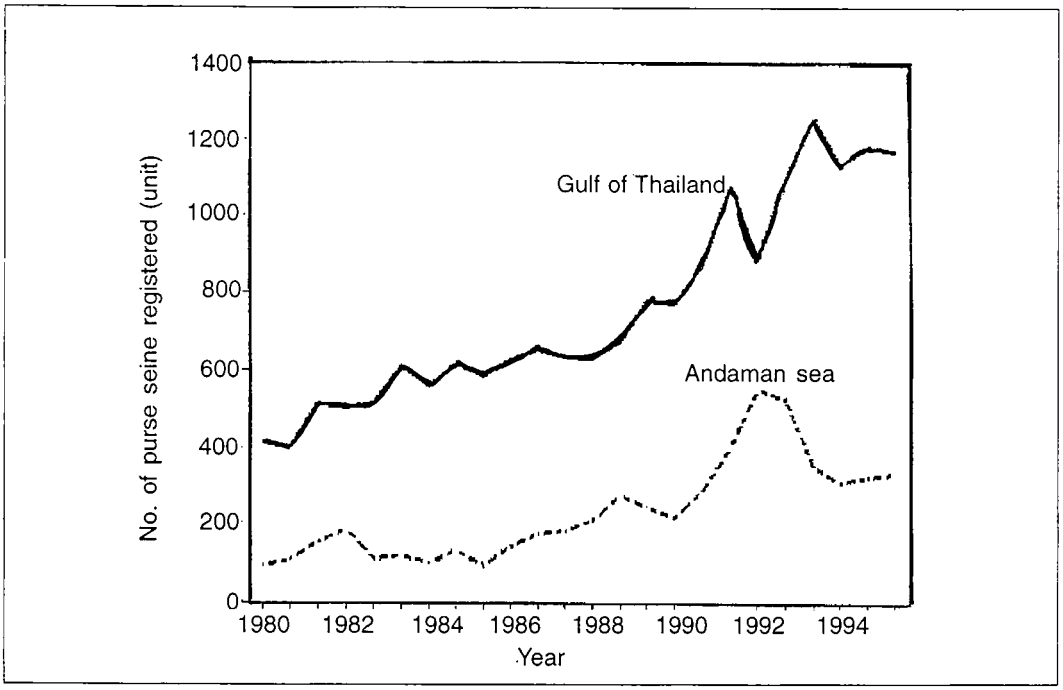



Fig. 1: Trend of number of purse seines registered in the Gulf of Thailand and Andaman Sea Coast of Thailand, 1971-1994.

Source: DOF, 1973, 1975; 1978; 1988a; 1993a and 1996b. (Data compiled)

Table 2: Percentage of important pelagic species caught by types of fishing gear in the Gulf of Thailand, 1994

| Species | Purse seine | Trawlnets | Gillnets | Other | Total (tons) |
|---|---|---|---|---|---|
| Indo-Pacific mackerel | 59 | 13 | - | 28 | 82,021 |
| Indian mackerel | 83 | 12 | 0 | 5 | 50,898 |
| Round scads | 100 | - | - | - | 38,394 |
| Small tunas | 91 | - | 9 | 0 | 99,833 |
| Anchovies | 90 | 3 | - | 7 | 102,729 |
| Sardines | 97 | - | - | 3 | 125,179 |
| King mackerel | 7 | 45 | 33 | 15 | 9,904 |
| Hardtail scad | 76 | 22 | 0 | 2 | 20,809 |
| Bigeye scad | 94 | 6 | - | - | 37,080 |

Source: DOF, 1996a

Remark: Purse seine = PS + APS + CPS
Trawl nets = OBT + PT + BET
Gill nets = KMN
Other = Other gears
0 = non-significant catches
- = nil

Table 3: Percentage of important pelagic species caught by types of fishing gear in the Andaman Sea Coast of Thailand, 1994

| Species | Purse seine | Trawlnets | Gillnets | Other | Total (tons) |
|---|---|---|---|---|---|
| Indo-Pacific mackerel | 76 | 24 | - | 0 | 65,499 |
| Indian mackerel | 88 | 12 | 0 | - | 13,695 |
| Round scads | 100 | - | - | - | 35,994 |
| Small tunas | 98 | - | 2 | - | 31,182 |
| Anchovies | 100 | 0 | - | - | 66,630 |
| Sardines | 98 | - | - | 2 | 29,455 |
| King mackerel | 25 | 52 | 15 | 8 | 6,473 |
| Hardtail scad | 61 | 39 | 0 | - | 14,143 |
| Bigeye scad | 97 | 3 | - | - | 2,487 |

Source: DOF, 1996a

Remark: Purse seine = PS + APS + CPS; Trawlnets = OBT + PT + BET; Gillnets = KMN; Other = Other gears; 0 = non-significant catches; - = nil

## 4. SPECIES COMPOSITION

The main pelagic species caught during 1980-1994 consists of Indo-Pacific mackerel, Indian mackerel, round scads, small tunas, anchovies and sardines, which share about 78-87% and 65-89% in the Gulf of Thailand and the Andaman Sea respectively (Table 4 and 5). Other pelagic fish species are bigeye scad, hardtail scad, and king mackerel which contribute about 13-22% and 11-35% in the Gulf of Thailand and Andaman Sea respectively.

Table 4: Percentage of pelagic fishes caught by commercial fishing gears* in the Gulf of Thailand, 1980-1994

| Year | Species (%) | | | | | | | | | | | Total catch (metric tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | **1-6** | 7 | 8 | 9 | 10 | |
| 1980 | 17 | 9 | 11 | 4 | 34 | 6 | **81** | 3 | 4 | 5 | 8 | 286,109 |
| 1981 | 19 | 5 | 10 | 6 | 38 | 4 | **82** | 3 | 1 | 8 | 6 | 339,076 |
| 1982 | 23 | 6 | 10 | 13 | 28 | 7 | **82** | 2 | 1 | 5 | 5 | 313,253 |
| 1983 | 14 | 12 | 6 | 19 | 23 | 9 | **83** | 2 | 4 | 5 | 6 | 424,795 |
| 1984 | 22 | 7 | 6 | 15 | 18 | 19 | **87** | 2 | 1 | 5 | 5 | 457,806 |
| 1985 | 20 | 7 | 5 | 16 | 14 | 21 | **83** | 2 | 1 | 3 | 11 | 495,051 |
| 1986 | 18 | 8 | 5 | 19 | 19 | 12 | **81** | 2 | 4 | 4 | 9 | 484,857 |
| 1987 | 18 | 7 | 8 | 19 | 17 | 11 | **80** | 2 | 3 | 5 | 8 | 499,968 |
| 1988 | 17 | 4 | 3 | 27 | 17 | 13 | **81** | 2 | 4 | 2 | 10 | 515,478 |
| 1989 | 17 | 5 | 3 | 22 | 20 | 17 | **84** | 2 | 3 | 2 | 9 | 559,445 |
| 1990 | 12 | 4 | 2 | 28 | 16 | 21 | **83** | 2 | 2 | 4 | 9 | 557,220 |
| 1991 | 10 | 3 | 4 | 26 | 21 | 21 | **85** | 1 | 2 | 3 | 8 | 534,599 |
| 1992 | 13 | 4 | 6 | 23 | 21 | 18 | **85** | 1 | 3 | 3 | 7 | 675,904 |
| 1993 | 12 | 6 | 8 | 18 | 19 | 20 | **83** | 2 | 3 | 3 | 9 | 583,895 |
| 1994 | 12 | 8 | 6 | 16 | 20 | 16 | **78** | 1 | 3 | 6 | 11 | 614,814 |

Source: DOF, 1983a, 1983b, 1984, 1985, 1986, 1987, 1988b, 1989, 1990, 1991, 1992, 1993b, 1994b, 1995, 1996a and 1996c

