

Development of Fisheries *Refugia* through Closed Seasons and Areas in the Gulf of Thailand

Pirochana Saikliang

Marine Fisheries Research and Development Division

Department of Fisheries, Thailand

email: pirochas@hotmail.com

Abstract

Marine capture fisheries of Thailand had been in the top ten fisheries production countries in the world. Indo-Pacific mackerel (*Rastrelliger brachysoma*) is one of the country's most important pelagic species, particularly those caught from the Gulf of Thailand. However, increasing demand of the Thai people together with the rapid development and improvement of fishing gear and fishing techniques resulted in the stock reduction of the Indo-Pacific mackerel and some other commercially important pelagic species in the Gulf of Thailand. Therefore, the Department of Fisheries of Thailand established fisheries *refugia* or closed seasons and areas in some parts of the Gulf of Thailand in order to prohibit some fishing gear and fishing techniques as well as monitor the changes in the status of aquatic species and also the fishing methods in order to determine appropriate measures from time to time for sustainable use of these pelagic species. During the past 60 years (1953~2015), the Department of Fisheries issued a total of 13 fisheries management measures in five periods relating to the development of fishing gears and fishing techniques corresponding to the "Gulf Closing" in the southern areas (Prachaup Khiri Khan, Chumphon, and Surat Thani) with the aim of conserving the spawning areas and nursery stage of aquatic resources in the Gulf. The measures for conserving the Indo-Pacific mackerel were used as basis for the formulation and development of other conservation measures. Cancellation and revision of these measures were also made from time to time in accordance with the change of status of the fishery resources and the effective management of the aquatic resources for sustainable exploitation.

Keywords: Fisheries *refugia*, closed seasons and areas, Gulf of Thailand

Introduction

Thailand's marine capture fisheries are highly significant both nationally and internationally, the country being among the top ten fish producing countries world-wide. The country's capture fisheries are dominated by "trawl fisheries" which mainly harvest demersal species. Pelagic fisheries are also significant with total production in 2011 that accounted for 38.0% of the total fisheries production, of which 66.0% was harvested from the Gulf of Thailand (GOT). Indo-Pacific mackerel (*Rastrelliger brachysoma*) is one of the most important pelagic species for the Thai people being considered "good meat and delicious". However, increasing demand of Thai people for protein sources together with rapid development and improvement of fishing techniques resulted in stock reduction of the Indo-Pacific mackerel and some other commercially-important pelagic species in GOT during the 1980s.

The GOT is one of the most highly productive shallow water areas due to high sediments and organic inputs including nutrients from river runoff that provide suitable conditions for high natural productivity. The Gulf of Thailand also supports high biological diversity and reports of a study indicated that there were more than 4,300 aquatic species found in the GOT (Sukhavisidh, 1996).

Inter-annual variations in climate, including extreme events are neither extreme nor frequent as in the Andaman Sea and together with the wide continental shelf, these conditions support important fishing grounds and permit the use of a variety of fishing gears including trawlers, surrounding nets, gill nets and various smaller gear types. Traditionally, capture fisheries in Thailand used to be operated in near-shore waters using stationary fishing gears such as bamboo stake traps. In 1925, this had changed by using "surrounding net" or "purse seines" based on the technology introduced from China in 1925. Subsequently, fishing operations evolved from the initial use of two small boats pulling the net from the mother boat, to the use of only a single main boat.

At the same time as the fishing technology changed, the size of fishing boats increased and as well as the means of propulsion from the original rowed boats, to sailing boats, and finally motorized vessels. Japanese trawlers with engines were also introduced in the 1930s, but these were not readily adopted by Thai fishers at that time. In the early development, Thai marine fisheries focused mainly on harvesting pelagic fishes and the development of fishing gear and methods to increase fishing efficiency.

Following the use of two purse seine boats and changing to a single large size fishing boat, the so-called “Thai purse seine” or “aun-chaloum” has become the dominant technology used by Thai fishers for catching the Indo-Pacific mackerel (Phasuk, 1979). Since the 1930s, aquatic resources had been increasingly harvested to meet the market demand resulting in declining fish stocks. Since the 1950s the Department of Fisheries of Thailand (DOF) has been monitoring the changes in status of aquatic species and also the fishing methods used, with the aim of determining appropriate measures for the sustainable utilization of these pelagic species.

