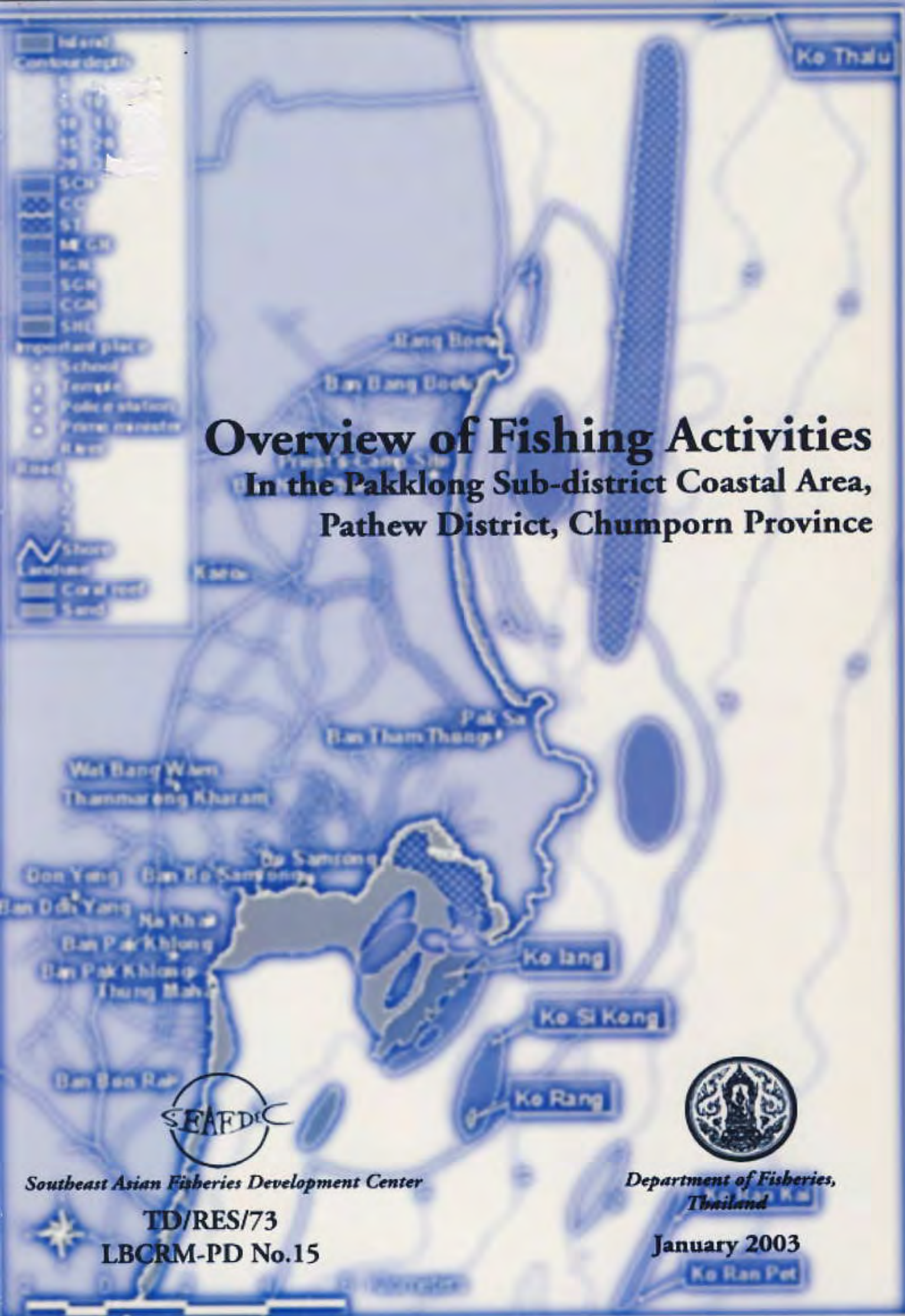




**Overview of Fishing Activities
In the Pakklong Sub-district Coastal Area, Pathew
District, Chumporn Province**



By

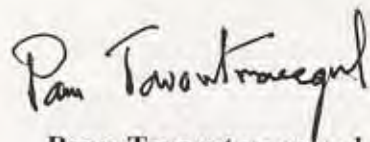
Sukchai Arnupapboon and Wirote Laongmanee

**Collaborative project between
Southeast Asian Fisheries Development Center
and Department of Fisheries, Thailand**

FOREWORD

Under the Fisheries Consultative Group (FCG) scheme, SEAFDEC/TD and the Department of Fisheries (DOF) has planned and implemented a joint involvement in "Locally Based Coastal Resource Management, Pathew District, Chumphon Province (LBCRM-PD)". This project has the objective of enhancing the people's awareness on the sustainable use of coastal resource management and to develop an effective management framework at the project site.

To lead to the outstanding success of the project activities, the project continues to conduct a base line survey including the fishing ground and fishing gear aspect. This volume is the result of a series of base line surveys that have been carried out since January 2002. I hope that these survey results will be of great use, not only for Thai coastal fisheries development, but also for other member countries of SEAFDEC-ASEAN.



Panu Tavarutmanee
Secretary General

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Overview of Fishing Activities In the Pakklong Sub-district Coastal Area, Pathew District, Chumporn Province

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ABSTRACT

This investigation on fishing ground, fishing season and ECPU (estimated catch per unit) for each gear used by Pakklong fishermen was carried out from March to August 2002 and compiled from interviewing local fishermen. All of the information is useful for sustainable resource management. The overall results indicate their seasonal change and what influences their recurring seasonal change. It was found that there were 7 categories comprising 24 types of fishing gear. There were 4 main types of fishing gear, which included squid cast net, squid trap, crab gill net and collapsible crab trap. In defining fishing ground, it was considered that Tham Thong bay, Thung Maha bay and around Lang Island were particularly favoured for fishing operation. The changing of fishing ground, fishing gear and ECPU were caused by three main factors; restricted fishing period, sea condition under local climatic atmosphere and situation of fisheries resources in the area.

Key words: fishing ground, fishing gear, ECPU, Pakklong fishermen

Introduction

This study is a part of "Locally Based Coastal Resource Management" project in Pakklong Sub-District, Pathew District, Chumporn Province. The project is a collaborative effort between Department of Fisheries of Thailand (DOF) and the Southeast Asian Fisheries Development Center. Pakklong sub-district was selected as a pilot area together with fishing area used by fishermen, who live there. The survey locations and marine bottom topography are shown in **Fig. 1**.

It is widely accepted that marine resources play significant role to fishermen. Currently, the marine resources are in critical condition because of over-exploitation, especially by the fishermen. From this reason, the poverty has become an integral part of fisherman life. Ruangsivakul, *et. al*, (2002) surveyed that In 2000, in Tambol Pakklong, the people earned or had an average income of 10,674 Bath per year. Therefore, it is important to study and understand more on harvesting area to alleviate poverty by managing the resource base from a sustainable aspect.

The objective of this study is to monitor the fishing ground of each type of fishing gear and their seasonal changes as used by Pakklong fishermen and to help achieving resources management within sustainable coastal resources. Further, this paper can be useful for both local fishermen and researchers who are involving in the resources management in this area. The significant information will be presented using Geographic Information Systems technology to enable easier understanding, especially the spatial information of fishing distributions area, number of fishing boats operating within fishing area using different fishing gears and the estimated catch per unit (ECPU) each month. It also covers type of operated fishing gear (**Fig. 2**) and percentage of each operating gear in each month (**Apx. III**).

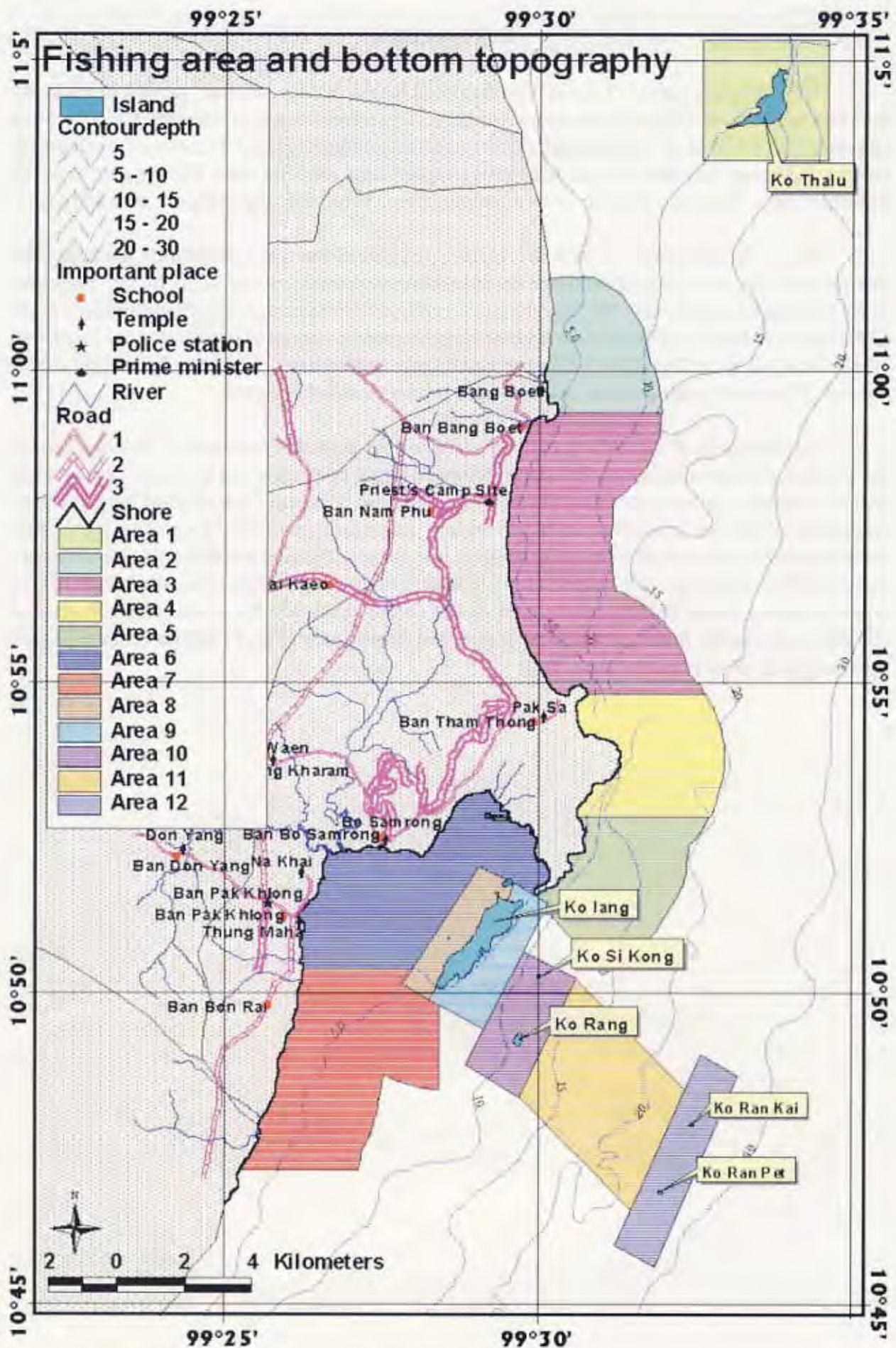


Fig. 1. Coastal fishing ground of Pakklong Sub-district.

Materials and Methods

The information from fishermen was recorded during the field survey collection from March to August 2002. The information was collected using two methods with two sources, which are the usage of global position system (GPS) and questionnaire. The first method, the portable GPS unit was used to identify the existent aquaculture sites. The second method, using the information obtained by interviewing fishermen and completing the questionnaire consisted of fishing area for different types of fishing gears, operation period, total catch and identifying all the type of fishing gears belong to the fishermen. The fishing gear survey was conducted each month at 5th to 7th day after full moon. Information on the aquaculture sites was collected once a year by interviewing fishermen and by assessment. All local fishermen in study area were interviewed on the interviewing day and the data source from questionnaire concerned the respondent's latest fishing operation.

To determine the seasonal changes in fishing ground by different type of fishing gears, the data of estimated catch per unit (ECPU) and percentage of fishing boat operating in fishing area was used for identification of changeable fishing area in each month (**Appendix II**). Their data were presented by GIS, using ArcView version 3.2 GIS software. This was used because it is a powerful tool to process, analyze, and display geographic characteristics of fishing operation distributions and percentage of fishing boat operating in fishing areas plotted on 2 dimension maps. In addition, the information of percentage of catch composition was included.

From the value of ECPU it may be estimated that there is a significant difference in abundant and distribution of aquatic animals within fishing areas, but the data obtained from the local fishermen varied. Therefore, for analytical purpose the ECPU of fishing gear were adjusted based upon the operating period and size of fishing gear. (**Table 1.**)

Table 1. Averaged operation period and size of fishing gears

Type of fishing gear	Operation period (day)	Size of fishing gear (m)	Remarks
Anchovy purse seine	1	1000	In length
Anchovy stick-held box net	1	20	Circumference
Squid cast net	1	20	Circumference
Mullet encircling gill net	1	1000	In length
Pomfret encircling gill net	1	1000	In length
Fish bottom gill net	1	1000	In length
Crab gill net	3	1000	In length
Indo-pacific mackerel gill net	1	1000	In length
Mullet gill net	1	1000	In length
Sand whiting gill net	1	1000	In length
Shrimp trammel net	1	1000	In length
Jelly fish scoop net	1	1	Scoop net
Squid hand-line	1	1	Line
Collapsible crab trap	1	1	Trap
Grouper trap	1	1	Trap
Squid trap	1	1	Trap

Results and discussions

During the survey collection period from March to August 2002, the total number of different fishing gear types was twenty-four during the period of the field survey. These may be broadly classified into 7 categories, being one type of purse seine, two types of cast net, thirteen types of gill net, one type of scoop net, one type of push net, three types hooks and line and three types of trap (shown in **Table 2.**). In addition, fishing areas were classified into 12 areas to more easily understand the seasonal change monitoring of fishing gear of each type (shown in **Fig. 1**).

Area 1:	around Thalu Island.
Area 2:	northern part of Tham Thong bay.
Area 3:	Tham Thong bay.
Area 4:	Northern part of Yai cape.
Area 5:	Southern part of Yai cape.
Area 6:	Thung Maha bay.
Area 7:	In front of Yai Bang Chak mountain.
Area 8:	Western part of Lang Island.
Area 9:	Eastern part of Lang Island.
Area 10:	Around Si Kong Island and Rang Island.
Area 11:	Between Si Kong Island and Ran Pet Island.
Area 12:	Around Ran Kai Island and Ran Pet Island.

Most of these are in coastal zone, Which consisted of areas 2, 3, 4, 5, 6, 7, 8, 9 and 10. These areas were main fishing areas used primarily by small-scale operation (typified by boat of less than 14 maters). According to data collected, it was found that almost 80% of the common fishing gears in study area was for small-scale fishing.

Fishing gear operation by type

A six-month research program to collect information on fishing gear used has been undertaken and it was found that the common fishing gears used in the study area was for catching squid (here in after, squid and cuttlefish will be referred to as squid) and crab. The gear was identified as squid cast net, squid trap, crab gill net and collapsible crab trap. It was found that these represented higher than 55% of the operation fishing gear in each month. The average is 65.5%. The period of most intense fishing operation of such gear was found in April and the lowest use was found in July, The percentage are 74% and 56%, respectively (**Fig. 2**).

Additional fishing gears used was classified into two groups (**Table 3.**) First group included anchovy purse seine, anchovy stick-held box net, mullet encircling gill net, pomfret encircling gill net, sardine encircling gill net, fish bottom gill net, indo-pacific mackerel gill net, mullet gill net, sand whiting gill net, shrimp trammel net, jelly fish scoop net, squid hand-line and grouper trap. While the fishermen still use the gear, there is no great activity. While they did not operate the gear fully during the six-month period each gear was used for a small percentage of each month. (see **Appendix III**)

Second group was fishing gears, that was not used for fisheries during survey collection. Even so, the fishermen keep them in storage. This group consists of barracuda gill net, grouper gill net, ray gill net, threadfin gill net, ray long line, and trolling line. Following the discussion with

local fishermen, the main reason of why they didn't operate the gear was that "the number of target fish was too small". Hence, the harvest was not enough to cover the cost of fuel and repair fishing gear".