Remark: 1 = Indo-Pacific mackerel; 2 = Indian mackerel; 3 = Round scads;
4 = Coastal tuna; 5 = Anchovies; 6 = Sardines;
7 = King mackerel; 8 = Hardtail scad; 9 = Bigeye scad
10 = Other trevallies, Silver pomfrets, Black pomfrets, Wolf herring, Blackbande trevally, Threadfins & Mullets
* = PS + APS + CPS + OBT + PAT + BET + KMN

Table 5: Percentage of pelagic fishes caught by commercial fishing gears* in the Andaman Sea Coast of Thailand, 1980-1994

| Year | Species (%) | | | | | | | | | | | Total catch (metric tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | **1-6** | 7 | 8 | 9 | 10 | |
| 1980 | 17 | 9 | 8 | 7 | 6 | 22 | **69** | 7 | 5 | 2 | 17 | 10,800 |
| 1981 | 16 | 6 | 9 | 15 | 3 | 15 | **65** | 8 | 5 | 3 | 19 | 13,527 |
| 1982 | 17 | 2 | 6 | 16 | 0 | 46 | **89** | 2 | 3 | 2 | 4 | 58,362 |
| 1983 | 21 | 3 | 15 | 6 | 1 | 39 | **85** | 1 | 5 | 4 | 5 | 62,920 |
| 1984 | 21 | 3 | 19 | 8 | 0 | 35 | **87** | 1 | 6 | 3 | 3 | 86,993 |
| 1985 | 21 | 2 | 12 | 8 | 1 | 41 | **85** | 2 | 5 | 2 | 6 | 66,378 |
| 1986 | 24 | 2 | 4 | 6 | 0 | 47 | **84** | 3 | 3 | 2 | 9 | 56,474 |
| 1987 | 15 | 2 | 14 | 6 | 1 | 41 | **80** | 2 | 4 | 3 | 11 | 101,400 |
| 1988 | 13 | 6 | 19 | 5 | 0 | 35 | **79** | 2 | 5 | 8 | 6 | 92,269 |
| 1989 | 16 | 6 | 19 | 4 | 0 | 25 | **71** | 2 | 7 | 8 | 12 | 114,822 |
| 1990 | 19 | 8 | 17 | 5 | 1 | 21 | **70** | 2 | 7 | 9 | 13 | 133,344 |
| 1991 | 24 | 9 | 15 | 9 | 7 | 15 | **79** | 2 | 7 | 4 | 9 | 162,611 |
| 1992 | 24 | 6 | 6 | 9 | 27 | 14 | **86** | 3 | 3 | 3 | 6 | 137,532 |
| 1993 | 28 | 6 | 4 | 17 | 17 | 16 | **87** | 1 | 2 | 1 | 8 | 239.980 |
| 1994 | 23 | 4 | 13 | 11 | 23 | 10 | **84** | 2 | 5 | 1 | 8 | 286,509 |

Source: DOF, 1983a, 1983b, 1984, 1985, 1986, 1987, 1988b, 1989, 1990, 1991, 1992, 1993b, 1994b, 1995, 1996a and 1996c

Remark: 1 = Indo-Pacific mackerel; 2 = Indian mackerel; 3 = Round scads;
4 = Coastal tuna; 5 = Anchovies; 6 = Sardines;
7 = King mackerel; 8 = Hardtail scad; 9 = Bigeye scad
10 = Other trevallies, Silver pomfrets, Black pomfrets, Wolf herring, Blackbande trevally, Threadfins & Mullets
* = PS + APS + CPS + OBT + PAT + BET + KMN

The group of pelagic species commonly found both in the Gulf of Thailand and the Andaman Sea are the followings; mackerels consist of Indo-Pacific mackerel (*Rastrelliger brachysoma*) and Indian mackerel (*R. kanagurta*); round scads consist of white tip round scad (*Decapterus maruadsi*) and slender round scad (*Decapterus macrosoma*); small tunas consist of longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*), sardinellas consist of goldstriped sardine (*Sardinella gibbosa*) and spotted sardine (*Amblygaster sirm*); Anchovies consists of shorthea anchovy (*Encrasicholina heteroloba*) and Indian anchovy (*Stolephorus indicus*) and group of bigeye scad (*Selar crumenopthalmus*). The restrictive species merely found in the Andaman Sea are skipjack tuna (*Katsuwonus pelamis*) and round scad (*D. macarellrus*).

## 5. FISHING GROUND

There are two main fishing grounds, the Gulf of Thailand and the Andaman Sea Coast of Thailand.

The fishing area in the Gulf of Thailand cover the whole Gulf which the depth ranges from 20 to 80 meters. The different fishing ground of specific species in this area are shown in Fig. 2. The fishing ground for Indo-Pacific mackerel is along the west coast and the upper part of the Gulf (Fig. 2a). Indian mackerel scatter in the Gulf where the depth range from 30-70 meters (Fig. 2b) while round scads are found in offshore area with the depth over 50 meters (Fig. 2c). Small tunas are found in the whole Gulf with the most abundance in the central part of the Gulf (Fig. 2d). Anchovies are mainly caught in coastal water along the western coast and eastern part of the Gulf (Fig. 2e). Sardines are also scatter in coastal and offshore area likely to Indian mackerel (Fig. 2f).

The fishing area in the Andaman Sea is the area within 3-45 kilometers from shore which the depth ranges from 20-100 meters. Figure 3 shows the fishing ground for specific species.

In Andaman Sea, the main fishing ground of Indo-Pacific mackerel are located in the lower part along the coast (Fig. 3a), while the Indian mackerel are found scattering (Fig. 3b). The fishing ground for round scads are scatting along the coast in the upper part and the area around Raja Island in the lower part (Fig. 3c). The fishing ground for small tunas are also scatteringe along the coast in the upper part (Fig. 3d). Sardines are widely distributed throughout the coast with high concentration in the coastal areas (Fig. 3e). Anchovies are commonly distributed in the inshore waters along the coast.

## 6. FISHING SEASON

Fishing of pelagic species in the Gulf of Thailand and Andaman Sea occur to be all year rounds. The peak of catch considers to be high during the southwest monsoon (June-October) and northeast monsoon (November-May) in the Gulf of Thailand and the Andaman Sea.

## 7. PRODUCTION AND CATCH RATE

### Gulf of Thailand

The annual catches of small pelagic fishes caught by commercial fishing gears during the period 1980-1994 show the increasing trend from 286,109 metric tons in 1980 to 534,599 metric tons in 1991. It rises up to show the peak of 675,904 metric tons in 1992 then drop to the ordinary increasing trend from 1993 (Fig. 4). The annual catches and catches rates of commercially important pelagic fish are shown in Table 6.

The annual catches of Indo-Pacific mackerel fluctuate and slightly decrease from the peak of 99,638 metric tons in 1984 to 73,727 metric tons in 1994. The trend of catch rates are shown to be identical to the trend of catches.

The catches of Indian mackerel increase from 29,827 metric tons in 1984 to 38,803 metric tons in 1986 then decrease to the lawest catch of 16,256 metric tons in 1991, after that it increase to the peak of 49,231 metric tons in 1994. Catch rates show the decreasing trend from 240 kgs/day in 1985 to the lowest catch rates of 61 kgs/day in 1988, after that it increase to the lighest peak of 278 kgs/day in 1994.