Various management measures have been promulgated including mesh size regulation, fishing zone delimitation, and establishment of

Implementation of Management Measures

Prior to 1953, no measures had been established for the conservation and management of any marine resources including the Indo-Pacific mackerel (Hongskul, 1975). In 1953, DOF recognized that the Indo-Pacific mackerel in the GOT had been exploited in substantial quantities, thus, a Notification of the Ministry of Agriculture and Cooperatives (MOAC) dated 25th August 1953 was issued in order to conserve the Indo-Pacific mackerel stock by prohibiting the use of some fishing gear and methods during their spawning period. The prohibition focused on the use of specific types of fishing gear (such as large-scale Chinese purse seine, Thai purse seine, etc.) operating in southern Chumphon Province to the southern Gulf of Thailand from first day of the fourth waning moon to full moon day of the sixth (**Fig. 1** (left)). In practice however, fishing vessels still continued to operate in the prohibited area during the closed season.

During Period Two (1954-1967), the rapid improvements and development of new fishing gear and methods for catching pelagic fish in the Gulf of Thailand, resulted in increased pelagic fish catch, particularly the Indo-Pacific mackerel. In 1957, the catch of Indo-Pacific mackerel started to decline. The DOF established a Technical Committee for Indo-Pacific Mackerel Investigation Program to study the causes of the declining stocks in response to requests and complaints from fishers. In 1960, some of the fishers changed their fishing gear to otter-board trawl, which had been introduced from Germany. Even though the overall production from pelagic capture fisheries was still at high level during that time, it was found that the quantities of Indo-Pacific mackerel displayed a decreasing trend.

fishing and closed seasons. One of the important measures was the “Gulf Closing” that has been implemented in the GOT to prohibit some fishing activities operating during the spawning and nursing periods.

Concurrently, such measures have also been implemented in the Andaman Sea. This report presents the development of marine fisheries management in the GOT over the past 62 years. During the course of implementation of the fisheries management measures, focused has been placed in conserving the Indo-Pacific mackerel. Later, other commercially important species have also been included under these measures. The management measures implemented in the GOT from the past to present are reviewed in the following section.

Therefore, Notification of MOA dated 18th March 1959 was issued to prohibit the use of some fishing gears and practices including the purse seine and encircling gill nets in the areas identified as spawning grounds of the Indo-Pacific mackerel. However, exceptions were provided for those who received individual fishing licenses (Phasuk, 1982).

In addition, this notification also aimed to obtain statistical information on catch data of the Indo-Pacific mackerel, through the use of logbooks provided by the DOF for recording catch data by fishers and submission of data to DOF. In practice, all fishers applied for licenses and none were refused.

Consequently, fishing effort remained much the same as before. In 1962, Notification of the MOAC dated 8th March 1962 was issued with the aim of defining the spawning duration of Indo-Pacific mackerel and limiting the use of mesh size in some fishing gear for catching small size Indo-Pacific mackerel. This was due to the heavy exploitation of the small size Indo-Pacific mackerel during the closed season. Then, the closed season was extended for one month and divided into two periods: the first from 15th January to 31st March defined as the spawning period of Indo-Pacific mackerel.

During this season, the use of all types of fishing gear equipped with purse line and also encircling gill nets were prohibited. The second from 15th April to 14th June defined as juvenile period. During this season, the use of purse seine and mackerel encircling gillnets of mesh size smaller than 4.7 cm were prohibited.

At the same time, the DOF also issued a regulation that any fishers who intend to engage in any fishing activity must receive individual permission in advance with the condition that the catch data should be recorded in the logbook (Phasuk, 1979). However, illegal and unreporting activities during the closed season continued to occur due to weak enforcement of the regulations. The first closed areas and life cycle of the Indo-Pacific mackerel in the Gulf of Thailand are shown in Fig. 1.

In Period Three (1968 to 1982), over capacity of the fishing fleet that had been rapidly developed resulted in serious problem over this period due to increasing number of fishing boats, as well as development and improvement of bottom trawlers in the GOT (Bunyubon and Hongskul, 1978). Modified trawlers for catching Indo-Pacific mackerel were developed resulting in increased quantity of fish being caught by these vessels for many years (Boonprakob, 1974).