Table 2. List of fishing gears found in study area

Group	Type of Fishing gear
Purse seine	- Anchovy Purse seine
Falling gear (cast net)	- Anchovy strick-held box net
	- Squid cast net
Gill net	- Encircling gill net for mullet, Pomfret, Sardine
	- Shrimp trammel net
	- Gill net for crab, ray, grouper, sand whiting, indo-pacific mackerel, mullet, baracuda and treadfin
	- Bottom gill net
Scoop net	- Jelly fish scoop net
	- Planktoic shrimp push net
Hooks and line	- Ray longline
	- Trolling line
	- Hand line
Trap	- Collapsible crab trap
	- Squid trap
	- Fish trap

Table 3. Group of fishing gear by frequency of operation

Main fishing gears			Squid cast net	Crab gill net
			Squid trap	Collapsible crab trap
Rest of fishing gears	Used gears	Always used	Mullet encircling gill net	Squid hand-line
			Indo-pacific mackerel gill net	
		infrequently used	Anchovy purse seine	Sand whiting gill net
			Anchovy stick-held box net	Sardine encircling gill net
			Pomfret encircling gill net	Shrimp trammel net
			Fish bottom gill net	Jelly fish scoop Net
			Mullet gill net	Grouper trap
	Unused gears	Baracuda gill net	Krill push net	
		Grouper gill net	Ray long line	
		Ray gill net	trolling line	
		Threadfin gill net		

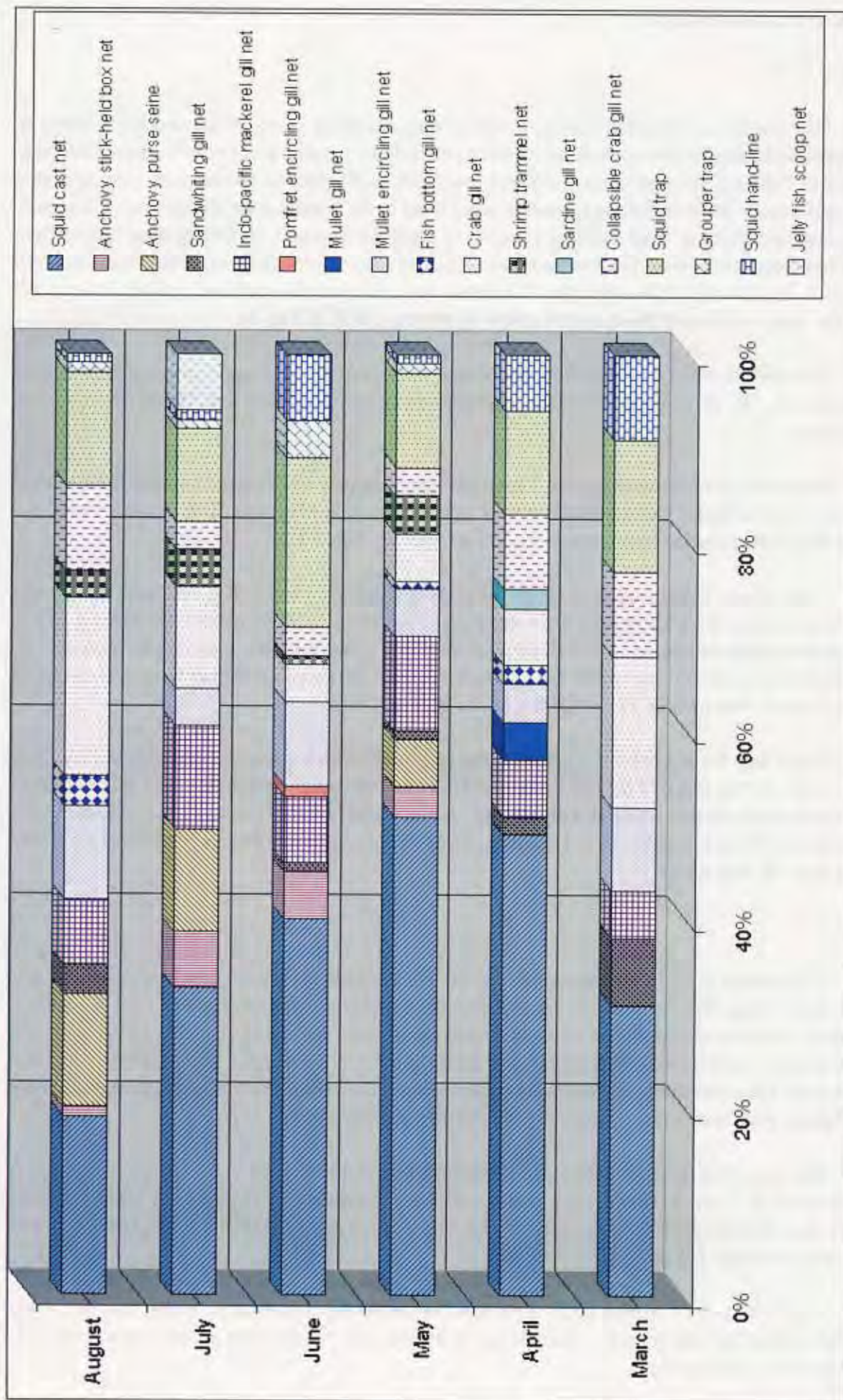


Fig. 2. Percentage of fishing gear operation by types in each month of the field survey

Fishing ground and ECPU

March

This month is a restricted season, so some types of fishing gears are banned for fisheries in these areas including trawl net, push net, anchovy stick-held box net, etc. For this reason, the wide diversity of fishing gears was not used. It was found that eight types of fishing gear were operated during this month. Most of fishing operation areas were in the coastal zone within three kilometers of the shoreline. Fishing areas were most dense in areas 3, 6, 8, and 9. In fishing area further than three kilometers, it was found that some types of fishing gears were operating. They were crab gill net in area 11, at water depth of nearly 20 meters and indo-pacific mackerel gill net in area 12, where the water depth of fishing area is about 30 meters (**APX. I, Fig. 1**).

The predominate types of fishing gears used in this month were squid cast net, crab gill net and squid trap. The percentage of fishing gears composition of each gear was 31%, 16% and 14%, respectively.

Squid cast net fishing area, area 9 had the highest density of the squid cast net fishing boat, the percentage of squid cast net fishing boat operated in this area was 50%. Furthermore, the highest ECPU was also in same area at 31,308 g (**Apx. II, Fig. 3.1**).

Crab gill net fishing areas, these may be classified into two areas. The first area was in area 11, further out than three kilometers from shoreline. This area was found to have the highest ECPU and had percentage of crab gill net fishing boat operating there at 15,560 g and 58%, respectively. The second area covered was within three kilometers from the shoreline. Other fishing areas are in areas 2, 3 and 6, and with ECPU < 5,000 g (**Apx. II, Fig. 10.1**).

Squid trap fishing area, it contained one area only, which covered wide extensively from area 1 to area 3. The shape of the trap is semi-cylinder and its operation is suspended at one-third of water depth under surface. A float with a bamboo pole marking the position is used to suspend the trap in water. The average number of used squid trap per one time was 95 pieces and its ECPU was 178 g (**Apx. II, Fig. 17.1**).

April

This month is still a restricted season, the fishing gear used were similar to those of last month there being little diversity in fishing gear. It was found that eleven types of fishing gears were used and three of the eleven types started to be operated during this month. These were fish bottom gill net, sardine encircling gill net, and mullet gill net. Nevertheless, none of these was main fishing gear. They were used only when the fishermen could detect suitable target fish or else where main fishing gear like anchovy purse seine could not be operated.

The main fishing areas were still within three kilometers that the high-density fishing areas were areas 6, 8, 9 and 3. However, it was found that the number of fishing boat was increasing beyond three kilometers area, especially in area 11 and 12. They used crab gill net, squid trap and squid cast net (**Apx. I, Fig. 2**).

The first three of fishing gears were used in this month consisted of squid cast net, squid trap and collapsible crab trap. The percentage of fishing gear composition of each gear was 31%, 16% and 14%, respectively.

Squid cast net fishing areas, the percentage of fishing gear composition of squid cast net was nearly half of used fishing gear (**Fig. 2**). Most of squid cast net fishing areas widely distributed in the coastal zone and its remainder was dispersed in area 1 and 12. Area 9 and 8 was first two of greatest percentage of fishing boats operating in each area, being 27.2% and 19.2%, respectively. While the highest value of ECPU found in area 3 that 55,481 g. (**Apx. II, Fig. 3.2**). However, when comparing the total ECPU between coastal zone and over 3 kilometers area, this showed ECPU of coastal zone as high as in the over 3 kilometers area.

In the squid trap fishing area, it was found that there were three fishing grounds apparent during April, but during other months only one fishing ground was found that covered a wide area from area 1 to area 3. These new grounds were in area 7 and 12. The highest ECPU was in the northern part of the study area that spread from area 1 to area 3. The highest ECPU was 210 g. while other area were less than 120 g (**APX. II, Fig. 17.2**).

Collapsible crab trap fishing area was conducted in Thung Maha gulf. The gulf includes areas 6 and 8 that have a water depth of not more than 15 meters. In addition, the water is rarely rough with large waves, because monsoon is diverted by Lang Island. The ECPU was 84 g. during this month (**APX. II, Fig. 15.2**).

May

The types of fishing gear used was greater than during the last two months, because this is after end of restricted period. Thirteen types of fishing gears were operated. Four of all just started operation in this month, these consisted of anchovy stick-held box net, anchovy purse seine, shrimp trammel net and grouper trap. This month is the first month that the first two gears have been legally permitted to operate, the last two of these fishing gears started operation, because target species increased during this month. It was noted that fishermen operated shrimp trammel nets in area 6. Following discussions with local fishermen, this gear will have the greatest operation during October when the northeast monsoon plays an influential role in the area. The target species between this month and October are different. The main target during this month is the pinkleg shrimp (*Metapenaeus sp.*) and in October the banana prawn (*Peneaus merguensis*) is prevalent.

A majority of the fishing areas were within the three-kilometer area. The high density of fishing areas were areas 3, 6, 7, 8 and 9. Further, the area more than three kilometers from the shoreline was also used for fisheries. The gear used were indo-pacific mackerel gill net and squid cast net in areas 11 and 12 (**Apx. I, Fig. 3**).

Squid cast net, squid trap and indo-pacific mackerel gill net were the three most prevalent types of fishing gear used. The percentages of fishing gear composition of squid cast net, squid trap and indo-pacific mackerel were 51%, 10% and 10%, respectively.

The squid cast net fishing area extends beyond the three-kilometer zone during this month and more than previous months. This was distinctly evident in areas 8 and 10. In area 8, the number of fishing boats operating in this area changed from 19.2% in April to 4.8% in May. In area 10, the number of fishing boats operating increased from 15.4% in April to 22% in May. The highest density of squid cast net fishing boats operating in all areas, was in area 9 at 27.1% and the highest ECPU was found in area 10 at 28,000 g (**Apx. II, Fig. 3.3**).

The squid trap fishing operation area covered extensively from areas 1 to 3. The average number of squid traps used for each operation was 70. The ECPU was 240 g

(Apx. II, Fig. 17.3), this was the highest ECPU of all the six months. The ECPU of each gear in each month are shown in **Table 4**.

Indo-pacific mackerel gill net fishing was used in areas 2, 3, 5, 6, 7, 11 and 12. The percentage of gear operated and the fishing distribution were highest in this month. The highest ECPU area was behind area 12 about twelve kilometers from the shoreline. The ECPU was 75,000 g. The lowest ECPU areas were areas 2, near the shoreline. The depth of the fishing area is not greater than 8 meters. The ECPU was 952 g (Apx. II, Fig. 11.3).

Table 4. The estimated catch per unit (ECPU) of each gear in each month

Type of Fishing gear	CPUE					
	March	April	May	June	July	August
Anchovy purse seine	*	*	30,000	*	310,000	223,300
Anchovy stick-held box net	*	*	8,333	10,277	7,710	937
Squid cast net	25,000	26,442	18,130	15,860	19,804	19,351
Mullet encircling gill net	48,000	77,777	96,590	30,434	60,975	79,254
Pomfret encircling gill net	*	*	*	100,000	*	*
Fish bottom gill net	*	133,333	25,000	*	*	3,125
Crab gill net	11,282	10,365	4,846	7,563	5,890	5,002
Indo-pacific mackerel gill net	24,264	21,739	13,163	38,338	14,866	4,878
Mullet gill net	*	28,431	*	-	*	*
Sadine gill net	*	92,592	*	*	4,300	*
Sand whiting gill net	15,000	6,940	5,000	13,214	*	4,347
Shrimp trammel net	*	*	3,885	190	2,604	1,060
Jelly fish scoop net	*	*	*	*	762,500	*
squid hand-line	9,857	6,250	2,000	1,250	625	2,000
Collapsible crab trap	42	84	53	33	68	40
Grouper trap	*	*	500	58	*	166
Squid trap	178	157	240	116	163	185

Remark: * No operation

June

The diversity of fishing gear was similar to last month. The only new gear was the pomfret encircling gill net. This is used in front of area 2. Even though the diversity of fishing gear was similar, the highest percentage of operating gear of each type decreased from last month. These are shown in **Appendix III**. In addition, the percentage of fishing gear composition of fishing gear used in the coastal zone, was higher than during the last three months especially squid traps and mullet encircling gill nets (**Fig. 2**). Because of a climatic depression that occurred during this month this caused bad and rough sea conditions. Only a few fishing boats could operate beyond three kilometers from the shoreline. Moreover, the depression also created turbidity and higher current

speeds during this month. According to Laongmanee, et. al, (2003) surveyed that the marine environmental are shown in **Fig. 3**. Also for this reason the abundance of resources also decreased, especially squid. It was found that both the ECPU of the squid cast net and squid trap during this month were the lowest of the field survey data collection (**Table 4.**).

The primary three types of fishing gear used in this month were the squid cast net, squid trap and mullet encircling gill net. The percentage of fishing gear composition of each gear was 40%, 18% and 9%, respectively.

The highest density area of squid cast net fishing boat returned to near the shoreline into area 9. There were still four areas of squid cast net operation beyond 3 kilometers offshore (risky area) but the total number of fishing boats operating in the area were low, because only big boats could operate. Most of the ECPU near shore was less than 15,000 g while in the risky area was more than 20,000 g (**Apx. II, Fig. 3.4**).

In the squid trap fishing area, covering areas 1 to 3, the average number of squid trap used per line was 95. The ECPU was 116 g. Discussion with the local fishermen on the low ECPU indicated that when water turbidity is rising, squid rarely enter the traps because of poor visibility (**Apx. II, Fig.17.4**).