Figure 2: The main fishing grounds of some economic pelagic species in the Gulf Thailand

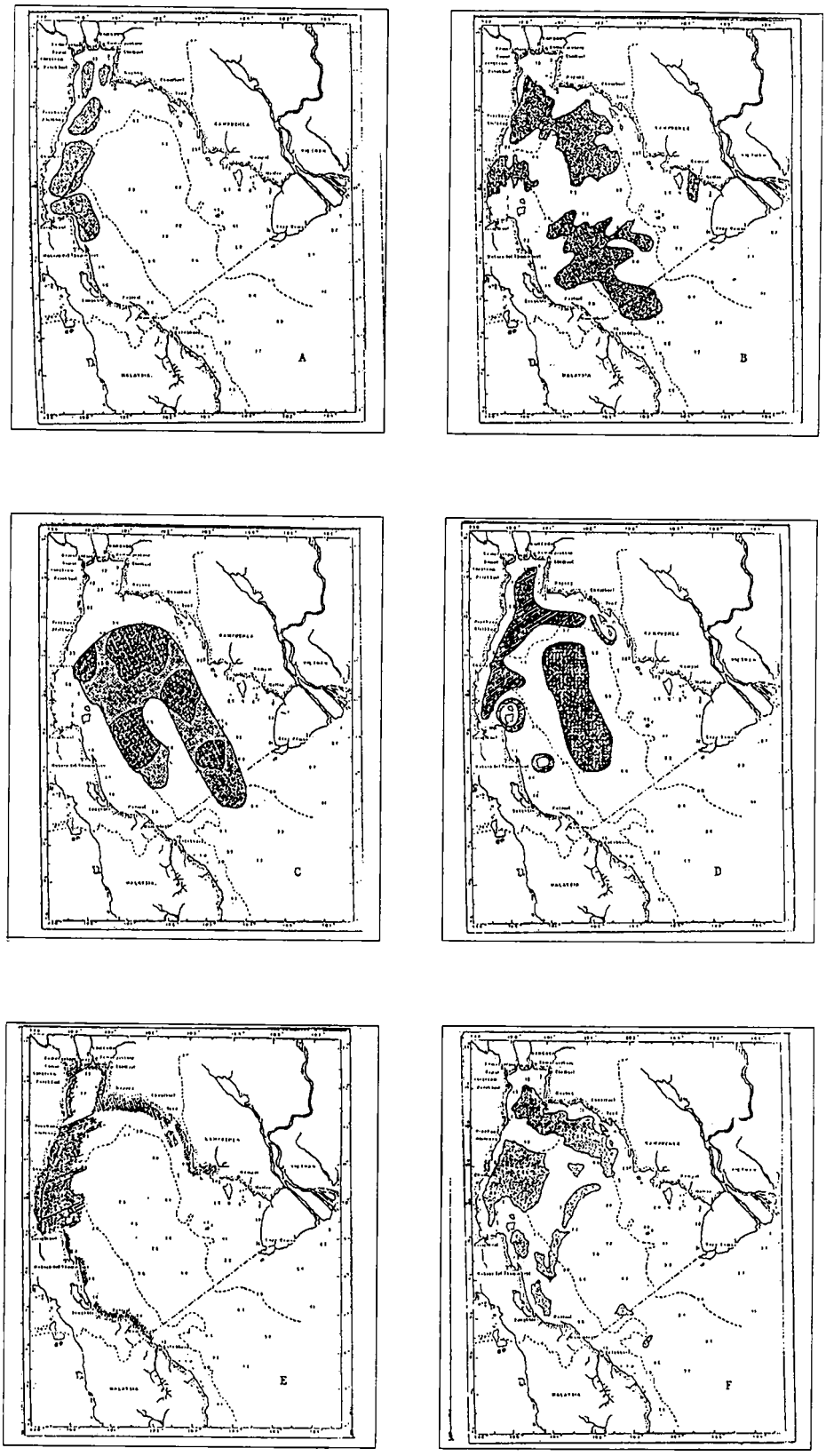
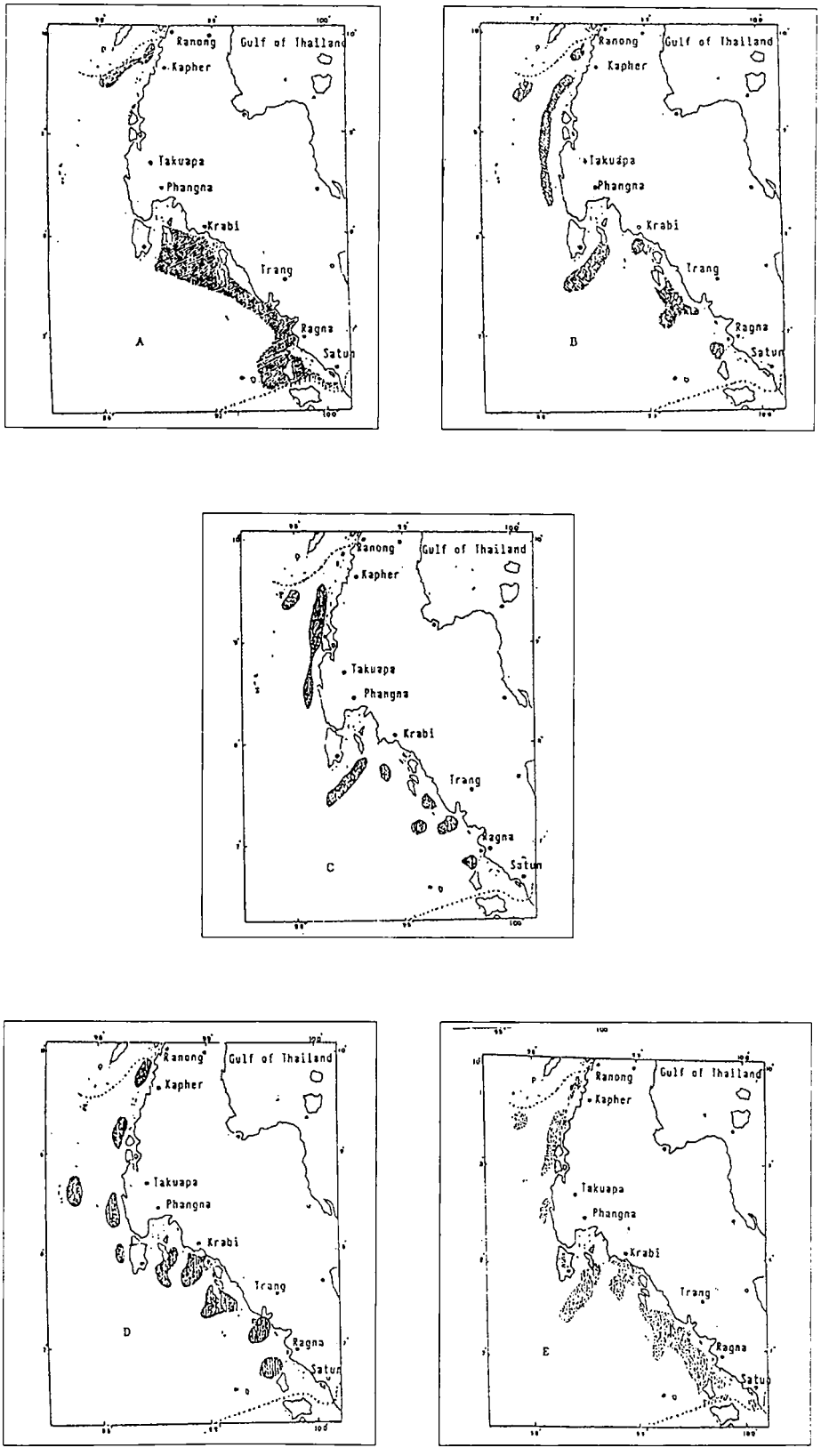
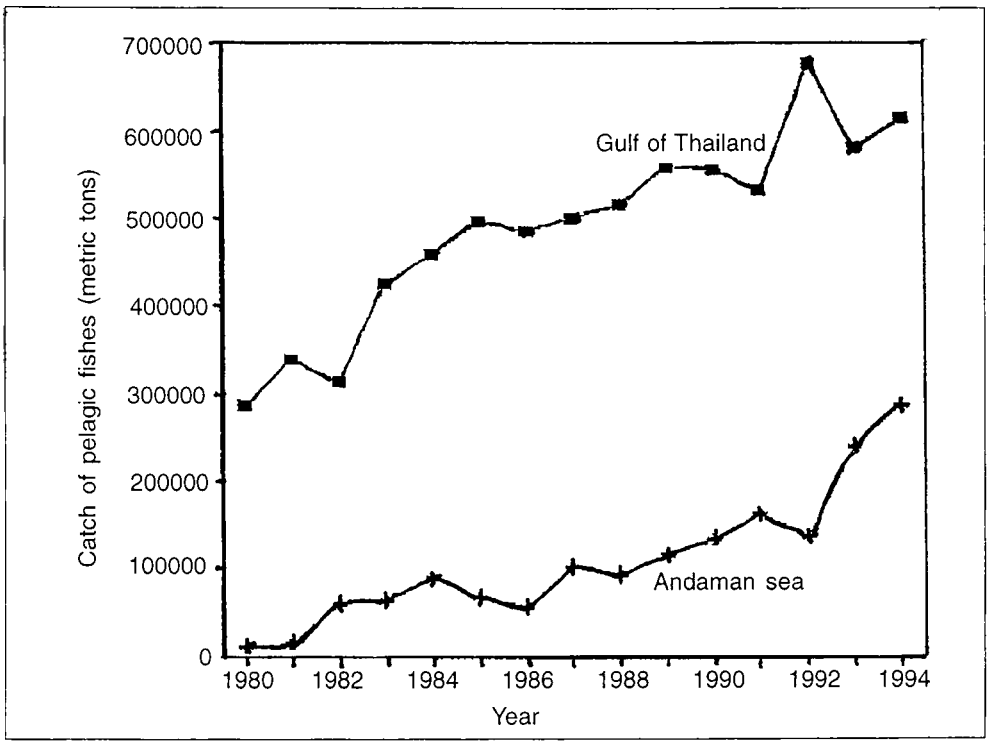