In 1972, MOAC Notification dated 13th October 1972 was issued to prohibit the use of trawlers in the southern areas (Prachuap Khiri Khan, Chumphon, Surat Thani, and Nakhon Si Thammarat Provinces), during the period from 1st February to 31st March. This regulation aimed to prevent trawlers from catching Indo-Pacific mackerel during the spawning period. This was based on the fact that between 17 and 22% of the catch taken from bottom trawlers and pair-trawlers were composed of spawners and juvenile stages.

The oil crisis in 1973 resulted in changes and modifications of pelagic fishing practices to reduce harvest expenses. These included the use of fish aggregating devices (usually using a bunch of coconut leaves) and light to attract fish (Phasuk, 1979). MOAC Notification dated 7th November 1975 was issued to specify the spawning season and prohibit the use of some fishing gear; and also to regulate mesh size. By revising the Notification dated 8th March 1962, gear prohibition was extended to include luring purse seine using coconut shelter with/without lights. The previously defined closed season was extended by an additional month starting from 15th April to 14th July annually (Phasuk, 1979).

During this period, a peak occurred for the first time in the GOT. The catch of Indian mackerel (*Rastrelliger kanagurta*) exceeded that of the Indo-Pacific mackerel. This could be probably a result of the increased number of luring purse seine fishing vessels from 100 in 1973 to 383 vessels in 1977 (Phasuk, 1979).

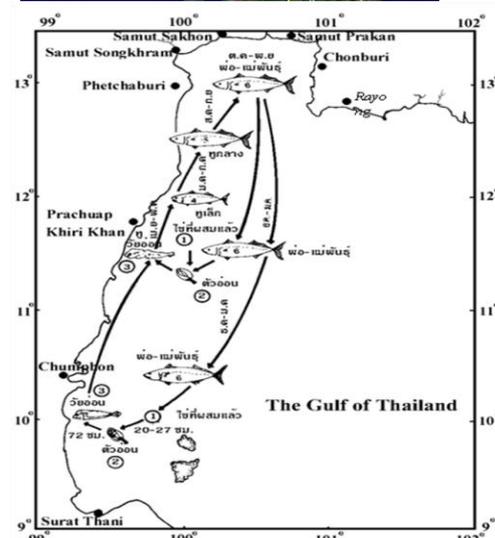


Fig. 1. Closed areas(above) and life cycle of the Indo-Pacific mackerel (below) in the Gulf of Thailand (Boonprakob, 1974)

Due to shortage of fuel gas in the domestic market, fishers started to lure fish by using lights generated by Dynamo-motor with capacities from 5 to 50 kW. The luring purse seine has become the common fishing practice since 1978 until the present (Sreungcheep, 1997).

Over the period from 1979 to 1981, fishers began to use electronic equipment such as echo sounders and sonar for locating fish schools. Since then, net hauler or power block had been used to minimize the number of crew during fishing operations.

Thus, from 1953 to 1977, a total of 5 Notifications relating to the management and conservation of Indo-Pacific mackerel were issued, aimed at protecting both the mature and juvenile stages of the Indo-Pacific mackerel. The contents of these notifications led to changes in the regulations regarding the length of closed seasons, gear prohibition and other regulations, and reflected the changes in the status of the fishery.

Effective control and enforcement of the regulations were major constraints reflecting both the insufficient number of officials and surveillance vessels. As fishers continue to defy the regulations (Phasuk, 1979), their gear and equipment had been modified in order to make their fishing gear different from those defined in the Notifications (Phasuk *et al.*, 1988).

The areas of Prachuap Khiri Khan, Chumphon, and Surat Thani are also important spawning and nursing grounds not only for the Indo-Pacific mackerel, but also for other aquatic species (Phasuk, 1982). It was obvious that the Notifications issued in 1975 – 1983 were used for effective management and protection not only for the Indo-Pacific mackerel but also other aquatic species (Phasuk *et al.*, 1988). Based on available data and information, the Pelagic Fisheries Investigation Unit of the Marine Fisheries Division of DOF had proposed to control the fisheries during the spawning and nursing period of Indo-Pacific mackerel by moving from closure of the whole area of GOT to closure of the specific spawning and nursing grounds during the two months period from 1st February to 31st March.