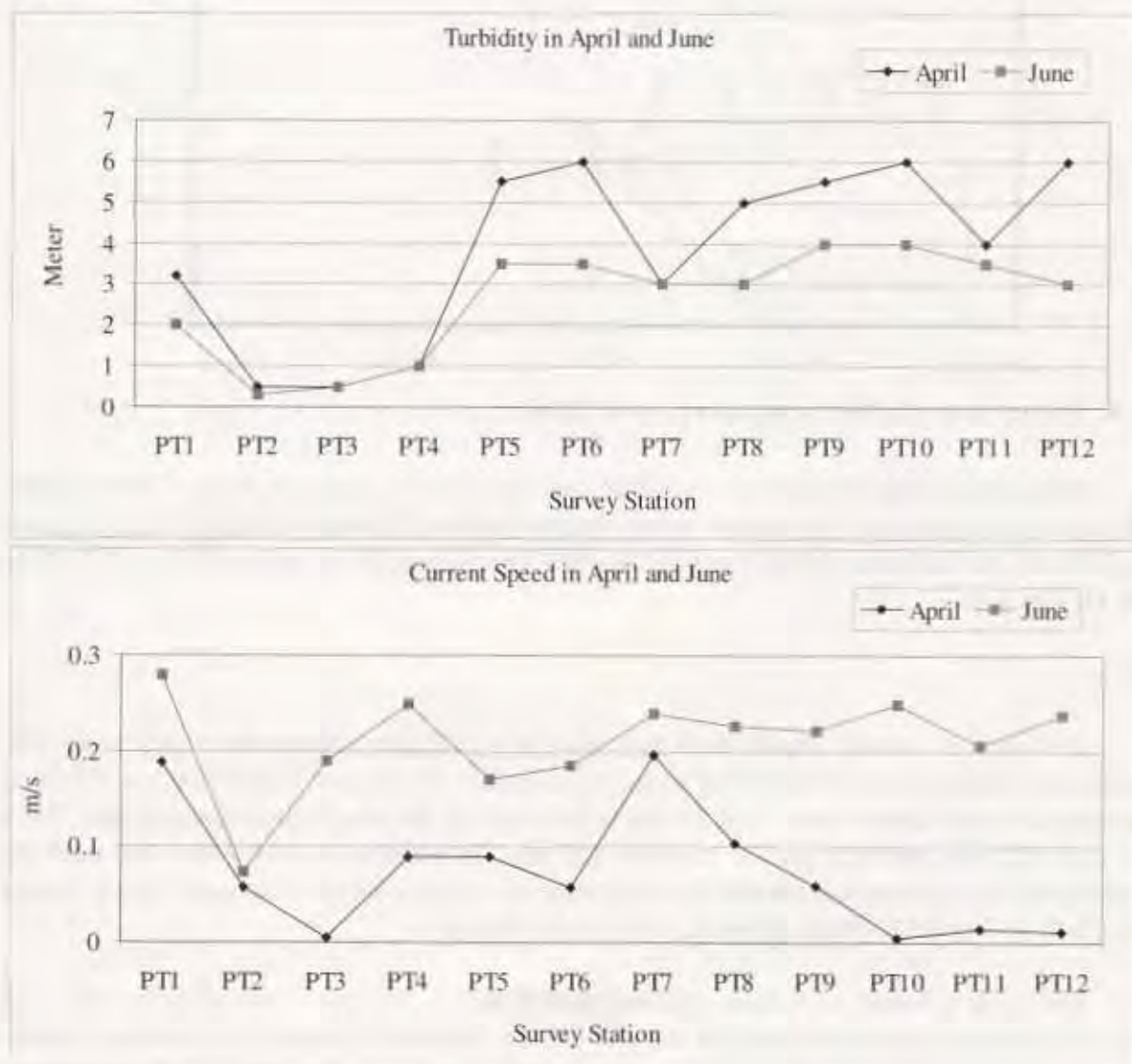


Fig. 3. Transparency depth and current speed of Pakklong sub-district's coastal area

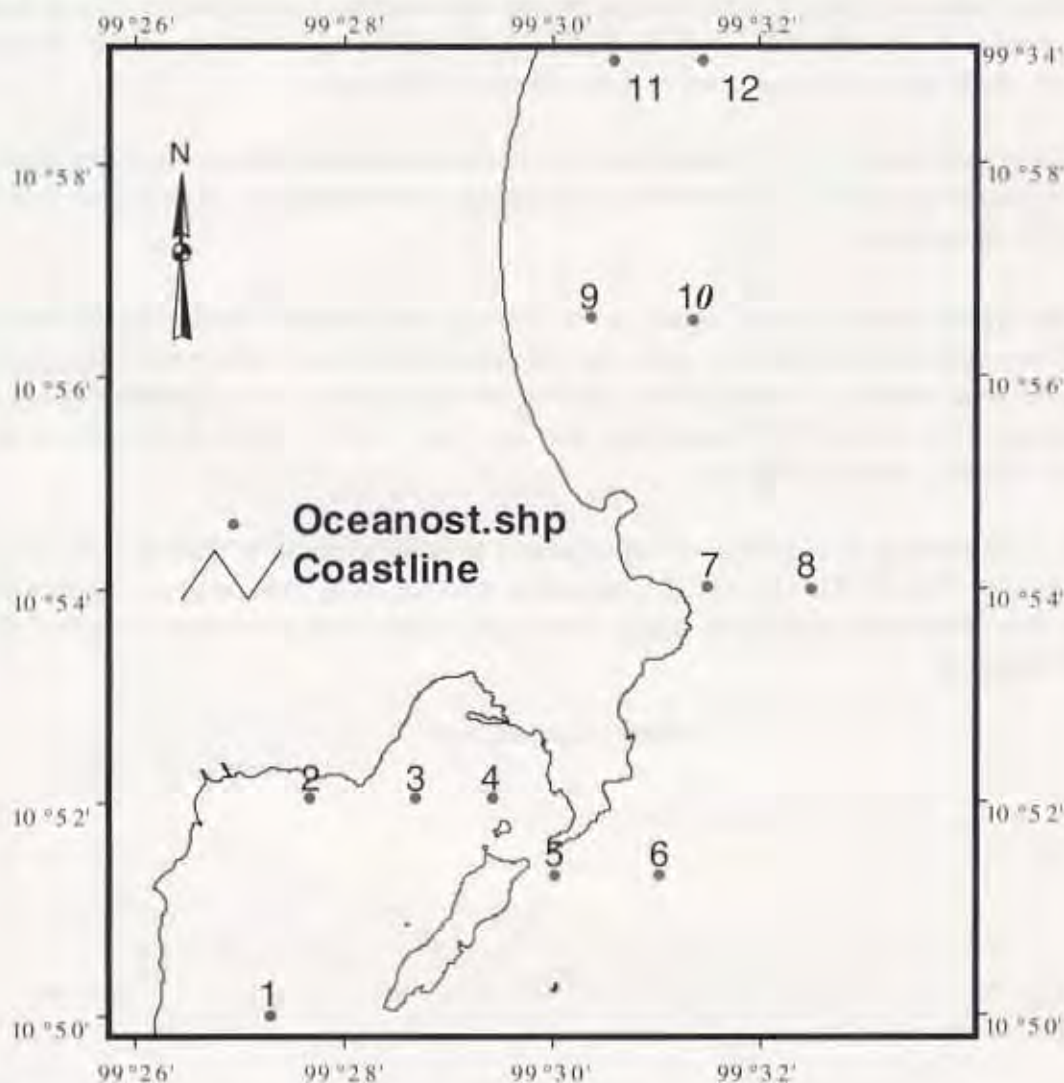


Fig. 4. Survey station (after Laongmanee, et. al, 2003)

Mullet encircling gill net was conducted near the shore in areas 4, 5, 6 and 7 because this fishing gear can operate only in shallow water, not greater than 10 meters in depth. This is because it is necessary for the sinker line to touch the bottom. The highest ECPU was in area 6 at 75,000 g (Apx II, Fig. 6.4).

July

During this month, depressions still play a significant role in the study area. The consequence was that most of ECPU for each gear decreases. There were only two types of fishing gear operated in the distant areas 11 & 12 and behind area 12 and also behind Thalu Island. These were crab gill nets and indo-pacific mackerel gill nets. In addition, It was found that both the percentage of fishing composition and the percentage of crab gill net used increase rapidly. Rising from 4% to 11% and 18.75% to 44.44%, respectively (Fig 2).

The highest density of fishing operation was in area 6. This composed of collapsible crab trap, squid cast net, mullet encircling gill net, crab gill net, indo-pacific mackerel gill net and shrimp trammel net. Further, the jellyfish scoop net was a new fishing gear in the area. This just started to operate. Its operating period was only during this month and the fishing area covered the adjacent

shallower waters from areas 3 and 5 (**Apx. II, Fig. 14.1**).

The four gears with the highest composition were squid cast net, anchovy purse seine, indo-pacific mackerel gill net and crab gill net. Their percentages of composition were 33%, 11%, 11% and 11%, respectively. The primary reason for them becoming the most used gear seems to be the size of the fishing boat, these are generally bigger than other types of gear, so they can be operated even through the climatic depression occurring in the fishing areas.

Squid cast net fishing areas were distributed all along the coastal zone except in area 11, however, the number of fishing boats operating in the area was 12.5% only. While the highest density of fishing boats were in areas 4 and 10, the total of their percentage was nearly 50%. The percentage of operating gear rapidly decreased from 81.08% last month to 51.06% during this month (**Apx. III**). Because harvests are not high enough to justify the investment of money and effort since last month, moreover, the ECPU of this month was still low, so the fishermen ceased operations (**Apx. II, Fig. 3.5**).

The anchovy purse seine fishing area was found along the near shores of areas 4, 5, 7 and 9. Although they generally operate in area with water depth of less than 15 meters, the fishing boats are bigger when compared with others using other gears. Thus, the percentage of operated gear was not decreased like other gears and became the large number of the gear used. Moreover, the value of the ECPU was also highest during the period of the survey collection, at 310,000g. dry weight (**Apx. II, Fig 1.2**).

The crab gill net fishing areas were mostly beyond three-kilometer area, distributed in areas 1, 6, 12 and behind area 12. The ECPU were 5,500 g, 8,600 g, 5,400 g, and 7,700 g, respectively. Area 12 had the highest percentage of fishing boats, but area 6 had the highest value of ECPU (**Apx. II, Fig 10.5**). Because long nets can be used in area 12 while in area 6 this could not be done because of large amounts of obstructive materials like fish cages and green mussel clam farms, these are shown in **Fig. 5**. The percentage of operating gear had increased and total length of crab gill net per time had increased by nearly ten times, which was from 6,280 meters to 60,100 meters.

The Indo-pacific mackerel gill net fishing areas, in southern part of the study area contains a higher proportion of fishing areas 6, 7, 10, 11 and 12 than in the northern part. The highest density of the indo-pacific mackerel gill net fishing boats was in areas 10 and 12, at 25% in each area. The area of highest ECPU was in 6, 7 and 11 at 20,000 g. and the percentage of operating gear becomes highest again during this month. The value is similar to that of May at 28.57% (**Apx. III**).

August

This is the month before the monsoon system plays a role in the study area. Discussion with local fishermen indicated that the monsoon system generally occurs at the end of October. This phenomena causes current direction changes from northerly to southerly and the resource harvest is high especially anchovy resources.

During the study period it was not happened like that, even though the state of the ocean was normal, the depression disappeared within the study area. The Sea State was quite smooth and appropriate for fishing operations. Actually, fisheries in study area still had problems. It was found that the value of ECPU for each gear was low. Though the various fishing gears were many but most types of fishing gear had the number of the operating gear lower than last month (**Apx. III**), this presumably indicates that aquatic animal are few in all area in this month.

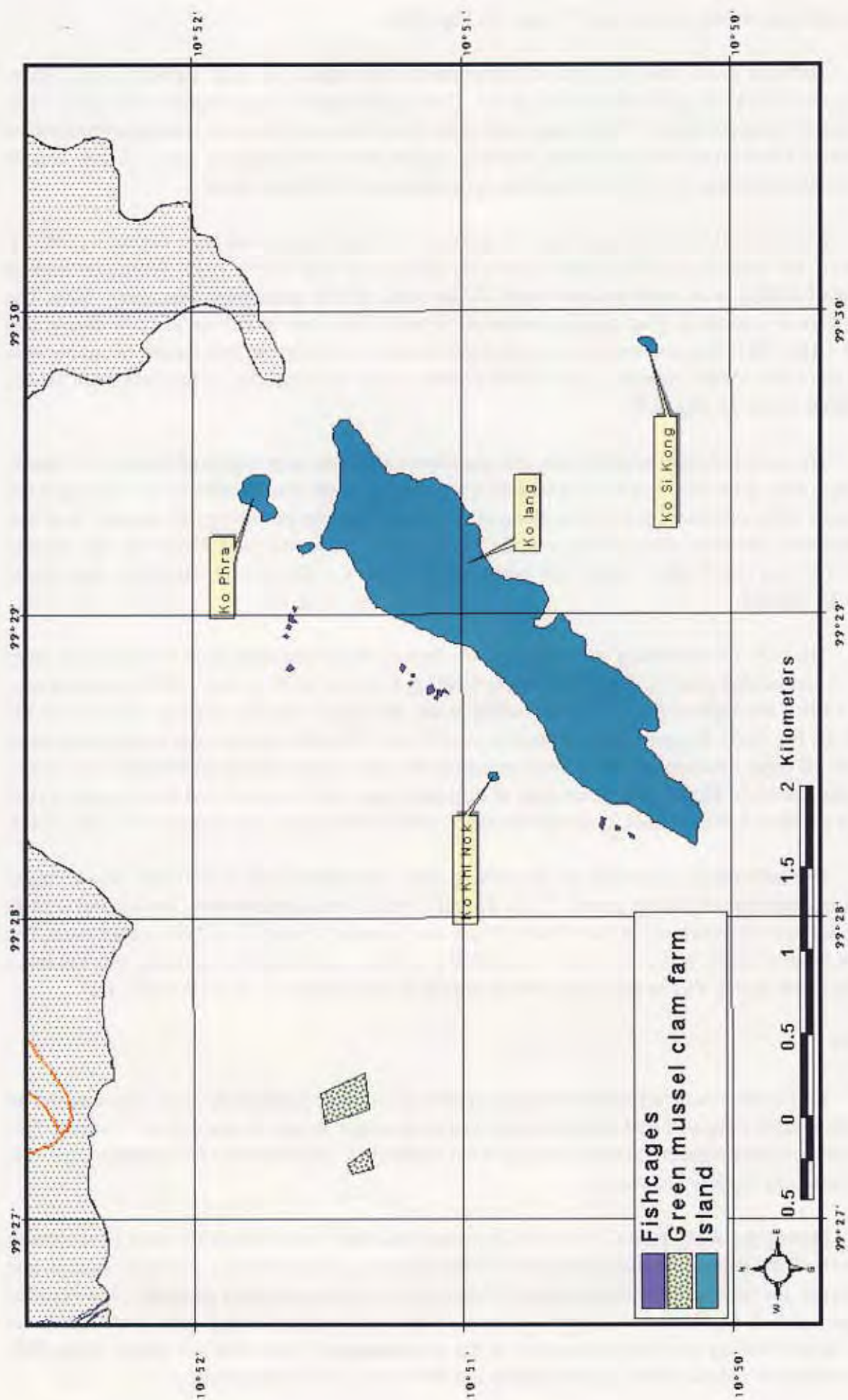


Fig. 5. The location of fish cage and green mussel clam farm during March

Fishing area distributed in near shore within 3 kilometers except crab gill net and indo-pacific mackerel gill net. They operated in area 11 and 12. Main useful areas were in area 3 and 6. There were 9 types of fishing gear in these areas, which were anchovy stick-held box, squid cast net, collapsible crab trap, squid trap, mullet encircling gill net, indo-pacific mackerel gill net, sand whiting gill net, crab gill net and shrimp trammel net. Total percentage of fishermen, operating in these areas was more than 60%.

The major four fishing gear compositions were squid cast net, crab gill net, anchovy purse seine, and squid trap. Their percentages were 19%, 19%, 12% and 12%, respectively.

The squid cast net fishing areas were within the three-kilometer zone, especially in area 4, where there was the highest density of the squid cast net fishing boats. The percentage of squid cast net fishing boats operating in area 4 was 33%, while the number of squid cast net fishing boats in other areas was less than 25%. But highest ECPU was in area 9 at 85,714 g (**Apx. II, Fig 3.6**).