Figure 3: The main fishing grounds of some economic pelagic species in the Andaman Sea



The trend of annual catches of round scads is slightly decrease from 27,475 metric tons in 1984 to 23,947 metric tons in 1986 then increase abruptly to 41,838 metric tons in 1987, after that it expresses sharply decreased to the lowest point of 10,676 metric tons in 1990. It increase again up to the peak of 46,186 metric tons in 1993. Catch rates of round scads fluctuate with decreasing trend from 1984 to 1990, after that it increase from the lowest point of 46 kgs/day in 1990 upto 254 kgs/day in 1994.

Figure 4: Total catch of pelagic fishes caught by main fishing gears in the Gulf of Thailand and Andaman Sea Coast of Thailand, 1980-1994.




The catches of small tunas increase from 69,355 metric tons in 1984 to 141,274 metric tons in 1988 then it fluctuates between 141,274 - 156,208 metric tons during 1988 to 1990. It fluctuates which shows the hightest peak of 157,163 metric tons in 1992, after that it shows the decreasing trend from 1993. The catch rates has shows the similar trend of catches. The lowest and the highest of catch rates are 330 kgs/day and 846 kgs/day in 1984 and 1991 respectively.

The catches of anchovies have been remarkably increased after 1981 to 1985, from 12,095 metric tons to 103,101 metric tons then declines to the lowest catches of 55, 466 metric tons in 1987. After 1988 the catches increase up to reach the peak again. Total landing of anchovies during 1990-1994 still maintain the level of 110,000 - 120,000 metric tons. Catch rates of this species fluctuate during the period of 1984 to 1994, with the lowest rate of 1,569 kgs/day and the peak of 6,282 kgs/day in 1987 and 1992 respectively.

The catches of sardines tend to be slightly increased from 83,814 metric tons in 1984 to 123,700 metric tons in 1994, with peak of 141,422 metric tons in 1992. The trend of catch rates is similar to the trend of catch which shows the peak in 1994.

Table 6: Total catches and catch rates of commercially important pelagic fish in the Gulf of Thailand, 1984-1994

| Species name/Year | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | Standard gear |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indo-pacific mackerel | | | | | | | | | | | | |
| Total catch (Tons) | 99,638 | 97,852 | 88,768 | 92,155 | 88,822 | 92,688 | 68,160 | 55,186 | 88,308 | 68,025 | 73,727 | |
| Catch rate (kgs/day) | 731 | 1,067 | 275 | 1,076 | 1,019 | 1,142 | 612 | 1,450 | 1,244 | 400 | 1,338 | MEN |
| Indian mackerel | | | | | | | | | | | | |
| Total catch (Tons) | 29,827 | 32,862 | 38,803 | 36,259 | 18,653 | 26,498 | 20,844 | 16,256 | 29,337 | 33,882 | 49,231 | |
| Catch rate (kgs/day) | 187 | 240 | 213 | 185 | 61 | 122 | 68 | 86 | 108 | 140 | 278 | SEINE |
| Round scads | | | | | | | | | | | | |
| Total catch (Tons) | 27,475 | 25,667 | 23,947 | 41,838 | 14,015 | 17,267 | 10,676 | 22,747 | 42,525 | 46,286 | 38,394 | |
| Catch rate (kgs/day) | 186 | 206 | 144 | 259 | 73 | 102 | 46 | 149 | 181 | 237 | 254 | SEINE |
| Small tunas | | | | | | | | | | | | |
| Total catch (Tons) | 69,355 | 81,200 | 90,225 | 96,131 | 141,274 | 124,899 | 156,208 | 137,869 | 157,163 | 106,797 | 99,811 | |
| Catch rate (kgs/day) | 330 | 489 | 426 | 495 | 651 | 681 | 626 | 846 | 617 | 491 | 600 | SEINE |
| Anchovies | | | | | | | | | | | | |
| Total catch (Tons) | 88,804 | 103,101 | 57,959 | 55,466 | 66,675 | 94,315 | 118,727 | 110,020 | 120,211 | 116,648 | 97,343 | |
| Catch rate (kgs/day) | 2,722 | 2,100 | 1,808 | 1,569 | 1,895 | 1,814 | 1,754 | 2,119 | 6,282 | 4,677 | 2,680 | APS |
| Sardines | | | | | | | | | | | | |
| Total catch (Tons) | 83,814 | 68,447 | 92,527 | 83,633 | 89,077 | 114,310 | 90,789 | 114,465 | 141,422 | 112,620 | 123,700 | |
| Catch rate (kgs/day) | 494 | 520 | 523 | 430 | 410 | 624 | 360 | 730 | 583 | 575 | 795 | SEINE |
| King mackerel | | | | | | | | | | | | |
| Total catch (Tons) | 8,099 | 8,380 | 10,978 | 11,924 | 12,050 | 9,181 | 9,153 | 6,110 | 6,711 | 9,568 | 8,537 | |
| Catch rate (kgs/day) | 89 | 93 | 99 | 92 | 82 | 78 | 63 | 87 | 83 | 94 | 98 | SEINE |
| Hardtail scad | | | | | | | | | | | | |
| Total catch (Tons) | 5,928 | 5,608 | 17,299 | 17,468 | 19,765 | 19,533 | 13,648 | 11,937 | 17,775 | 18,345 | 20,532 | |
| Catch rate (kgs/day) | 102 | 106 | 291 | 281 | 241 | 393 | 212 | 315 | 431 | 313 | 463 | SEINE |
| Bigeye scad | | | | | | | | | | | | |
| Total catch (Tons) | 23,061 | 17,174 | 18,728 | 22,978 | 11,931 | 12,063 | 19,972 | 15,451 | 21,851 | 19,581 | 37,080 | |
| Catch rate (kgs/day) | 152 | 136 | 112 | 135 | 52 | 60 | 74 | 90 | 87 | 95 | 230 | SEINE |

Source: DOF, 1986, 1987, 1988b, 1989, 1990, 1991, 1993b, 1994b, 1995, 1996a and 1996c.