Under this Notification dated 13 October 1974, all types of fishing gears and methods were not allowed to operate, except the bamboo stake trap (Phasuk, 1982). The increasing number of trawl nets in the GOT resulted in the demersal resources reaching critical levels, since juveniles of both pelagic and demersal resources were over-exploited. From 1983 to 1984, it was also found that a lot of juvenile Indo-Pacific mackerel were caught, usually comprising 27-30% of the total catch of mackerel (Srireungcheep, 1997).

Therefore, DOF issued MOA Notification dated 3rd March 1983, by revising the Notifications dated 19th October 1972 and 7th November 1986. All trawl nets and purse seines with purse lines were not allowed to operate during the period from 1st February to 31st March (spawning period), and during 1st June to 31st July (nursery and juvenile period) for a total period of 4 months. This Notification which was effective from 1st June 1983 was meant to reduce the pressure of trawling and purse seining on all demersal and pelagic resources especially the Indo-Pacific mackerel. However, this Notification was temporally suspended due to the fishers' complaints, and then MOAC issued a Notification dated 6th May 1983 to support the temporary cancellation.

After 1984, the management measures for bamboo stake trap and encircling gill net with mesh size larger than 4.7 cm were accepted and these were considered appropriate gears (Phasuk *et al.*, 1988). Subsequently, MOA issued Notification dated 28 November 1984 revising the Notification dated 29th August 1983 by extending the closed season from 2 months to 3 months and again dividing it into two periods: the first phase, spawning period from 15th February to 31st March, and the second phase, nursery and juvenile period from 1st April to 15th May of each year. Under this Notification, trawl nets and otter board beam trawls were not permitted to operate during daytime and purse seines were prohibited during the 45 days from 15th February to 31st March. From 1980 onwards, the anchovy purse seine fishing fleets had developed and expanded rapidly due to market driven demand, and the fishing fleet from the Andaman Sea had moved to the Gulf of Thailand in the waters of Surat Thani and Chumphon Provinces.

Anchovy fishers who were affected by the existing measures requested DOF to allow them to fish during the spawning period and quoted that their fishing practices targeted mainly anchovies and had little by-catch or no effect on other economically important species (letter of complaint dated 2nd February 1984). Later, the Surat Thani Governor requested DOF to consider the proposal on anchovy fisheries and DOF agreed to delay the implementation and issued instead a new Notification dated 11st January 1988. Based on this new Notification, anchovy purse seine was allowed to operate only in the daytime during closed season from 15th February 31st March annually.

The above Notifications reflected the recurring conflict among resource users, especially in Chumphon and Surat Thani Provinces. At the same time, the anchovy purse seine fleet from the eastern port that had moved into the western part of the GOT with the use of light luring and small mesh size, resulted in substantial catches of juvenile fish and other aquatic animals. As a consequence, fishers from Chumphon and Surat Thani Provinces requested the government to control the anchovy purse seine fishery. At the same time, the Thai Fishermen Association submitted a complaint document dated 14th April 1989 to DOF not to allow only anchovy purse seine to operate in the closed area and requested i DOF to reconsider and repeal the measure for anchovy purse seine.

Together with the results from the Seminar on “Fishermen and Aquatic Animals Conservation” organized in Surat Thani Province in December 1989, and the details of the joint meeting among governmental and private representatives on 8th March 1990, all parties agreed to delay the implementation of the Notification dated 11st January 1988.

DOF issued Order No. 7/2533 dated 3rd January 1990 with regard to the appointment of the members of a committee to study and resolve the problems and complaints concerning anchovy fishing. Results of the study showed that the distribution of anchovy eggs and larvae was extensive covering the area from 1 - 40 nautical miles from shore during January to March.

On the basis of such findings, Thai DOF issued Notification dated 12nd February 1994 which aimed to conserve anchovy resources, and prohibiting the use of some fishing gear that operate during spawning and nursery periods in specific areas. This Notification, which eventually caused the cancellation of the Notification dated 11st January 1988, also included the prohibition of daytime anchovy fishing during the period from 15th February to 15th May annually. This Notification has resulted in the stabilization of the Indo-Pacific mackerel production in the Gulf of Thailand of about 90,000 metric tons (MT) annually for the next six years.