The crab gill net fishing areas were similar to last month, most were beyond three kilometer area and the high ECPU area was in the coastal zone. The fishing areas were distributed in areas 2, 6, 11, 12 and behind area 12. The ECPU were 9,903 g., 6,000 g. 3,125 g., 5,324 g and 5,920 g. respectively. Area 12 had the highest percentage of fishing boats at 41.7%. The percentage of operating gear had increased from 44.44% to 63.12% (**Apx. III, Fig. 8**). The total length of gear used increased more than twice from 60,100 meters to 145,030 meters. This month was considered the peak period of crab gill net fishing operation during field survey.

The anchovy purse seine fishing area was wide covering areas 4, 5, 7, 9 and 10 water depth for capture was not more than 15 meters. This month was the peak season for anchovy quantity during the field survey. It was found that the value of the ECPU increased rapidly from 149,700 g to 223,300 g (**Apx. III, Fig. 1**).

The squid trap fishing area was extensive from area 1 to 3 (**Apx. II, Fig 17.6**). The sea condition in the study area was of low turbidity that is a suitable situation to operate squid traps. The percentage of operating gear and the value of the ECPU showed little increase from the previous two months, because there was no climatic depression (**Apx. III, Fig. 17.6**). The average number of squid trap used per time was 73 and the ECPU was 185 g.

Conclusions

During survey collection period from March to August 2002, it was found that the total number of different fishing gear types during the field survey was 24, all of which had different operation periods (**Table. 5**). Most of them were used in the coastal zone because of the size of the fishing boat. The local fishermen usually have a small boat (not more than 8 meters in length). For this reason, they cannot use some types of fishing gear like trawl nets, bottom vertical longline, push nets etc. thus, they do not have the capacity to operate commercial-scale fishing gear. Even though, the areas around their communities were suitable for the operation of commercial-scale-fishing gear, fishermen from other communities do this. That was a part of reason why the diversity of fishing gear was small and the fishing area was narrow.

Table 5. Fishing duration by type of fishing gears.

Types of fishing gear	March	April	May	June	July	August
Anchovy purse seine						
Anchovy stick-held box net						
Squid cast net						
Mullet encircling gill net						
Pomfret encircling gill net						
Sardine encircling gill net						
Fish bottom gill net						
Crab gill net						
Indo-pacific mackerel gill net						
Mullet gill net						
Sand whiting gill net						
Shrimp trammel net						
Jelly fish scoop net						
Squid hand-line						
Collapsible crab trap						
Grouper trap						
Squid trap						

Anchovy purse seine: The operation was usually conducted in the early morning and evening. Fish schools were sought by eye or fish finder and the fishing area was in 5-10 meters depth near the shore or Island. The area covered from the northern part of Yai Cape and extended to the southern part, Lang Island, Si Kong Island, Rang Island up to the front of Yai Bang Chak Mountain.

Anchovy stick-held box net: This Fishing operation was carried out at night, from a boat equipped with an electric luring light. The fishing areas were narrow, and were only distributed in the near shore area.

Squid cast net: This form of fishing operation was similar to the anchovy stick-held box net. The fishing areas are widely distributed all over the study area, but especially around Lang Island. Further, it was found that some of the fishermen operated far from the study area in front of Supphe Sub-district in June when there are few squid.

Mullet encircling gill net: The encircling gill net for mullet is widely used gear in Pakklong sub-district and It may be operated during both day time and at night. In the day time operation the fish school is first encircled by the net, after which the fishermen create noise by beating the water surface to frighten the fish into the mesh of the net. In nighttime, operation by electric lamp is used for the same purpose. The fishing areas were in the shallow water around the northern part of Yai Cape, southern part of Yai Cape, Thung Maha Gulf, In front of Yai Bang Chak Mountain, and Lang Island. The depths for capture are less than 5 meters because the maximum length of net used was only 5 meters.

Pomfret encircling gill net: during field survey, it was found that this is only used one time in June, its operation is in the northern part of Tham Thong Gulf only, because it is difficult to find

this target species in the study area and even though pomfret is a very high valued fish.

Sardine encircling gill net: it was found that this is used one time only in Thung Maha bay in April.

Fish bottom gill net: the fishing areas, where the bottom is rocky or around a reef, is around Thalu Island and Tham Thong bay. In operation, the rock must be encircled by the net, after which the fishermen create noise by beating the water surface. The fish was freighting then was entangling in the net.

Crab gill net: This fishing operation may be done both in coastal area and beyond three kilometers area. The fishing areas were in the coastal zone during the first to fourth month of the field survey, especially in the Thung Maha bay. After that, the fishing areas start widely distribute over the three-kilometer area, where there are bigger crab sizes than in the coastal zone operated in and around Ran Kai Island and Ran Pet Island.

Indo-pacific mackerel gill net: These fishing areas covered from the shoreline to beyond three kilometers area in front of the Pakklong Sub-district. However, most are normally operated from Yai Cape to the southward than to the northward.

Mullet gill net: It was found that the mullet gill net was only used in April because fishermen usually operate with an encircling method. Because of the size of gill net and material were the same, but the catch was different to that of the encircling gill net method, which can catch more. The area of operation was in Tham Thong bay only.

Sand whiting gill net: This fishing operation has two methods. Firstly, the gill net was operated to intercept the sand whiting swimming through the net. In the second method the fishermen drive the fish from shelter to the net. The fishing area is sandy bottom near the shore with a water depth between 1-10 meters. These are in Tham Thong bay, Thung Maha bay, including around lang Island, Si Kong Island and Rang Island.

Shrimp trammel net: Fishing operation was carried out in either by day or at night. The net is shot across the tide, and allowed to drift by the current for one-three hours before hauling. The water depth of the fishing area was very shallow in Thung Maha bay.

Jelly fish scoop net: It was found that the Jelly fish scoop net was only operated in July because this month was the high season for jelly fish. Fishing areas extended widely near shore from the Tham Thong bay to the southern part of Yai Cape.

Squid hand-line: We considered fishermen who have only squid hand-line activity during fishing operation if they have another activity such as squid cast net, we didn't include in analysis. It was found that fishing areas were in southern part of study area, especially eastern part of Lang Island.

Collapsible crab trap: The collapsible crab trap used in Pakklong sub-district has a rectangular shape about 50 cm long, 30 cm wide and 15 cm high. The trap was hauled once or twice a day. The fishing areas were in Thung Maha bay and around the western part of Lang Island.

Grouper trap: The grouper trap used in Pakklong sub-district has a semi-cylindrical shape with a wooden frame. The trap is about 100cm long, 30cm wide, 60cm high. The trap is hauled once or twice a day and the fishing areas were near rocks or coral reefs in the southern part of the study area.

Squid trap: The trap used for squid is semi-cylindrical. The top of the trap is covered with coconut leaves. Squid traps were set separately and hauled once a day. The fishing area covered from Thalu Island to the northern part of Yai Cape.

It was found that squid and crab were the main harvest during survey period. So the fishing gear used to catch them were the main fishing gears represented by squid cast net, squid trap, collapsible crab trap and crab gill net. According to the fishing gear data collection, this showed that the total percentages of the fishing gear composition of these gears was not less than 50%, though the total of types of fishing gear were high at 24.

From the survey, the main fishing areas are in and around the Tham Thong bay and Thung

Maha bay (**Fig. 1**). The data from the field survey shows that the total percentage of fishing boats operating in these areas was almost 40% each month. Because these areas are shallow with depths of less than 10 meters and their locations are also near shore. Thus, these are capable for operation by small boats, as there were no rough seas in these areas throughout the survey period. In addition, some fishing gears can operate only in shallow depths. This depends on the net depths like the encircling gill net, stick-held box net, etc. Therefore, these fishing areas were good for such operation. Further, the big local community of pakklong sub-district where many fishermen live are near Thom Thong bay and Thung Maha bay. So it is quite easy to go there, even though sea condition was sometimes rough.

The fishing areas and the diversity of fishing gears used during each month were clearly affected by two factors. The first was the restricted season as it affects the diversity of fishing gears because some types of fishing gear are banned like the trawl net, push net, anchovy stick-held box net, anchovy purse seine, etc. The second factor was the sea conditions, which were affected by climatic depressions. This reduces the percentage of operating gear. Further fishing area was restricted in the near shore from June to July especially in areas 3, 6, 8 and 9 for safety reasons.

Acknowledgements

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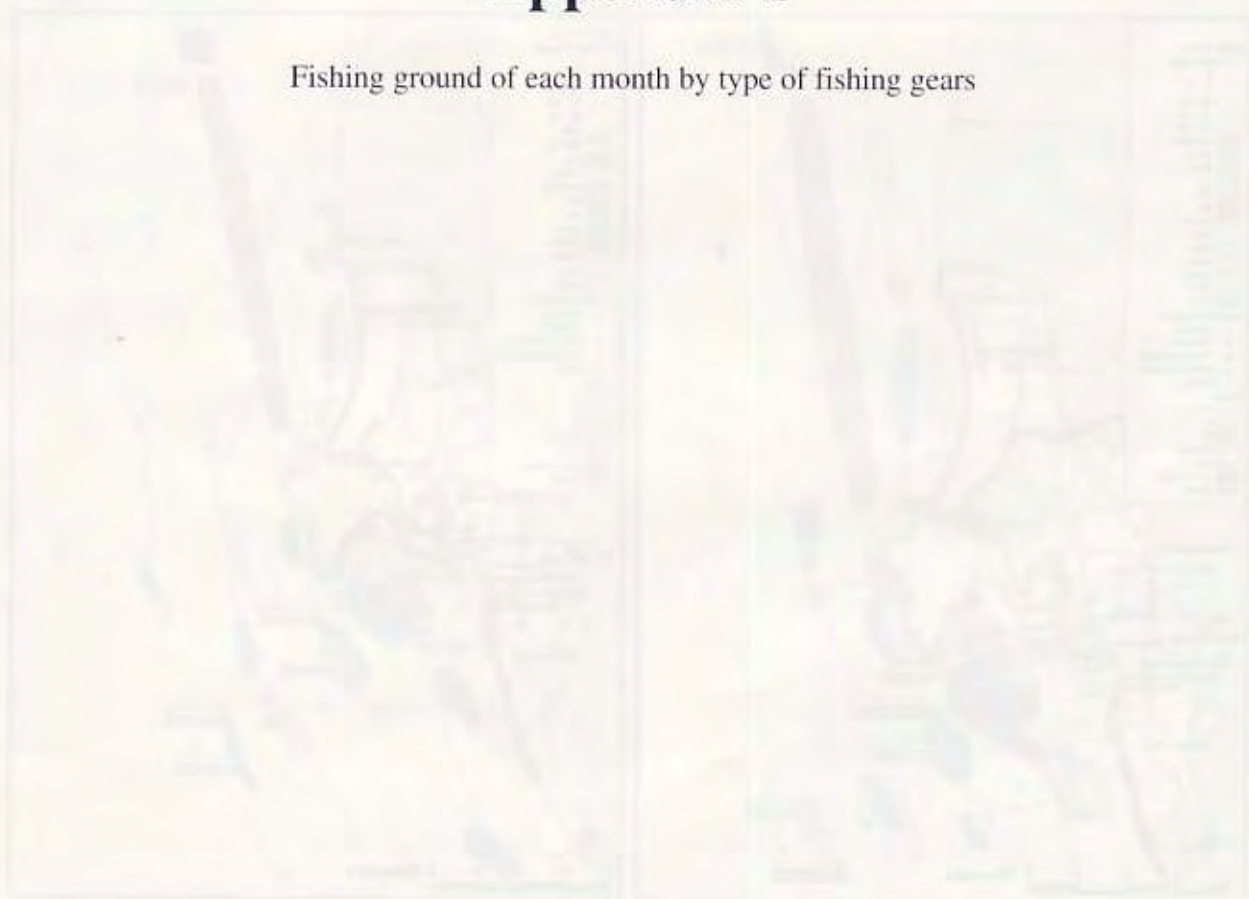
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Appendix I

Fishing ground of each month by type of fishing gears



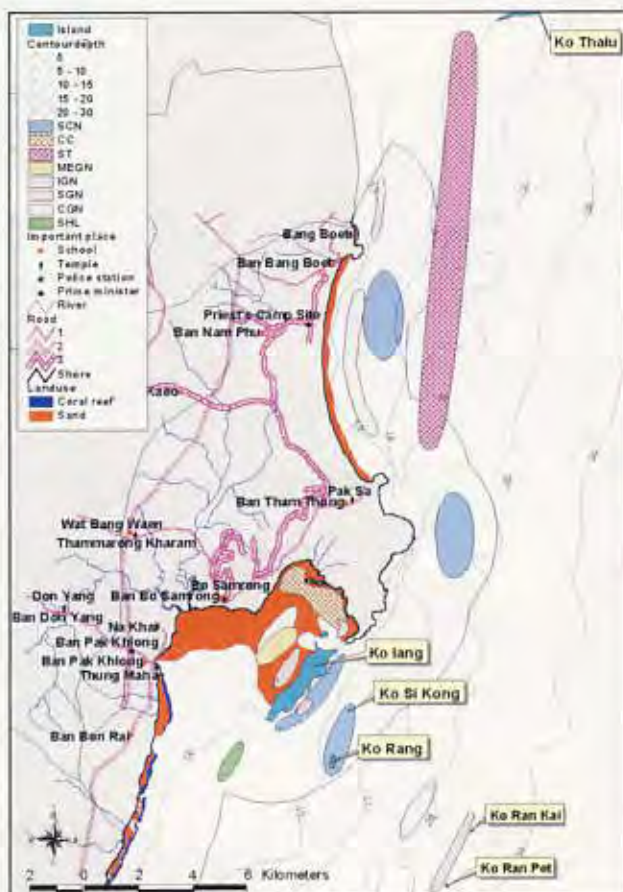


Fig. 1. Fishing ground in March.

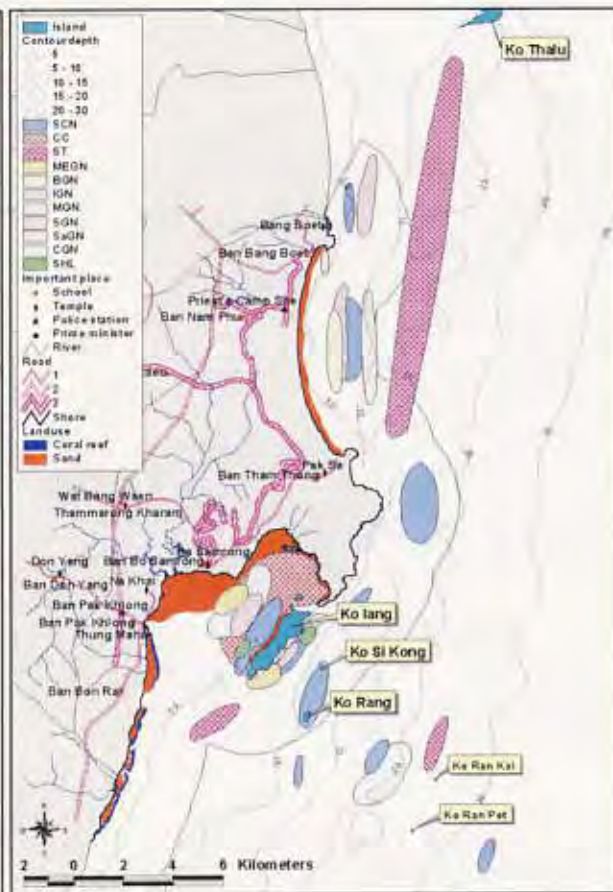


Fig. 2. Fishing ground in April.