The annual catches of king mackerel shows the increasing trend from 8,099 metric tons in 1984 to the peak of 12,050 metric tons in 1988. After that it declines to the lowest point of 6,110 metric tons in 1991, then increases again. The catch rates shows the decreasing trend from the peak of 99 kgs/day in 1986 to the lowest rates of 63 kgs/day in 1990 and turn upward to 98 kgs/day in 1994.

The landings of hardtail scad tend to increase from the lowest catch of 5,608 metric tons in 1985 to 19,765 metric tons in 1988. After that it increases to 11,937 metric tons in 1991 then increases again up to the peak of 20,532 metric tons in 1994. The trend of catch rates show the same pattern of the catching trend.

The annual catches of bigeye scads fluctuate from 1984 to 1994, the lowest catch of 11,931 metric tons and the peak of 37,080 metric tons are found in 1988 and 1994 respectively. The trend of catch rates appears to be similar to the trend of total catch with the lowest catch rates about 52 kgs/day and the peak of 230 kgs/day in 1988 and 1994 respectively.

**Andaman Sea**

In the Andaman Sea, small pelagic catches in 1980 and 1981 are about 10,800 and 13,527 metric tons respectively. The annual catches range from 60,121 metric tons in 1982 to 309,834 metric tons in 1994 (Fig. 4). It shows the fluctuation every 2-3 year during 1982-1988, after that it increases to reach the peak in 1994. The catch rates show the decreasing trend from the peak of 4,280 kgs/day in 1983 to the lowest catch rate of 1,790 kgs/day in 1988 then aburtly increase to 2,397 in 1989 after that it drops until 1991 then increases to reach the peak 2,916 metric tons in 1994. The amount of catches and catch rates of commercially important pelagic fish are shown in Table 7.

The total catches of Indo-Pacific mackerel increase from 10,056 metric tons in 1982 to 65,499 metric tons in 1994 with the peak of 66,985 metric tons in 1993. Catch rates fluctuate from 474 kgs/day in 1982 to the lowest catch rate of 237 kgs/day in 1988. After that it increase up to the peak of 994 kgs/day in 1993.

The total catches of round scads in overall view increase from 3,758 metric tons in 1982 to rise the peak at 23,982 metric tons in 1991 and sharply decrease to 8,434 and 8,984 metric tons in 1992 and 1993 respectively. The catches increase abruptly with the peak of 35,994 metric tons in the year after. The trend of catch rates show declining trend from 213 kgs/day in 1983 to the lowest 102 kgs/day in 1986 then increase to 484 the rate of kgs/day in 1989, after that it decrease again to 143 kgs/day in 1993.

The total catches of small fluctuate year by year from 1982 to 1989 with the peak of catch about 40,784 metric tons in 1993. Catch rates decrease from 465kgs/day in 1982 to the lowest catch rate of 89kgs/day in 1988, then it increase up to the peak of 634kgs/day in 1993.

The total catches of sardines in overall view show slightly decrease from 27,030 metric tons in 1982 to 20,893 metric tons in 1992, then increase abruptly to the peak of 38,440 metric tons in 1993. The trend of catch rates during 1982 to 1994 is identical to the trend of the total catches.

The other economically important pelagic fishes that contribute to the fishery of the West Coast of Thailand or Andaman Sea are Indian mackerel, king mackerel, hardtail scad, bigeye scad and anchovies. There seems to be non-significant trend of catches of these species except anchovies which shows the jumping increase from 1991. This group contribute about 101,138 metric tons of catches of anchovies increase abruptly from 782 metric tons in 1990 due to the development of fishing technique by using the light for attracting the fish school and further moving offshore.

Table 7: Total catches and catch rates of commercially important pelagic fish in the Andaman Sea, 1984-1994

| Species name/Year | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | Standard gear |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indo-pacific mackerel | | | | | | | | | | | | |
| Total catch (Tons) | 18,675 | 13,757 | 13,766 | 15,029 | 12,044 | 17,487 | 25,127 | 38,616 | 32,863 | 66,833 | 65,499 | |
| Catch rate (kgs/day) | 507 | 593 | 548 | 362 | 237 | 366 | 378 | 461 | 667 | 994 | 715 | SEINE |
| Round scads | | | | | | | | | | | | |
| Total catch (Tons) | 16,777 | 8,025 | 2,464 | 14,276 | 17,747 | 22,330 | 22,559 | 23,982 | 8,434 | 8,984 | 35,994 | |
| Catch rate (kgs/day) | 646 | 373 | 102 | 336 | 359 | 494 | 352 | 335 | 194 | 143 | 520 | SEINE |
| Small tunas | | | | | | | | | | | | |
| Total catch (Tons) | 7,369 | 5,594 | 3,392 | 6,261 | 4,845 | 4,695 | 6,883 | 14,256 | 11,908 | 40,784 | 31,182 | |
| Catch rate (kgs/day) | 269 | 251 | 124 | 146 | 89 | 94 | 99 | 187 | 247 | 634 | 440 | SEINE |
| Sardines | | | | | | | | | | | | |
| Total catch (Tons) | 30,563 | 27,545 | 26,604 | 41,641 | 32,619 | 29,186 | 27,375 | 24,167 | 20,893 | 38,440 | 29,455 | |
| Catch rate (kgs/day) | 995 | 1,162 | 1,098 | 905 | 660 | 632 | 427 | 337 | 450 | 596 | 418 | SEINE |
| Total Pelagic | | | | | | | | | | | | |
| Total catch (Tons) | 90,846 | 67,852 | 59,960 | 120,563 | 98,912 | 121,646 | 146,281 | 176,794 | 140,969 | 243,176 | 309,834 | |
| Catch rate (kgs/day) | 2,812 | 2,754 | 2,316 | 2,263 | 1,790 | 2,397 | 2,192 | 1,888 | 2,029 | 2,836 | 2,916 | SEINE |

Source: DOF, 1986, 1987, 1988b, 1989, 1990, 1991, 1993b, 1994b, 1995, 1996a and 1996c.

## 8. THE STATUS OF PELAGIC RESOURCES AND THIER FISHERIES

The pelagic resources in Thailand have likewise been intensely fished during the past two decades, especially, Indo-Pacific mackerel which is one of the most economically important species caught both in the Gulf of Thailand and the Andaman Sea. However, the most effective gear used is purse seine which is the multipurpose of catching pelagic fishes. Therefore, it cause the different effect on each of species and fishing ground as follow described. In the Gulf of Thailand, it is considered that the stocks of small pelagic resources in the Gulf of Thailand have been fully exploited. Morever there is a noticeable sign of stock depletion of round scad (DOF, 1993c). The assessment on the state of stock taken from previous reports and present study based on the sampling data through statistical section during 1984-1994 using Scheaffer's model are shown in Table 8. The MSY estimation of Indo-Pacific mackerel in the Gulf of Thailand is about 94,791 metric tons at an exerted fishing effort of about 106,550 days fished by mackerel encircling gill nets which indicates that there has been fully exploited since 1984. The Indian mackerel has no definite sign of overfishing with the estimated maximum sustainable yield about 34,282 metric tons and optimum fishing effort about 185, 411 days fished by purse seine. Other estimation of the maximum sustainable yield for small tunas, anchovies; sardines, king mackerel, hardtail scad and bigeye scad are also shown in Table 8.