Results of the monitoring and evaluation of this measure indicated that the catch decreased to around 80,000 MT from 1990-1991 and 1993 (Srireungcheep, 1997). In addition to the problems on anchovy fishing, fishers tried to develop and change their fishing gears and methods to increase fishing efficiency, and to enable them to operate during the closed season. Indo-pacific mackerel fishers also modified their encircling gill nets of mesh size over 4.7 cm targeting mature Indo-Pacific mackerel and Indian mackerel by increasing the net length, which was not prohibited by the Notifications. The number of this type of gear increased rapidly (DOF, 1996). From the monitoring and evaluation of this measure in 1996, it was found that the catch using mackerel encircling gill net of fishing boat size lower than 10 meters was approximately 90 kg/boat/trip. The catch by fishing boats size 10 -14 and more than 14 meters was 1,212 - 1,218, and 1,270 - 1,740 kg/boat/trip, respectively.

From a study in 1998, it was found that the average weight of catch from the mackerel encircling gill net was 941-1,367 kg/trip during

the prohibited period (in Prachuap Khiri Khan, Chumphon, and Surat Thani areas). More than 80% of the catch was Indo-Pacific mackerel mixed with Indian mackerel, carangids, other hardtail scads, flying fishes, croakers, and pony fishes. This study found that the total length of individual Indo-Pacific mackerel ranged from 15.19 – 16.20 cm representing completely mature individuals (DOF, 1998). The encircling gill net fishing from February to June 1999 yielded a total fish catch of 6,316 metric tons, calculated as 86,365 mature individuals of Indo-Pacific mackerel. It was calculated that such numbers of Indo-Pacific mackerel individuals could themselves produced 130,027 million mature individuals (Nakrobru and Saikliang, 2003). At the same time, other developments occurred in terms of fishing technology. Fishers had improved push net fishing gear by increasing the net size, using longer push sticks operated with bigger boats and more powerful engines. Such gear is considered destructive fishing gear to various types of aquatic resources and benthic habitats. In addition, fishers had modified the push net and anchovy purse seine fishing boats into casting net, falling net, and lift net equipped with light for catching anchovy.

A study on this type of fishing operation found that the catch included large numbers of juveniles of commercially important species. Based on the results of the study on the status of marine fisheries development mentioned above, amendment was made by MOAC of the 1984 Notification by issuing Notification dated 24th September 1999 encompassing the waters of Prachuap Khiri Khan, Chumphon, and Surat Thani Provinces. The focus of this Notification covered the spawning and nursery period from 15th February to 15th May annually, and specified the prohibition of certain types of fishing gear as follows:

1. Pair trawl and bottom trawl that had been changed to all types of motorized trawls except trawl net and used together with single motorized boat of length less than 16 meters operating at night between sunset and sunrise
2. Entangling net of mesh size lower than 4.7 cm that had been changed to entangling gill net operated with motorized fishing boat for surrounding and entangling Indo-Pacific mackerel or similar method
3. Surrounding net, the same as before, no revision
4. Additional prohibited fishing gears included: cast net, falling net and lift net using generated electricity for catching anchovy; and push net using motorized boats of length over 14 meters

Following the announcement of these measures, various groups of fishers especially the Fishermen's Association of Lang-soun District, Chumphon Province did not want to accept these measures as they used mackerel encircling gill net to catch Indo-Pacific mackerel during the closed season. The Thai DOF sent an official team to explain the background and rationale of this measure which was issued based on a scientific study. It was agreed to postpone the implementation of the measures for a year (Notification dated 24th September 1999). During the intervening period, the Notification issued in 1984 was temporarily used. In order to solve the problems that may occur in the area, multi-stakeholders committees were established in each province, consisting of representatives from each group of fishing gear users, and relevant governmental officials to address the new challenging issue of reducing the area to be closed. **Fig. 2** shows the present closed areas.