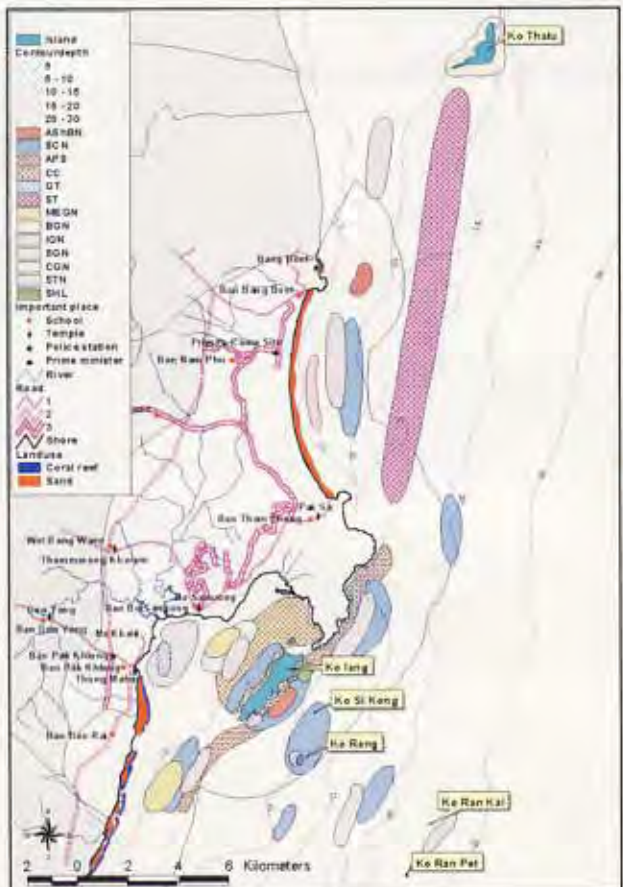


Fig.3. Fishing ground in May.



Fig. 4. Fishing ground in June.

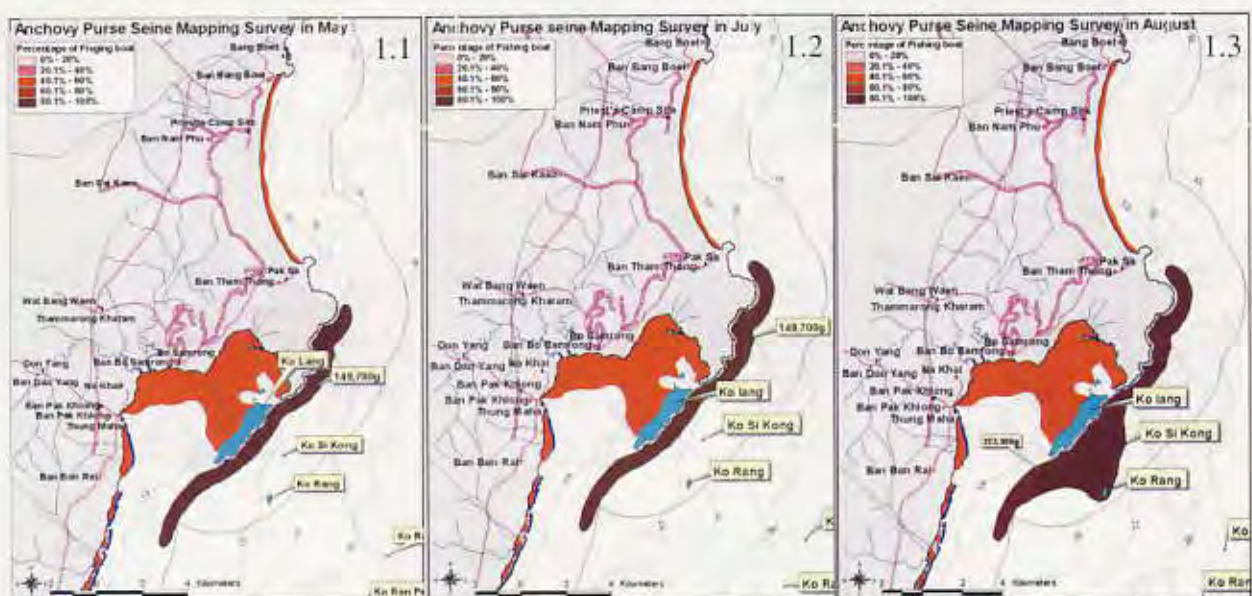


Fig. 1.1, 1.2 and 1.3 Anchovy purse seine fishing area and the ECPU in May, July and August, respectively.

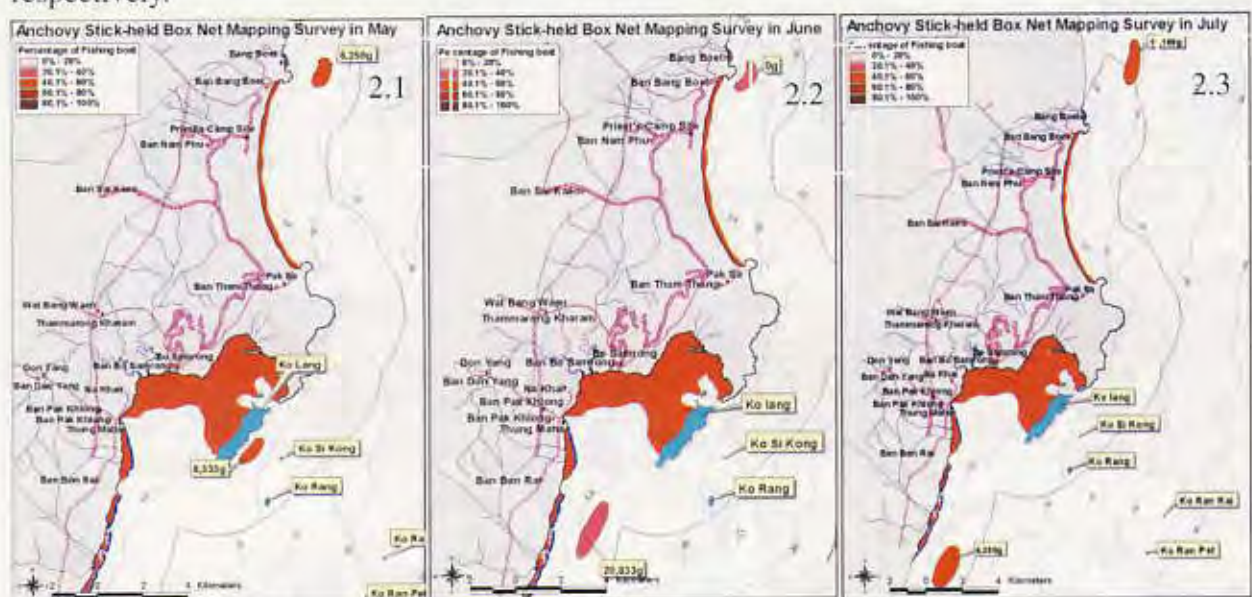


Fig. 2.1, 2.2 and 2.3 Anchovy stick-held box net fishing areas and the ECPU in May, June and July, respectively.



Fig. 2.4 Anchovy stick-held box net fishing area and the ECPU in August.

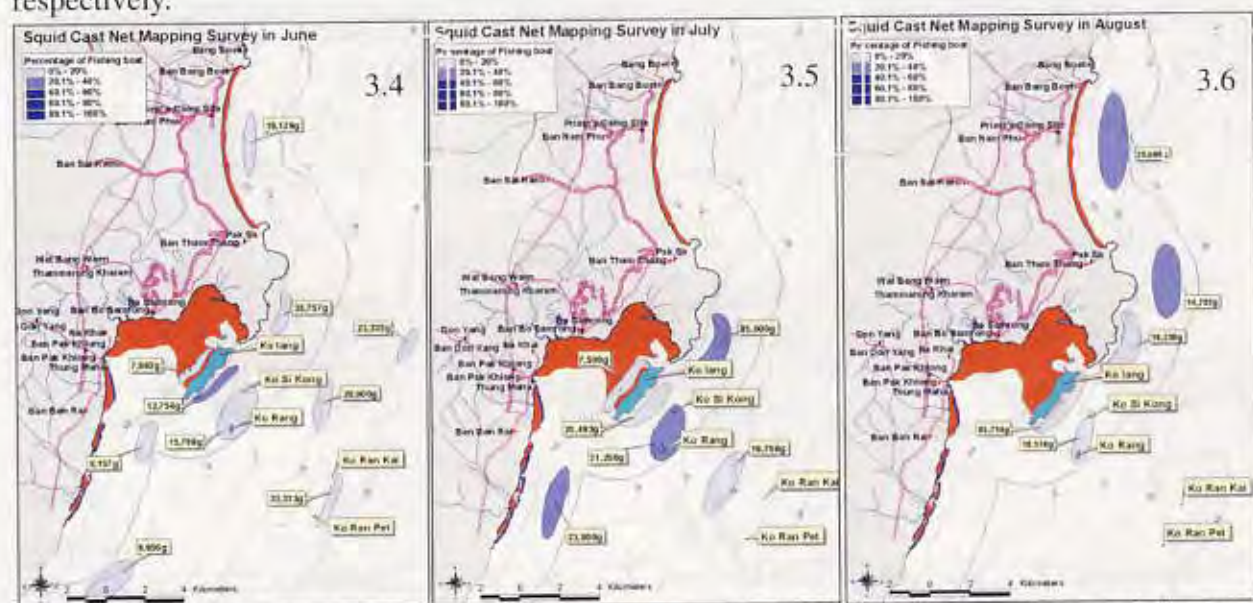
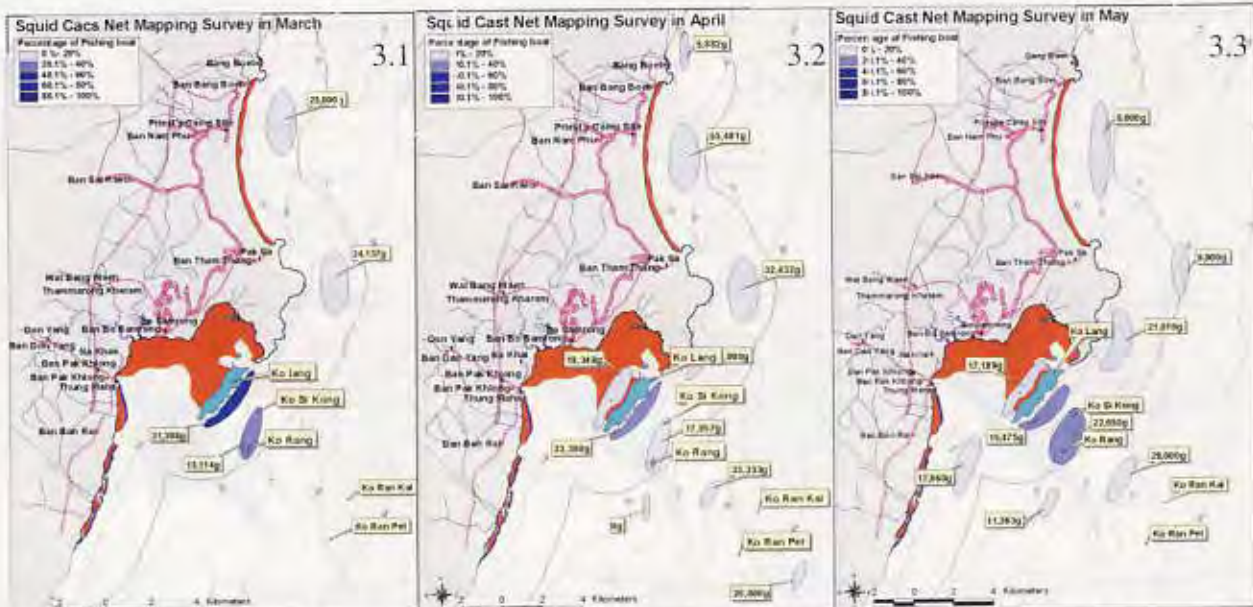


Fig. 4.1 Sardine encircling gill net fishing area and the ECPU in April.



Fig. 5.1 Pomfret encircling gill net fishing area and the ECPU in June.

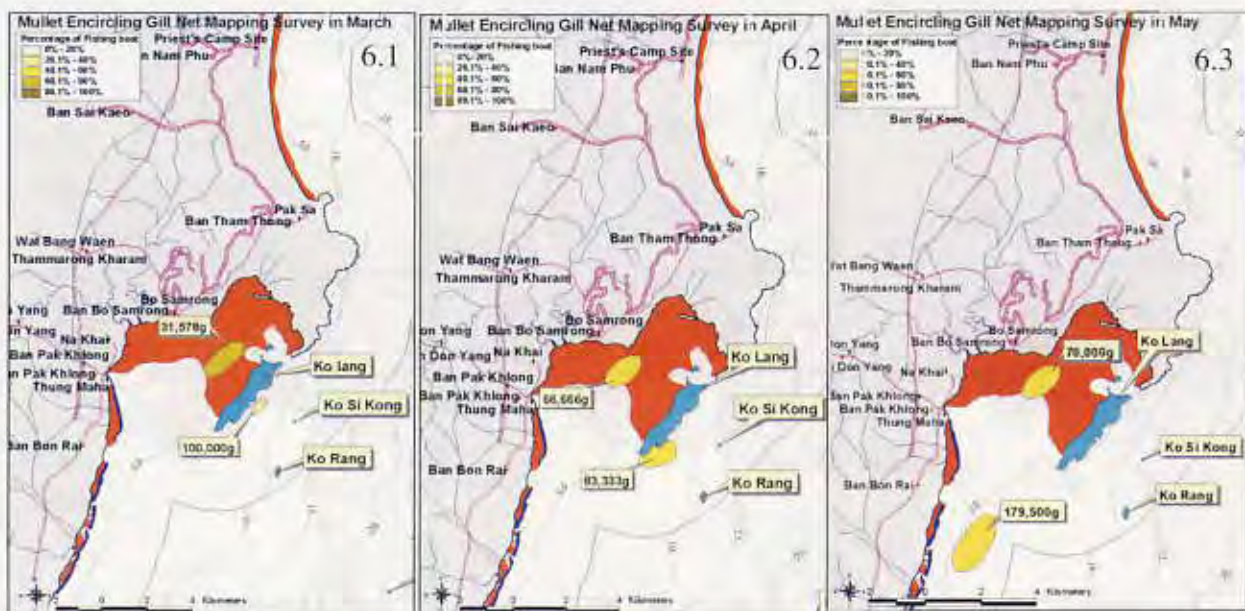


Fig. 6.1, 6.2 and 6.3 Mullet encircling gill net fishing area and the ECPU in March, April and May, respectively.