Table 8: Catches and maximum sustainable yield of important pelagic species in Gulf of Thailand

| Species | 1984-1994 (tons) | Average (tons) | MSY (tons) | References |
|---|---|---|---|---|
| Indo-Pacific mackerel | 55,186 - 99,638 | 83,022 | 94,791 | |
| Indian mackerel | 16,256 - 49,231 | 30,223 | 34,282 | |
| Round scads | 10,676 - 46,286 | 28,258 | 29,280 | |
| Small tunas | 69,355 - 156,208 | 114,630 | 86,000 | Cheunpan, 1996 |
| Anchovies | 55,466 - 120,211 | 93,570 | 106,118 | |
| Sardines | 68,447 - 123,700 | 101,346 | 110,457 | |
| King mackerel | 6,110 - 12,050 | 9,154 | 14,599 | |
| Hardtail scad | 5,608 - 20,532 | 15,258 | 18,433 | |
| Bigeye scads | 11,931 - 37,080 | 19,988 | 18,500 | Isara, 1993 |
| All pelagic species | 286,109 - 614,814 | 543,549 | ? | |

In the Andaman Sea, the consideration of all parameters combining with other information on fishery are as follow:

- The signs of overfishing have been observed for Indo-Pacific mackerel and sardines, but further the recovery of these stock seem to be gradually improved.
- No definite sign of overfishing has been observed for other important economic species. Forever the less, some species such as Indo-Pacific mackerel, the production and fishing effort are close to MSY (Table 9).

Table 9: Catches and maximum sustainable yield of important pelagic species along the Andaman Sea

| Species | 1984-1994 (tons) | Average (tons) | MSY (tons) |
|---|---|---|---|
| Indo-Pacific mackerel | 12,044 - 66,833 | 29,021 | 24,453 |
| Round scads | 2,464 - 35,994 | 16,507 | - |
| Small tunas | 4,695 - 40,784 | 12,470 | 8,383 |
| Sardines | 19,874 - 41,641 | 29,651 | 36,228 |
| All pelagic species | 56,474 - 286,509 | 108,346 | 144,848 |

Taking into account, the review of status of small pelagic fisheries resources in Thailand mention earlier, it is recognized that the development of pelagic fisheries has been clearly observed since 1973 up to the present. It shows the remarkable increase in pelagic fish production almost four folds of the previous production to 901,323 metric tons in 1994. It is certainly that almost all species of pelagic fishes are subjected to fully exploitation and some stock such as round scads has been depleted without the recovery compared with the Indo-Pacific mackerel, since the lack of strong enforcement under the inhabiting regulation and the rapid development of fishing efficiencies especially light luring technique together with the increasing in number of fishing vessels. The deteriaration of pelagic stocks in Thailand is effected to further progress in fisheries. Large scale purse seines have been modernized; equiped with colour echo-sounder or sonar for fish school detection; installed power saving devices (e.g. purse line winch, power block) that enabling a boat to reduce its man power; facilitating radar, wireless communication equipment, satellite navigation and refrigerator unit as well; therefore it makes them extended their fishing ground to the longer distance and period. Especially, small tunas fishery has been rapidly developed since 1982. Being supported by the strong demand for canning industries, small tuna fisheries has been dramatically expanded due to the improvement of fishing gear and fishing method of purse seines. The catches has been increased from 39,368 metric tons in 1982 to 157,163 metric tons in 1992, which was the outcome of promoting fisheries outside the Thai waters through joint ventures or fisheries agreements with neighbouring countries, and the exploration for new fishing grounds. These may lead to make the resources faster depleted. Nevertheless, the pelagic fish resources in the Gulf of Thailand are multispecies in nature, it is easy for the fishermen to change the target species from heavily exploited species to another without much difficulties. Therefore, the problem of resource depletion for pelagic resources are not so serious as it should be.

## 9. THE BIOLOGICAL AND ENVIRONMENTAL PARAMETERS

Thai seas are located in the tropical zone, which environment in this area is generally less variable than the temperate zone. The Gulf of Thailand can be considered as one of the large marine ecosystem owing to its unique topography and general oceanographic characteristics govern by prevailing climatic conditions, it is one of the richest areas in the world, because the coastal areas have high level of nutrients. Therefore, it is abundant in living aquatic resources. Recently, environmental condition of the Gulf has markedly changed. The Gulf of Thailand is now facing with great ecological loss caused by economic and social growth. The most severe problems are the biological over-

overexploitation using excessive fishing effort and destructive fishing gears, uncontrolled urban and industrial waste discharge, waste water discharge from shrimp farms, habitat destruction and run-off. It is known fact that marine biological communities are fragile and susceptible to accept foreign substances. It may result in the change of their population and distribution.

There has been a study on the environmental impacts of mariculture in the inner Gulf of Thailand and Andaman Sea suggest a possibility that a portion of nitrate in the inshore waters might derive from nitrate discharged from shrimp farm and it could boost primary production and lead to eutrophication. This is implicated by the periodic formation of Noctiluca blooms and subsequent anoxic bottom condition in inshore area that impose a high risk to fishery resources (Suvapepun, 1995). The influence of waste water from shrimp farms in the southern part of the Gulf has also affected on water quality which further controlled the abundance of pelagic and benthic communities in the adjacent area. Anyhow there has been no relative informations on environmental factors to discussed herewith.

The important biological features of small pelagic fish in the Gulf of Thailand and along the Andaman Sea coast of Thailand compiled from research works conducted by many scientists of the Department of Fisheries are given in Table 10. They comprise 9 species of economical important pelagic fish, i.e. Indo-Pacific mackerel, Indian mackerel, round scad, small tunas, anchovies, sardines, king mackerel, hardtail scad and bigeye scad. It is noted that the results of studies given in the table very greatly according to the period and area surveyed as well as methodologies applied. Therefore those parameters given in the table are based on available, update and average values for further consideration.

On the account of research undertaken, pelagic resources in Thailand have become very important for commercial fisheries since the begining of marine fishery development up to the present. The Marine Fisheries Division of the Department of Fisheries have initiated intensive studies on many small pelagic species during the past 30 years. But those activities have not covered all numbers of important species since each group comprises many species. An important shortcomings is the availability of specimens and data to be collected continuously for a certain long-term period. More intensified research and study for their relevant species of each group are awaited for comparative study.

## 10. MANAGEMENT OF THE PELAGIC FISHERIES

The rapid development and expansion of pelagic fisheries in the Gulf of Thailand during the last two decades resulted in intensive exploitation of both nearshore and offshore pelagic resources. Many groups of small pelagic fish have been subjected to fully exploitation and may be overfished. It seems that the room for further fishery development is very scarce. Many scientists have reported their status and proposed to set up an appropriate measure to conserve, manage and control fishing operation with a view to harmonize fishing activities for the available potential resources. It is a known fact that without systematic management, monitoring, control, survillance and rehabilitation, it will lead to greater conflict in their use.

In order to conserve the marine fishery resources, the Department of Fisheries of Thailand has set up various management measures through the Fisheries Act of 1901 which was consequently revised in 1947 and 1982 (Annex 1). The regulations that have been issued, with the objective of conserving marine fishery resources, include: determination of the size and kinds of fishing implements that are

permitted in fisheries; prohibiting the use of certain types of fishing methodology in certain areas; establishing spawning and nursing seasons and areas of marine resources and prohibiting the use of certain types of fishing gear during the said season and areas; mesh size regulation for purse seining, gill netting and lift netting; limiting the new entry of trawl fisheries and ceasing to grant new trawl licenses.

Under the 1947 Fisheries Act, a series of Ministerial rules and regulations concerning the conservation of pelagic resources and its relevant have been issued. The actives regulation concern to the management metod are as follows:

**Closed area**

To served the purpose of maintaining the productivity in coastal area or near-shore waters, Department of Fisheries established the regulation of 20th July 1972 to prohibit fishing by trawlers and push netters within a distance of 3,000 m from the shoreline and within a perimeter of 400 m of any stationary fishing gear in Thailand.

**Closed season in an area**

A conservation area in the Gulf of Thailand about 26,400km$^2$ was declared to protect several commercially exploited species of demersal and pelagic fish during their spawning and breeding seasons from 15th February to 15th May each year. This regulation of 28th November 1984 is to prohibit all types and sizes of trawlers except beam trawlers, all types of purse seiners and encircling gillnetters with less than 4.7cm mesh size, to operate in the area along the coastline of Prachuap Khirikhan, Chumphon and Surat Thani provinces, as well as Khanom District in Nakhon Sri Thammarat province in the Gulf of Thailand. According to the description of purse seine, the anchovy purse seine operating in day time during 15th February to 31th March, are excluded. Recently, the anchovy purse seine are also prohibitate under the regulation of 12th February 1994.