Since then, the Thai DOF proposed to MOAC to issue a Notification dated 10th February 2000 prohibiting the use of some types of fishing gear in the area of Prachaup Khiri Khan, Chumphon, and Surat Thani during the closed season (2nd Edition). The main reason was to temporarily delay the implementation of the Notification dated 24th September 1999, that will be effective from 15th February to 15th May 2000. Consequently, fishers of Lang-soun District demonstrated as they disagreed with this Notification. As a result of consultations with fishers on 22nd February 2001, permission was

given for the joint scientific study on the use of certain fishing gear:

1. During the first 45 days (15th February to 31st March 2001), permission was given only for beam trawl or bottom otter board (small trawl) using only one single motorized boat and operate at night time; push net; anchovy purse seine to operate during day time; lift net; anchovy cast net equipped with electric generator
2. During the last 45 days (1st April to 15th May 2001), permission was given only for encircling gill net that use motorized boat and similar fishing method with Indo-Pacific mackerel purse seine.

The Notification specified that a study would be carried out in collaboration with Thai DOF, fishers and scientists, through a working committee. Subsequently however, 23 fishers from Paknam Lang-soun submitted a plea to the Central Administrative Court for the revision of the Notification dated 24th September 1999, with the Minister of Agriculture and Cooperatives as the primary defendant and Thai DOF as co-defendant.

As Undecided Case number 1284/2544 under consideration of Administrative Court (Undecided Case number A. 12/2546) which later became Decided Case number A.51/2547 of the Highest Administrative Court dated 26th July 2004. Finally, the Courts settled the case and acquitted the defendants.

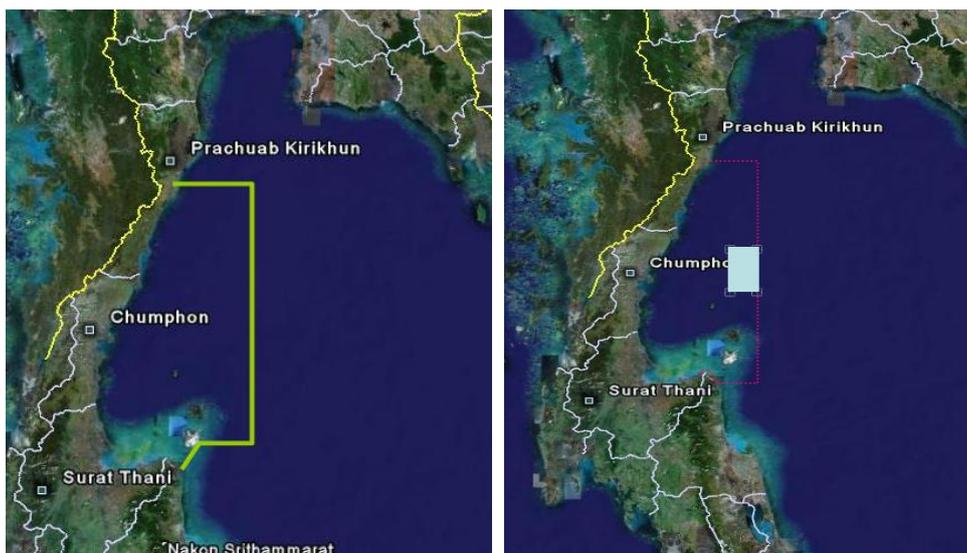


Fig. 2. Closed areas: the current (*left*) and challenged (*right*)

Recommendations and Way Forward

Following the prohibition of the use of mackerel encircling gill net resulting from the Notification dated 24th September 1999, there was a dramatic increase in the numbers of Indo-Pacific mackerel caught by drift gill netters during 2002 and 2005. The catch composition was mainly medium- and large-sized Indo-Pacific mackerel, approximately 10-15 and 8-10 individuals/kg, respectively. In addition, various demersal fishes were also caught, e.g. red snappers, big eyes, lizard fishes, and wolf herring. At the same time, some of fisher groups improved their techniques of drift gillnet fishing (targeting Indo-Pacific mackerel) by increasing the net depth from 50 - 80 to 200 - 300 meters. Fishing methods were also changed from straight set up nets to nets set in circles, zigzag, or something similar. This type of gear was called “auon-short” (gill net).