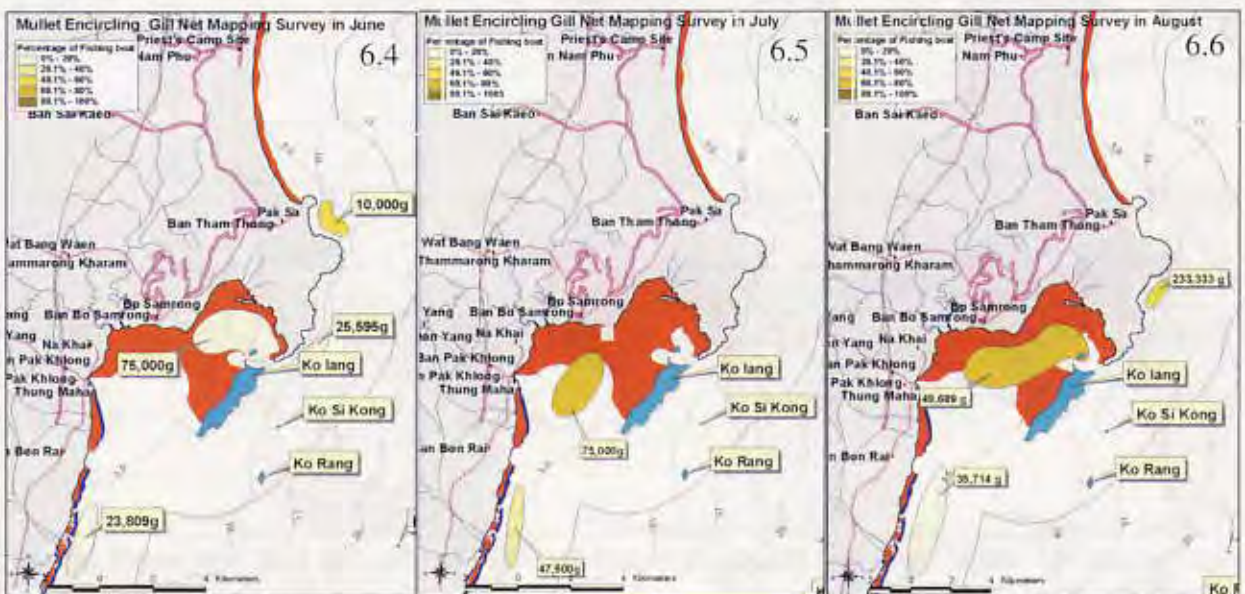
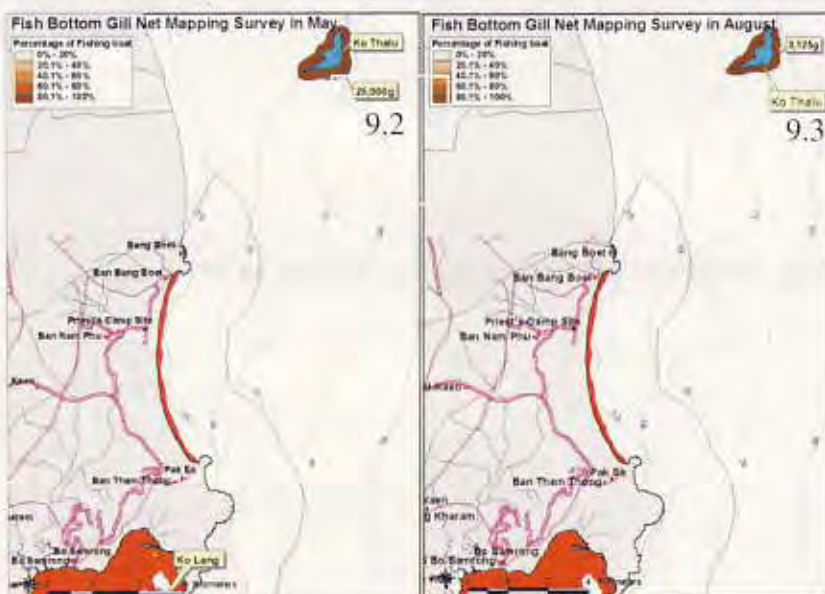
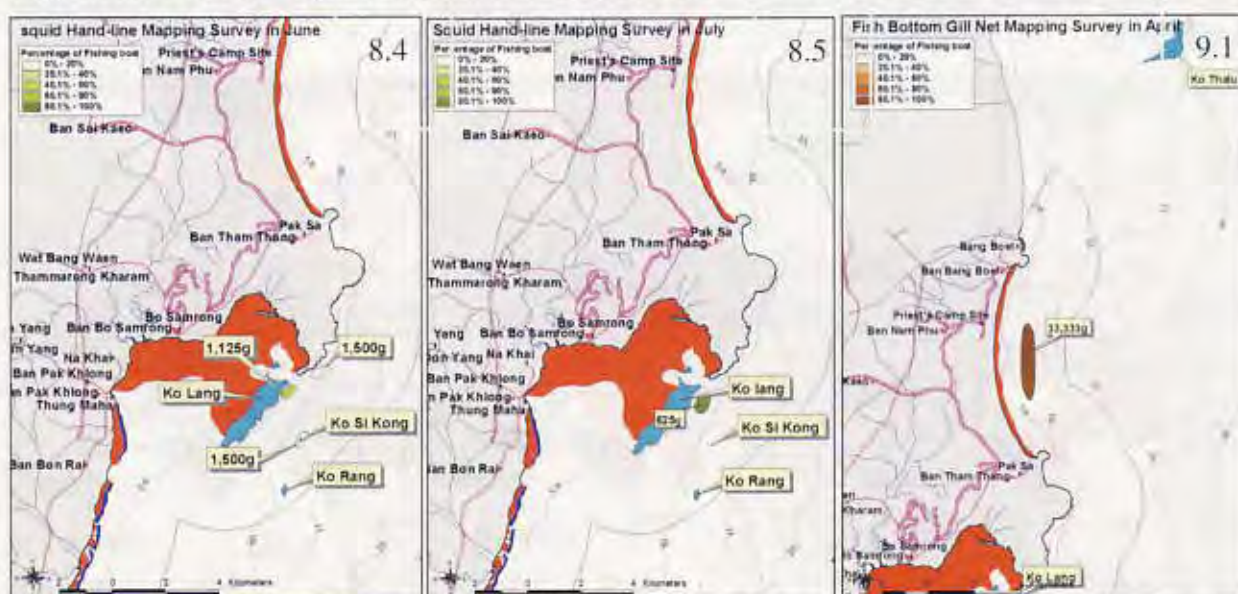
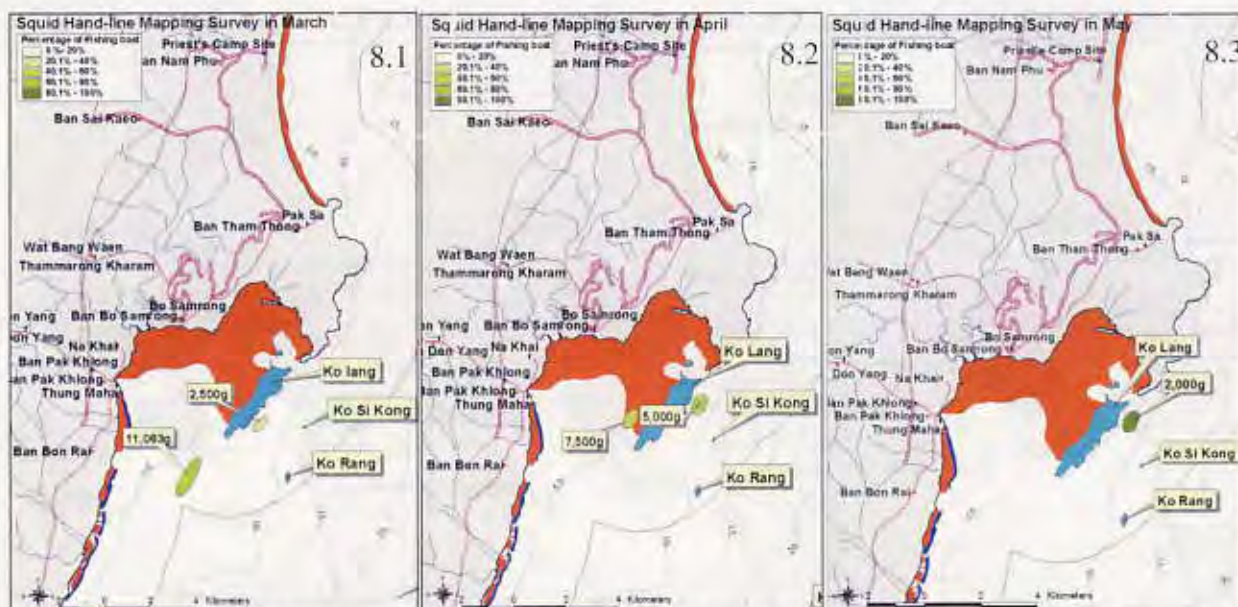


Fig. 6.4, 6.5 and 6.6 Mullet encircling gill net fishing areas and the ECPU in June, July and August.



Fig. 7.1 Mullet gill net fishing area and the ECPU in April.



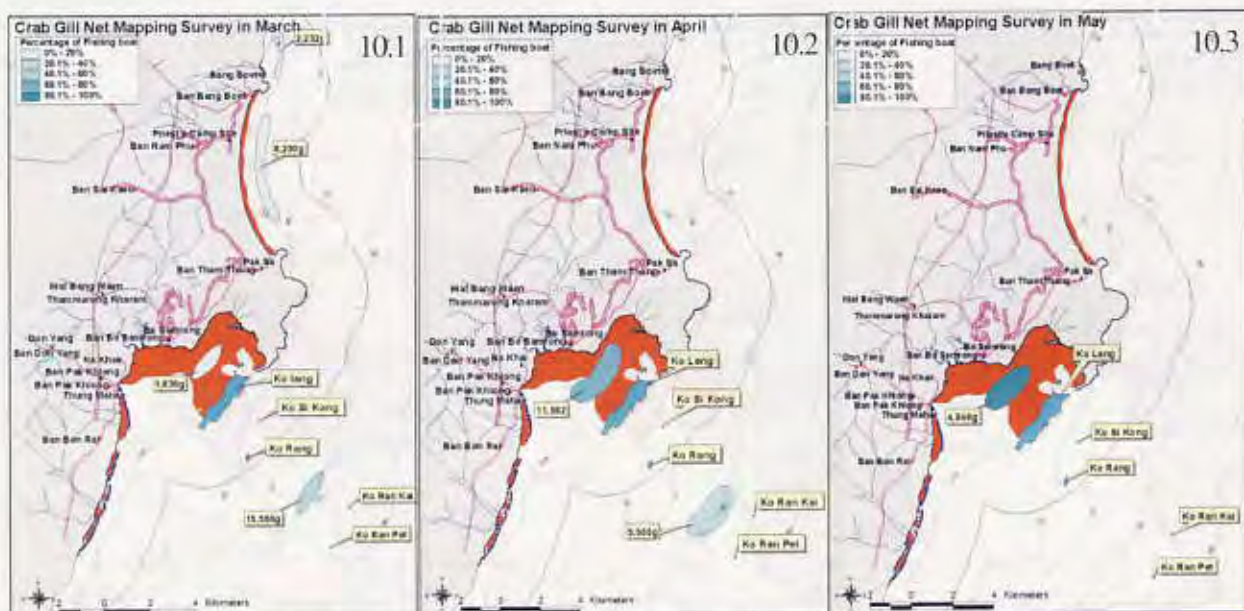


Fig. 10.1, 10.2 and 10.3 Crab gill net fishing areas and the ECPU in March, April and May, respectively.

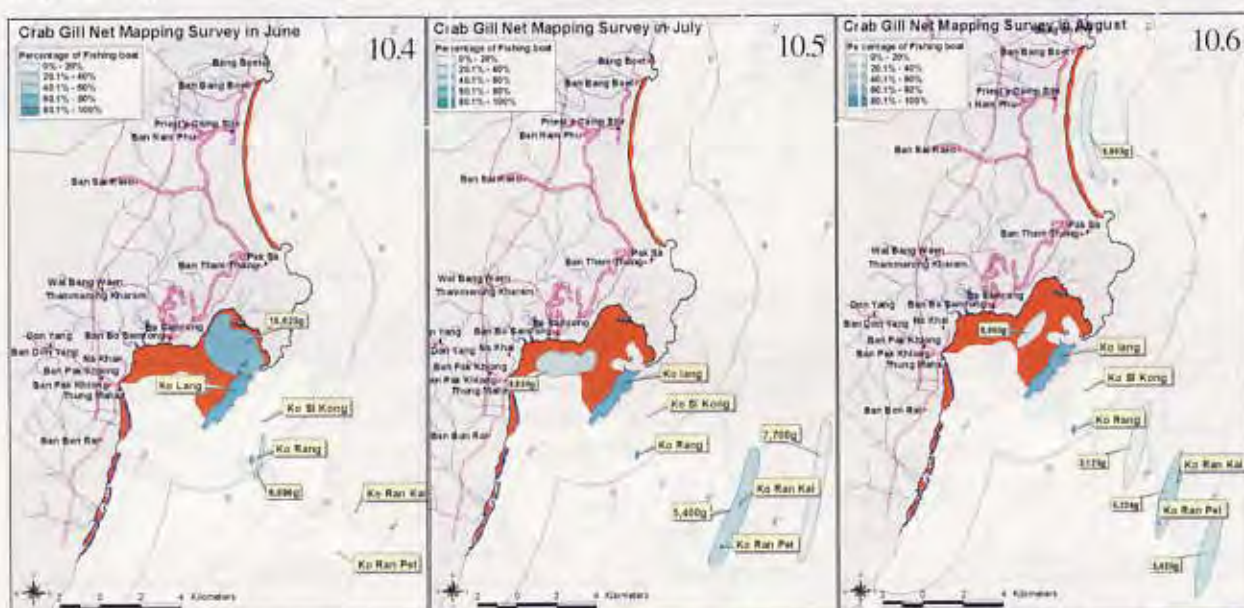


Fig. 10.4, 10.5 and 10.6 Crab gill net fishing area and the ECPU in June, July and August, respectively.

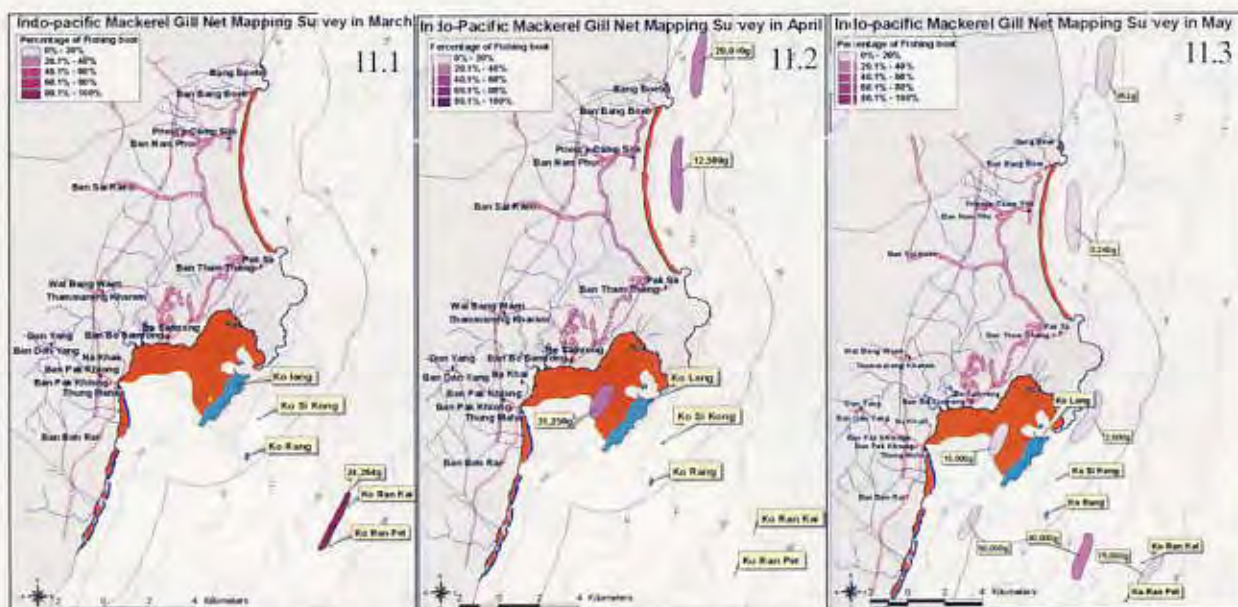


Fig. 11.1, 11.2 and 11.3 Indo-Pacific mackerel gill net fishing area and the ECPU in March, April and May, respectively.