The conservation measures for protecting the breeding species in their spawning and nursery grounds were extended to the Andaman Sea by the declaration of 1,800km$^2$ about to Phangnga and Krabi as a zone of conservation through selectively controlled fishing by closed seasons and/or prohibition of selected fishing gear during 15th April to 15th June. The same rules regarding the types of prohibited fishing gear as applied in the Gulf of Thailand and laid out in the afore-mentioned Ministry regulation of 11th April 1985, where also extended to the conservation zone in the Andaman Sea.

**Prohabited fishing gears**

The night-time operation of small mesh size of purse seine nets (less than 2.5cm) are banned in both fishing ground in Thailand under the regulation of 14th November 1991.

However, such regulations particularly the restriction on fishing gear and provision of closed areas and seasons have not been fully enforce and some fishermen still operate illegal fishing gear evading the regulation. In particular, complete enforcement of regulations to small-scale fishermen is difficult. Taking this problem into account, it is proposed that improvement in fishery management will be necessary, e.g. license limitation, mesh size regulation, light luring devices regulation and zoning system for a certain size of fishing vessel and fishing methods. Recently, the Department of Fisheries has established a project on artificial reef installation which form physical obstacles to fishing operation and provide habitats for juveniles allowing more fish to reach marketable and reproductive size.

Table 10: Important biological features and parameters of small pelagic fish in Thailand

(Body size refers to total length unless specified as FL: fork length or SL: standard length; sexes are combined unless specified as M: male or F: female)

| Species | Area (country) surveyed | Vertical distribution range (m) | Body size captured | | Spawning | | Fecundity | Recruitment | | Size at first maturity (cm) | Sex ratio (M:F) | Growth (rate or coefficient) | Mortality (coefficient) | Life span (year) | Food organisms | Length-weight relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean (cm) | Maximum (cm) | Area | Season (month) | | Size (cm) | Season (month) | | | | | | | |
| FAMILY SCOMBRIDAE *Rostrelliger brachysoma* | Gulf of Thailand[1] | 20-40 | 15.0 | 20.95 21.5 | 10-14 mi off Prachuab Surattani | 2-4, 6-8 | egg = $9 \times 10^{-8} L^{4.8356}$ 20 000-30 000/ batch | 10.25 | 1-3, 7-9 | 17.5 | 1:1 | 0.33 | z = 1.06 | 2-3 | Phyto-planktons, zoo-planktons | $W = 0.006138L^{3.215}$ M:W = $0.000005732L^{3.1235}$ F:W = $0.000006578L^{3.1235}$ |
| *R. brachysoma* | Andaman Sea[2] | - | 17.5 | 21.0 | Koh Yao Krabi | 12-3, 8-10 | 30 000/ batch 97 250-241 832 | 9.5-12.5 | 4, 8-10 | 17.8 | 1:1.3 | 2.1 | - | - | Phyto-planktons, zoo-planktons, diatoms, copepods | Log W = 1.8874 + 3.2104* Log L |
| *R. kanagurta* | Gulf of Thailand[3] | 30-60 | 16.0 | 22.9 | - | 2-4 7-8 | 200 000 | 7.5 | 5-6 | 18.6 | 1:1 | k = 2.76 | M = 3.75 F = 4.973 Z = 8.73 3 | 2-3 | Phyto-zoo-planktons, diatoms, copepods | M:W = $0.000001958L^{3.7653}$ F:W = $0.000009454L^{3.0375}$ |
| *R. kanagurta* | Andaman Sea[4] | - | - | 19.2 | - | 12.2 | 25 000/ batch 94 495 263 178 | 13.0-14.0 | 5-12 | 18.67 | 1:0.9 3 | - | - | - | Phyto-planktons, diatoms, zoo-plankton crustaceans dinofla-gellates | |

Source: FAO, 1986

[1] Boonprakob (1965, 1967, 1972); Tabtimtai 91968) Succhondhamam et al. (1970); Somjaiwong et al. (1970); Suvapepun and Suwanrumpha (1970).

[2] Boonragsa et al. (1984); Bussarawitch (1984, 1984a, 1984b)

[3] Vanichkul and Hongskul (1965); Boonprakob (1967); Tantiswetratana (1979)

[4] Boonragsa et al. (1984); Bussarawitch (1984)

Table 10: (continue)

| Species | Area (country) surveyed | Vertical distribution range (m) | Body size captured | | Spawning | | Fecundity | Recruitment | | Size at first maturity (cm) | Sex ratio (M:F) | Growth (rate or coefficient) | Mortality (coefficient) | Life span (year) | Food organisms | Length-weight relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean (cm) | Maximum (cm) | Area | Season (month) | | Size (cm) | Season (month) | | | | | | | |
| *Auxis thazard* | Gulf of Thailand[5] | 20 | 35.0 | - | - | 4-6<br>8-9 | - | 19.0<br>27.0 | 8-11<br>2, 4-5 | 34.1 | 1:1 | - | - | 3-4 | - | $W = 0.00002L^{2.99}$ |
| *A. thazard* | Andaman Sea[6] | | | | | | | | 2-4,9 | 34.0 | | | | | | $W= 0.00002316L^{2.9617}$ |
| *Euthynnus affinis* | Gulf of Thailand[7] | 20 | 37.0 | - | - | 1-3,<br>6-7 | 1 730 000 | 21.0<br>26.0 | 2-4,<br>6.12 | 37.5 | 1:1 | - | - | - | - | $W = 0.000015L^{2.979}$ |
| *E. affinis* | Andaman Sea[8] | | | | | 1-3,<br>6-7 | | | | 37.0 | | | | | | $W= 0.00001731L^{2.9992}$ |
| *Thunnus tonggol* | Gulf of Thailand[9] | 20 | 38.5 | - | - | 3-5<br>7-12 | 1 400 000 | 22.0-<br>26.0 | 1-2,<br>4-6 | 39.6 | 1:1 | 1.5cm/<br>month | - | - | - | $W = 0.000021L^{2.979}$ |
| *T. tonggol* | Andaman Sea[10] | | | | | 3-5,<br>8-12 | | | | 40.0 | | | | | | $W= 0.00002493L^{2.9471}$ |
| *Scomberomorus commerson* | Gulf of Thailand[11] | 20-60 | 50.0 | 92.0 | - | 2-3,<br>6-9 | 500 000<br>3 800 000 | 11.0-<br>21.0 | 3-5,<br>7-10 | 58.6 | 1:1.6 | 0.12<br>3.4cm/<br>month | - | 4-5 | Fish, molluses, cristaceans | $W = 0.01302L^{2.8843}$ |
| FAMILY ENGRAULIDAE<br>*Stolephorus heterolobus* | Gulf of Thailand[12] | 5-50 | 4.5 | 8.89 | 30 mi off Prachuab | 3-4,<br>7-9 | 2000-<br>4000 | 2.8-<br>4.0 | All around 4-12 | 5.5-<br>6.0 | 1:1 | k=0.198<br>k=1.8/<br>year | Z=13.50<br>M=3.54 | 1-1.5 | Phyto-planktons | M:W=<br>$2.064 \times 10^{-6}L^{3.2494}$<br>F:W=<br>$7.089 \times 10^{-6}L^{2.9329}$ |
| FAMILY CLUPEIDAE<br>*Sardinella gibbosa* | Gulf of Thailand[13] | 15-40 | 10.0 | 18.4 | entire coastal zone | All around 3-4, 7-8 | - | 12.9 | - | - | - | 0.33 | - | 1-2 | Phyto-plankton | $W = 9.28*10^{-6}$<br>$*L3^{.0047}$ |