Conclusion

In conclusion, during the past 62 years (1953 - 2015), the Thai DOF issued a total of 13 Notifications (specific management measures) relating to closures of fishing area in the Gulf of Thailand with the objective of conserving the spawning and nursery stages of aquatic resources. It was clearly observed that the measures for conserving Indo-Pacific mackerel were used as

References

- Department of Fisheries. 1996. Summary of technical procedure on marine resource conservation at protected area Prachaup Khiri Khan, Chumphon and Surat Thani provinces in 1996. Particular of marine resource conservation during spawning period and habitat center in 1996
- Department of Fisheries. 1998. Summary of technical procedure on marine resource conservation of protected areas in Prachaup Khiri Khan, Chumphon and Surat Thani provinces in 1998. Particular of marine resource conservation during spawning period and habitat center in 1998
- Nakrobru, C. and P. Saikliang. 2003. The effect of Mackerel Encircling Gill Net Fishery of Indo-Pacific Mackerel parent stock in protected area, Prachuap Khiri Khan, Chumphon and Surat Thani provinces. Technical Paper No. 14/2003. Marine Fisheries Division, Department of Fisheries; 35 p
- Phasuk, B. 1979. Situation of pelagic fishery in the Gulf of Thailand. Thai Fisheries Gazette 32(1): 27-50
- Phasuk, B. 1982. Pelagic fishery management in the Gulf of Thailand. Technical Paper No. 29/1982. Pelagic Fisheries Section. Marine Fisheries Division, Department of Fisheries; 21 p
- Phasuk, B., M. Bunyubon, C. Vibhasiri, U. Sriruangcheep and C. Tantisawetrat. 1988. Effectiveness of fisheries resource enhancement on closed period in Prachaup Khiri Khan, Chumphon, Surat Thani and Khanom district, Nakhon Si Thammarat Provinces. Thai Fisheries Gazette 41(3): 183-196
- Bunyubon, M. and V. Hongskul. 1978. Conclusion of fishery situation, demersal fish in the Gulf of Thailand in 1961-1975. Demersal fish research No. 1/1981. Marine Fisheries Division, Department of Fisheries; pp 1-6
- Charyakul, R. 1994. Spawning ground and spawning season of *Stolephorus heteroloba* (Ruppell) in Prachaup Khiri Khan, Chumphon and Surat Thani Provinces. Technical Paper No.25/1994. Upper Gulf Marine Fisheries Research and Development Center, Department of Fisheries; 256 p
- Hongskul, V. 1975. Marine Fisheries in Thailand. A Paper Presented to the 1st Administered Seminar (Fisheries Development), Fish Market Organization; pp 1-17
- Hongskul, V. 1990. Anchovy fisheries problems. Thai Fisheries Gazette 43(5): 349-353
- Boonprakob, U. 1974. Conclusion of Indo-Pacific mackerel's dynamic in the Gulf of Thailand for conservation on Indo-Pacific Mackerel. Technical Paper, Pelagic Fish Conservation Unit during 1967-1972 part 1. Survey and Research Division, Department of Fisheries; pp 203-231
- Sriruangcheep, U. 1997. Changes in size composition of *Rastrelliger neglectus* (van Kamphen, 1907) caught from the Gulf of Thailand during 1968-1994. Technical Paper No. 2/1997. Marine Fisheries Division, Department of Fisheries; 63
- Sukhavisudh, P. 1996. Checklist of Marine Fishes of Thailand. Technical Paper No. 2/1996. Marine Resources Surveys Section, Bangkok Marine Fisheries Development Center, Marine Fisheries Division, Department of Fisheries; 120 p

In 2005, results from the follow-up study indicated that the catch rate of this gill net, operated by using long-tail boat and inboard engine boat of length less than 10 m, was approximately 60-100 kg/day/boat of which 85.00% was Indo-Pacific mackerel. The catch rate for short nets operated by boats over 10 m in length averaged 800 kg/day/boat of which 77.49% was Indo-Pacific mackerel. It was also found that 75-98% of both males and females were fully mature. Since these fishing gears are newly developed with high efficiency and target mainly large size of Indo-Pacific mackerel, the Thai DOF has considered establishing an appropriate measure to conserve the Indo-Pacific mackerel.

basis for the formulation and development of other fishery resources in the same areas. Cancellation and revision of these measures were made from time to time in accordance with the changes in status of the fishery resources and the development of fishing practices with an attempt to effectively manage the aquatic resources for sustainable fisheries.