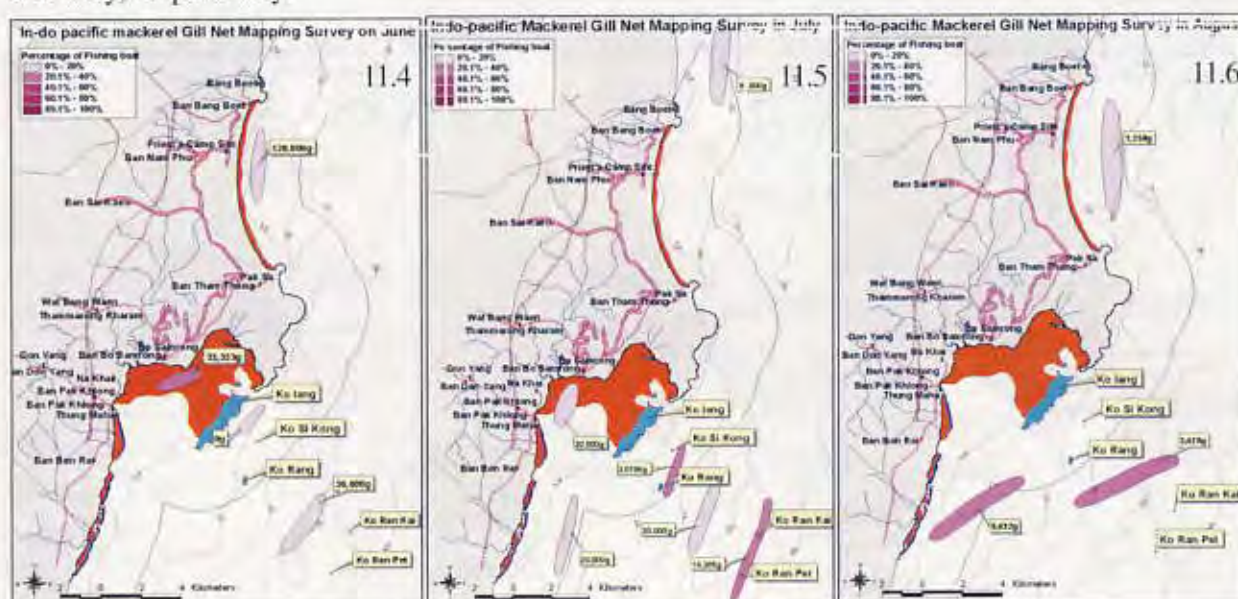


Fig. 11.4, 11.5 and 11.6 Indo-Pacific mackerel gill net fishing areas and the ECPU in June, July and August, respectively.

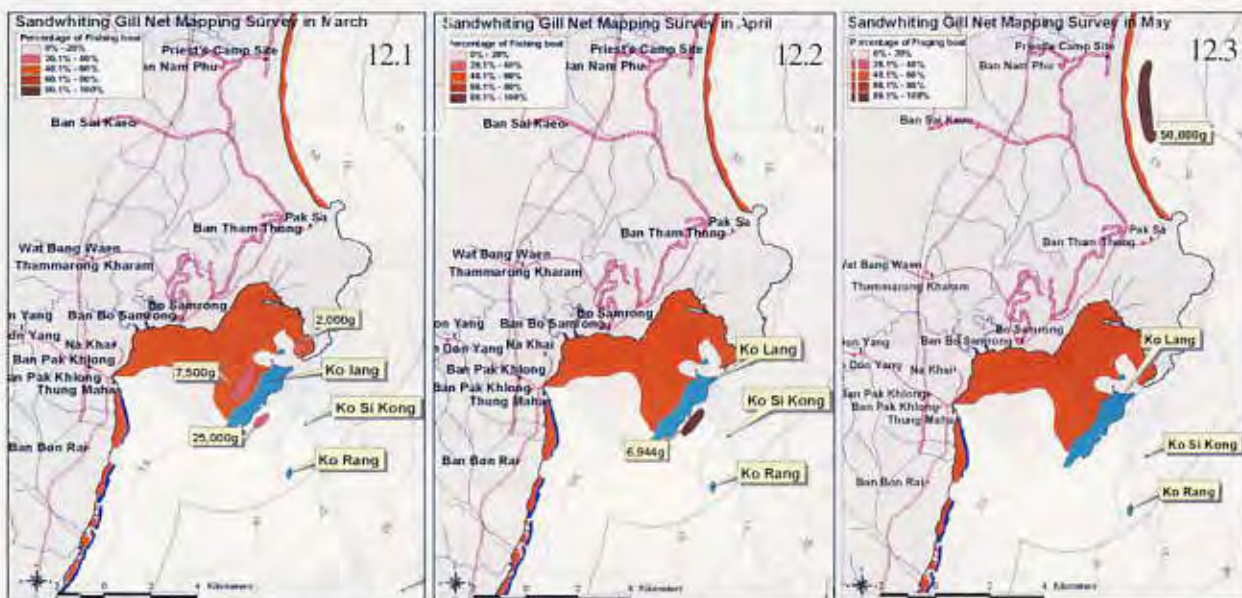


Fig. 12.1, 12.2 and 12.3 Sand whiting gill net fishing areas and the ECPU in March, April and May, respectively.

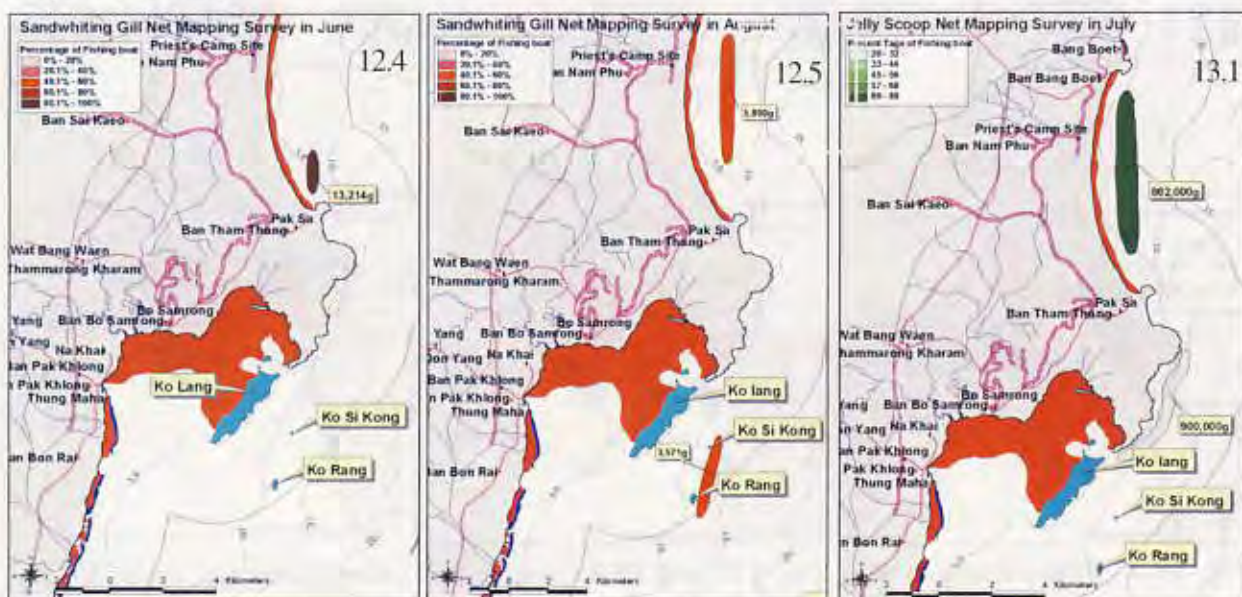


Fig. 12.4 and 12.5 Sand whiting gill net fishing area and the ECPU in June and August.

Fig. 13.1 Jelly fish scoop net fishing area and the ECPU in July.

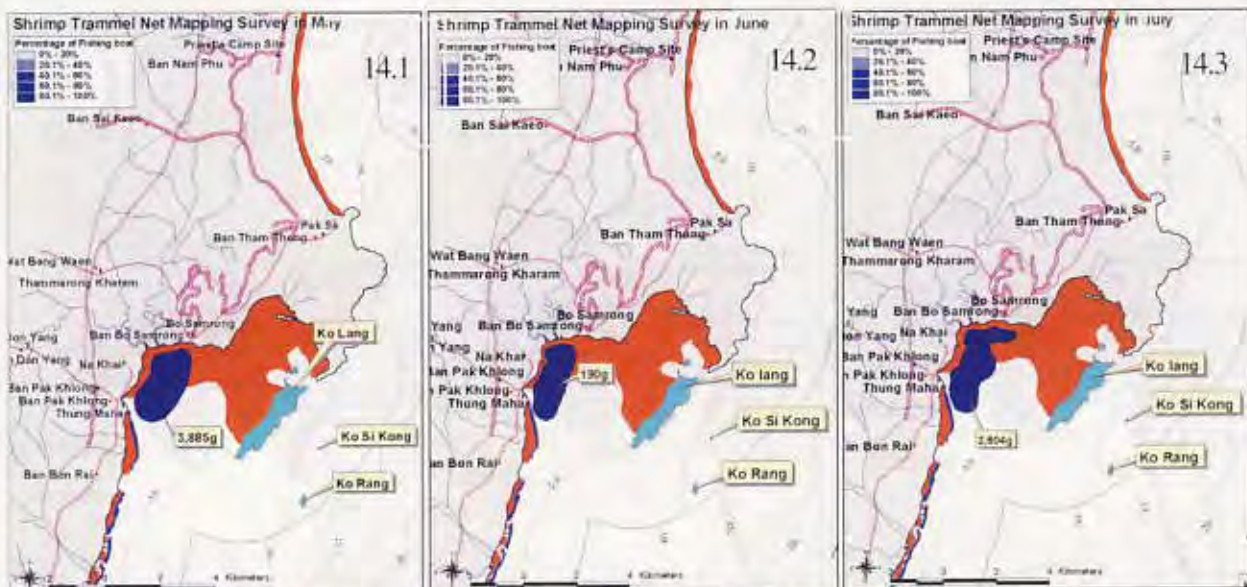


Fig. 14.1, 14.2 and 14.3 Shrimp trammel net fishing area and the EPUE in May, June and July.

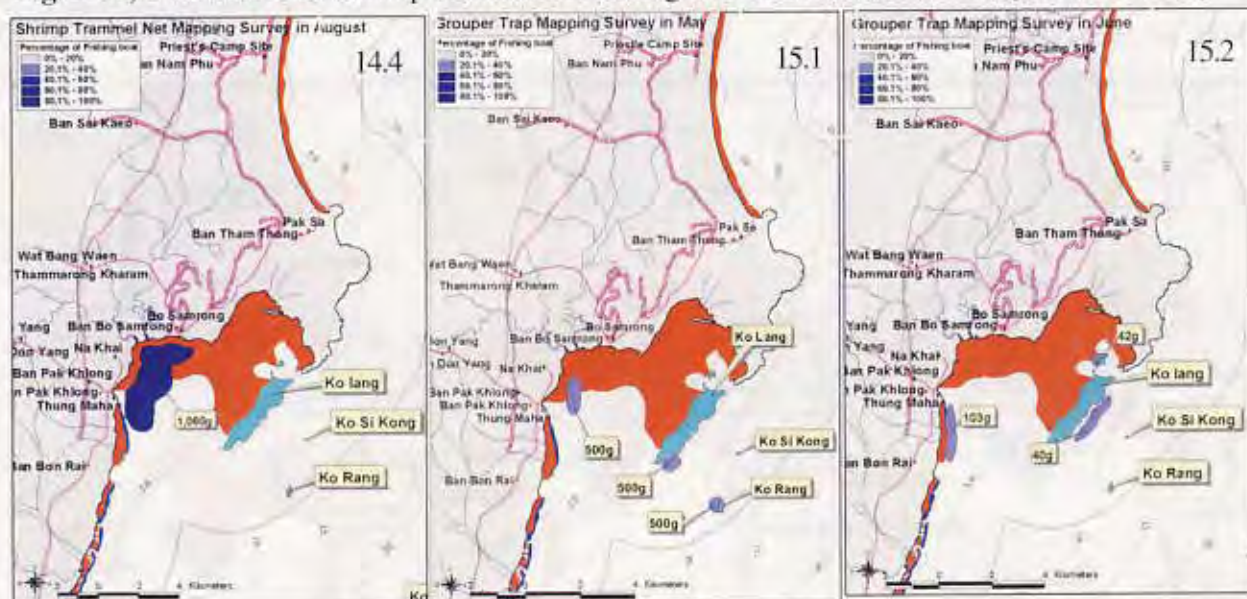


Fig. 14.4 Shrimp trammel net fishing area and the ECPU in August.

Fig. 15.1 and 15.2 Grouper trap fishing areas and the ECPU in May and June.

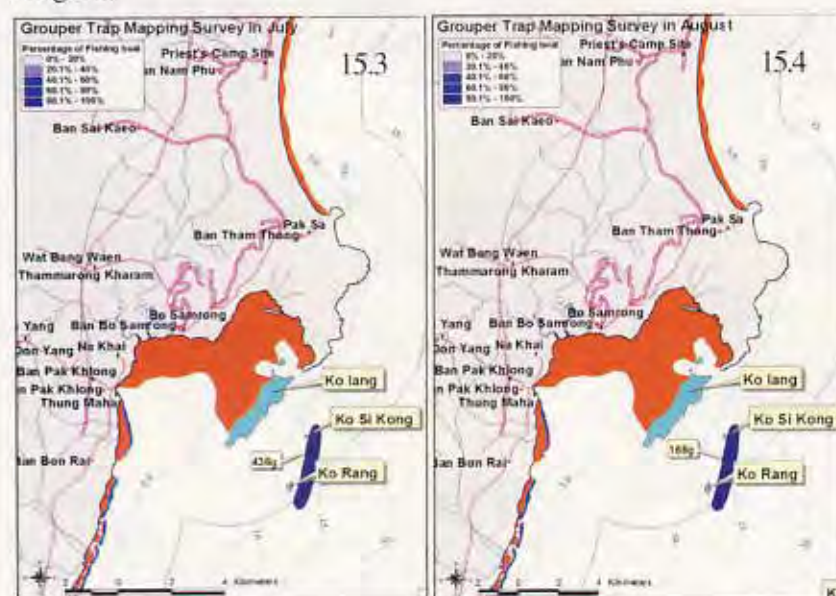


Fig. 15.3 and 15.4 Grouper trap fishing area and the ECPU in July and August.

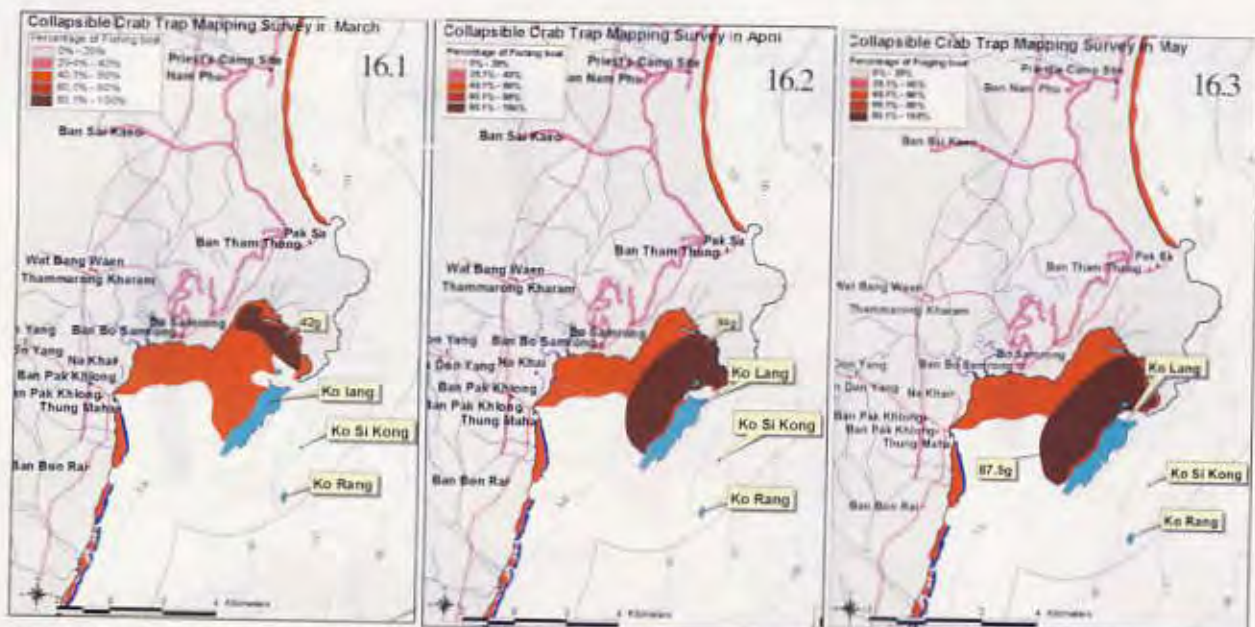


Fig. 16.1, 16.2 and 16.3 Collapsible crab trap fishing area and the ECPU in March April and May.