[5] Klingmuang (1978, 1981); Cheunan (1984)
[6] Yesaki (1982); Boonragsa (1993)
[7] Klinmuang (1978, 1981); Cheunpan (1984)
[8] Yesaki (1982); Boonragsa (1993)
[9] Klingmuang (1978, 1981); Cheunan (1984)
[10] Boonragsa (1993)
[11] Chullasorn, Chotiyaputtad Chayakul (1973); Supong and Chayakul (1979)
[12] Sdtichokpun (1970); Taweesith (1979); Isara (1972); Supongpan et al. (1984)
[13] Chullasrn, (1979)

Table 10: (continue)

| Species | Area (country) surveyed | Vertical distribution range (m) | Body size captured | | Spawning | | Fecundity | Recruitment | | Size at first maturity (cm) | Sex ratio (M:F) | Growth (rate or coefficient) | Mortality (coefficient) | Life span (year) | Food organisms | Length-weight relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean (cm) | Maximum (cm) | Area | Season (month) | | Size (cm) | Season (month) | | | | | | | |
| FAMILY CARANGIDAE *Decapterus maruadsi* | Gulf of Thailand[14] | 30-40 | 13.2 | 23.1 | Central Gulf | 2-3, 7-8 | 38 000-515 000 | 5.5-6.5 | 1-2, 6-8 | 16.1 | 1:1.2 | 0.11 1-2cm/ month | - | 2-3 | crustaceans copepods | $W = 0.00005L^{2.811}$ |
| *D. macrosoma* | Gulf of Thailand[15] | 30-60 | - | - | - | 12-5 | - | - | - | 16.5 | 1:0.9 | - | - | - | - | - |
| *Atule mate* | Gulf of Thailand[16] | 15-45 | 16.0 | 25.8 | 30 mi off Chumporn-Nakorn | 3-4 | - | 5.5-6.5 | 1-3, 6-9 | -- | | 0.8cm/ k=0.107 | - | 2-3 | - | - |
| *Selar crumenophthalmus* | Gulf of Thailand[17] | 30-60 | 20-25 | 28.4 | - | - | - | 10.0 | - | 19.4 | 1:1.3 | k=2.4 | Z=9.7 M=3.3 F=6.5 | - | - | - |
| *Megalaspis cordyla* | Gulf of Thailand[18] | 20-50 | 22.0 | 28.8 | - | 12-5, 8-11 | - | 10.5-11.5 | 5, 9 | - | 1:0.8 | 1-2cm/ month 0.2 | - | - | Fish, crustacean | $W=0.144L^{2.9785}$ |
| *M. cordyla* | Andaman Sea[19] | - | - | 34.2 | - | 3-4 | - | 15.2 | 9-12 | 28.0 | 1:1.24 | - | - | - | - | - |

[14] Chullasorn and Yusuksawad (1977); Chantarasri (1980); Cheunnan (1981)

[15] Chullasorn and Yusuksawad (1977)

[16] Piyathirativorakul (1983)

[17] Department of Fisheries, Thailand (1984)

[18] Nupech et al. (1983); Supongpan et al. (1982)

[19] Bhatia et al. (1979)

## 11. CONCLUSION AND RECOMMENDATION

Resulting from the rapid development and expansion of pelagic fisheries, it has effected a great pressure on the available resources in Thailand. It is clear that almost all of pelagic fish stock have been fully exploited and some stocks are subjected to overfishing. The catch composition is changing toward smaller size of fishes and less in values as clearly observed in sardine stock that over 40% have been used for fish meal production due to too small size and unacceptable for canning factories. It is anticipated that this situation will be continued in the future if adequate countermeasure for fishery management, resource conservation and utilization have not. been undertaken.

It is recommended that urgent management measure, including limitation of fishing effort through licensing system, mesh size regulation, fishing efficiency reduction regulation (such as light intensity limitation for luring purse seine), closed area and seasons during spawning and nursing season, quota system (such as limitation on quantity and size of fish that can be allowed to land) and etc. have to be issued and implemented. In order to receive a good success, monitoring, control and survillance of those management has to be strictly practised.

It is recognized that oppropriate research used for generating management advises to the decision maker is very necessary. There are gap in knowledge on biological information still remained in many subjects of many species. It is noted that information on spawning areas, season, size at first maturity, life span, food and feeding, growth and mortalities of many species are still lacking. Besides, information on migration of other pelagic species that are migratory fish are also very sparse.

It is well known that the most important basic requirement in stock assessment is the statistics especially time series of catch and effort and size composition by species. Although the statistics particularly catch by species/group of species and its associated effort are available, its reliability is still the question. In using of such information, careful examination and cross check should be taken into consideration.

Another constraint is a confusion and lack of firm basis for the species identification. At present, the concensus on species identification of scientific name of many small pelagic fish such as *Decapterus, Encrasicholina (Stolephorus), Sardinella* and etc. has not yet been established. It is recommended that this problem has to be solved as soon as possible in order to have proper research plan in the right way.

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**Annex 1:**

The notification of the Ministry of Agriculture and Cooperatives concerning the prohibition of fishing some aquatic species*

| Subject | Date | Content |
|---|---|---|
| The prohibition of using any trawl and any push net with a motor boat for fishing | July 20, 1972 | No person shall fish with any baged trawl and any push net or all kinds and size of baged trawl with motorboat for fishing by all means within 3,000 metres from a coastline and within 400 meters from the locating area of all fixed fishing gears or any gulfs in all coastal provinces except any activities done by the government authorities for scientific purposes with any written permission issued by the Director-General, Department of Fisheries. |
| The prohibition of using some fishing gears for fishing within the spawning season and nursery season in some areas in specific period | November 28, 1984 | 1. The spawning season shall be started from 15th February to 31st March of each year.<br>2. Subject to timming in 1, no person shall fish with any pair trawl net using with a motorboat, otter board trawls using with a motorboat or any purse seines (except bamboo stake trap) in some parts of prachuab Khirikhan-Chumporn-Surathani seas except any fishing activities during the night time by using beam trawl with a motor or using otter board trawls with a motorboat.<br>3. The nursery season shall be started from 1st April to 15th May of each year.<br>4. Subject to the season in 3, no person shall use pair trawl net with a motorboat, otter board trawl with a motorboat, purse seine (except bamboo stake trap) for fishing in the marine area designated in 2. However, this shall not be applied to any beam trawl with a motor boat or otter board trawl with a motorboat.<br>5. This notification shall not be applied to any activities the authorities for scientific research after having the written permission by the Director-General of Department of Fisheries. |

* The Important Notifications of the Ministry of Agriculture and Cooperatives Regarding Thailand's Fisheries, Division of Law and Treaties, Department of Fisheries.

| Subject | Date | Content |
|---|---|---|
| The prohibition of using some fishing gears to fish within spawning season and nursery period in some areas within a computed period of time. | April 11, 1985 | 1. The spawning season and nursery period will be designated from 15th April to 15th June of each year.<br>2. Refering to 1., no person shall use all types, of sizes trawl net with a motorboat, use purse seine and any net which has mesh size smaller than 4.7cm. For fishing in the sea within the area of Krabi province. Exception: This notification shall not apply to any fishing by anchovy purse seine during the day time, not apply to any fishing by beam trawl, otter board trawl with beam, with a motorboat which will fish during the night time only and fishing by towing line and bamboo stake trap.<br>3. This notification shall not be applied to the authorities activities involving in scientific experiment after getting Director-General of Department of Fisheries. |
| The designation of prohibited purse seine which has its mesh size smaller than 2.5cm to fish during the night time. | November 14, 1991 | No person shall use any purse seine which has its mesh size smaller the 2.5cm to fish during the night time in the sea or the gulfs located in all coastal provinces except any fishing activities for scientific purposes after receiving the written permission issued by the Director-General, Department of Fisheries. |