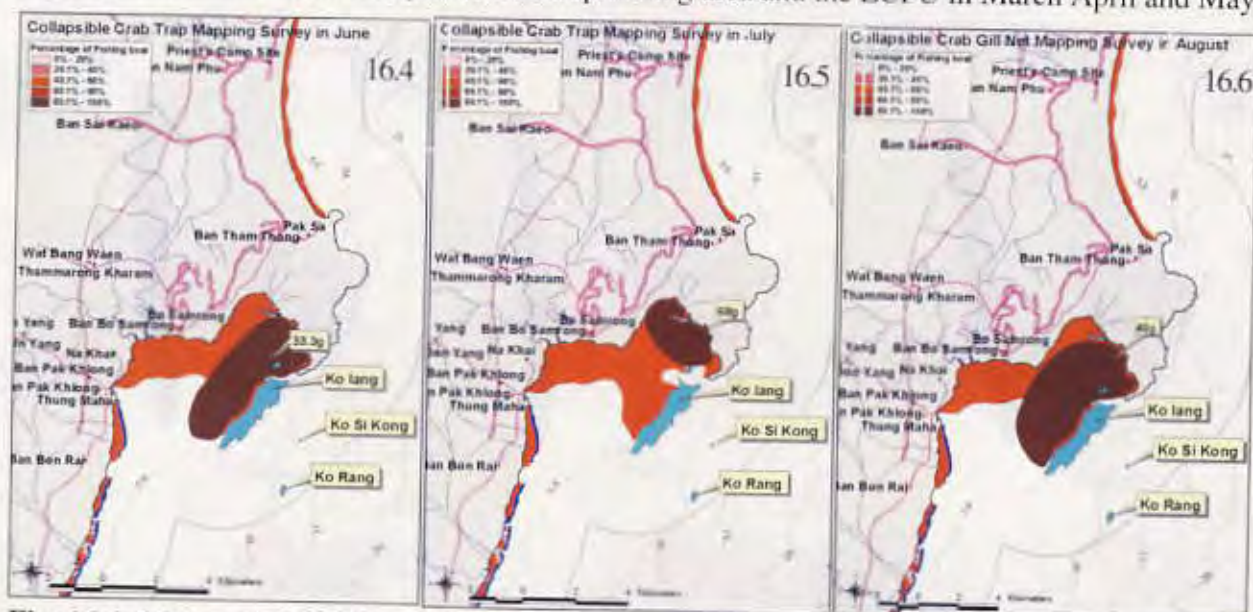


Fig. 16.4, 16.5 and 16.6 Collapsible crab trap fishing area and the ECPU in June, July and August.

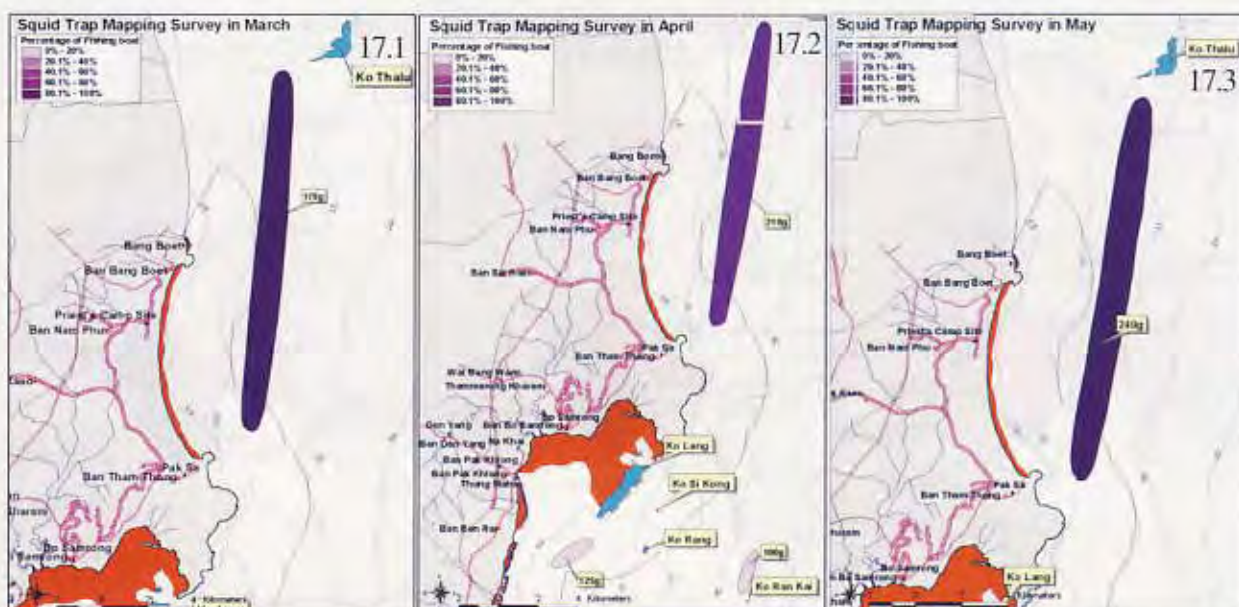


Fig. 17.1, 17.2 and 17.3 Squid trap fishing area and the ECPU in March, April and May.

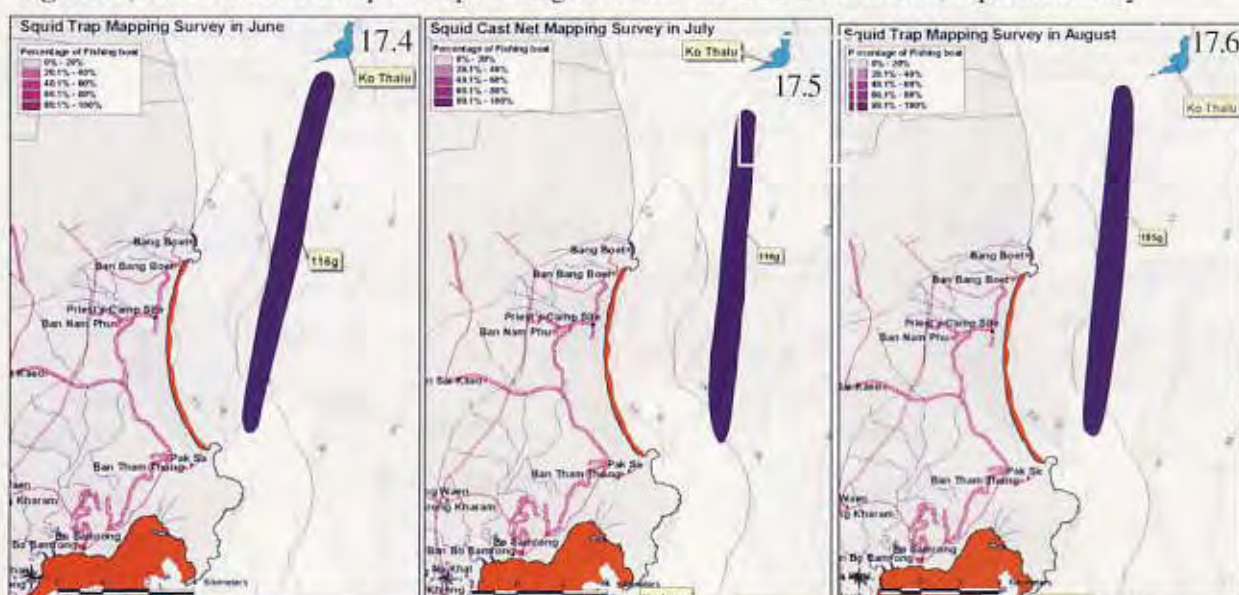


Fig. 17.4, 17.5 and 17.6 Squid trap fishing area and the ECPU in June, July and August.

Appendix III

The percentage of each operating gear and the ECPU in each month

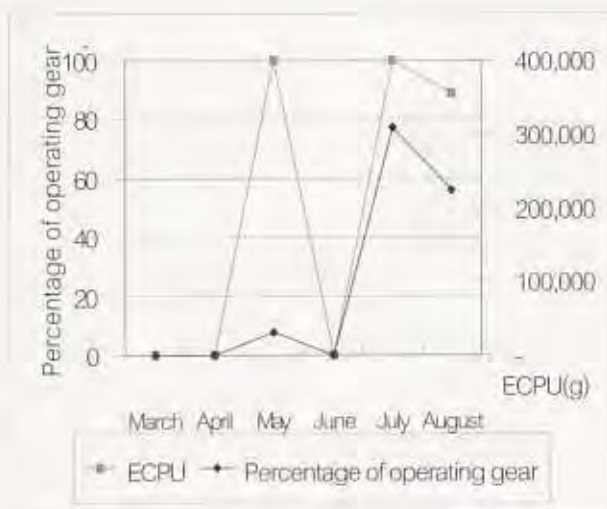


Fig. 1. The percentage of operating gear and the ECPU of anchovy purse seine.

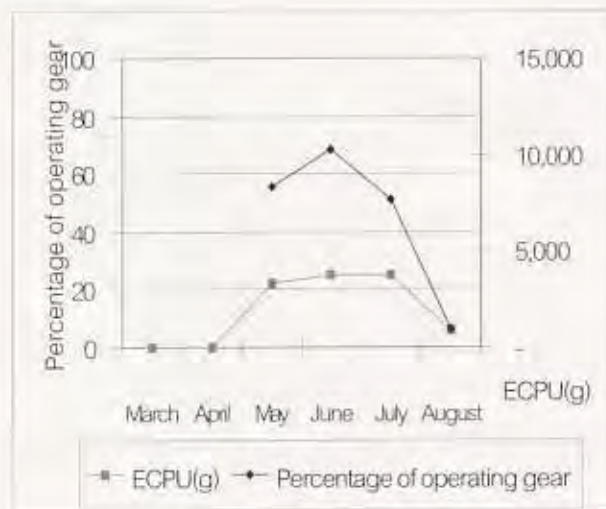


Fig. 2. The percentage of operating gear and the ECPU of anchovy stick-held box net.

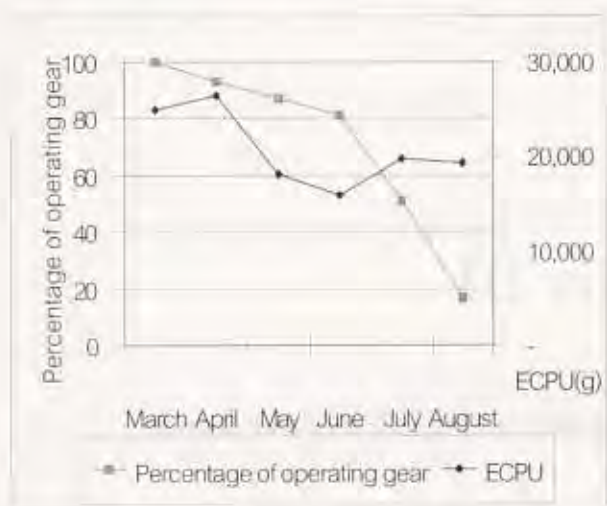


Fig. 3. The percentage of operating gear and the ECPU of squid cast net.

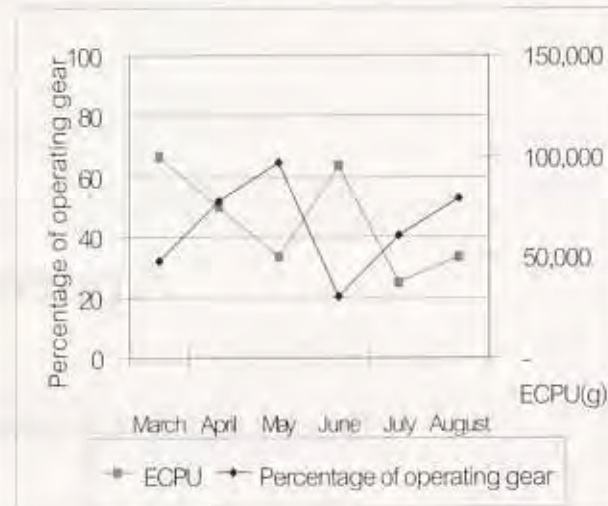


Fig. 4. The percentage of operating gear and the ECPU of mullet encircling gill net.

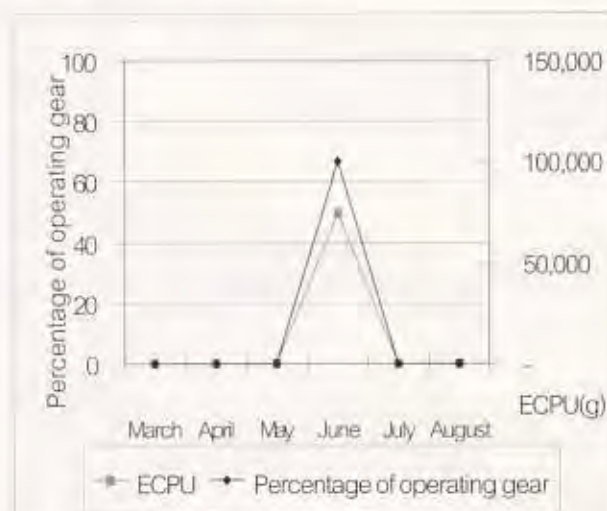


Fig. 5. The percentage of operating gear and the ECPU of pomfret encircling gill net.

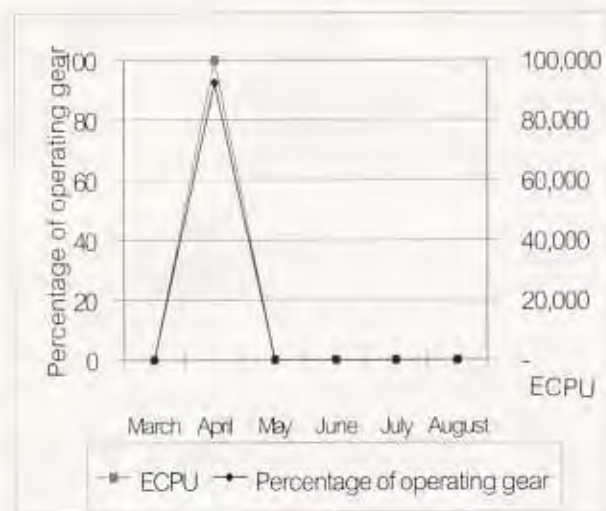


Fig. 6. The percentage of operating gear and the ECPU of sardine encircling gill net.

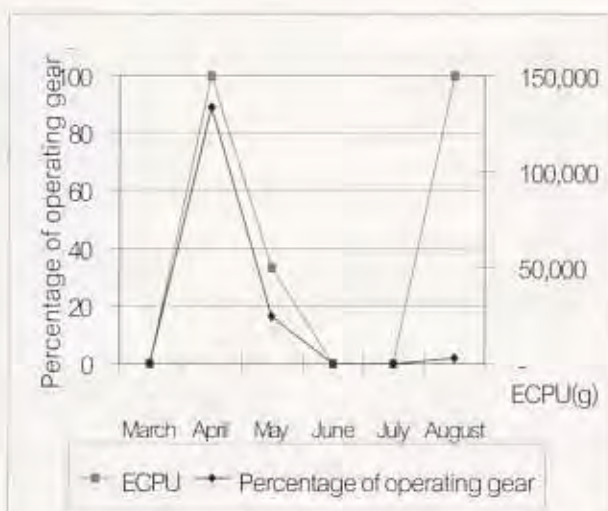


Fig. 7. The percentage of operating gear and the ECPU of fish bottom gill net.

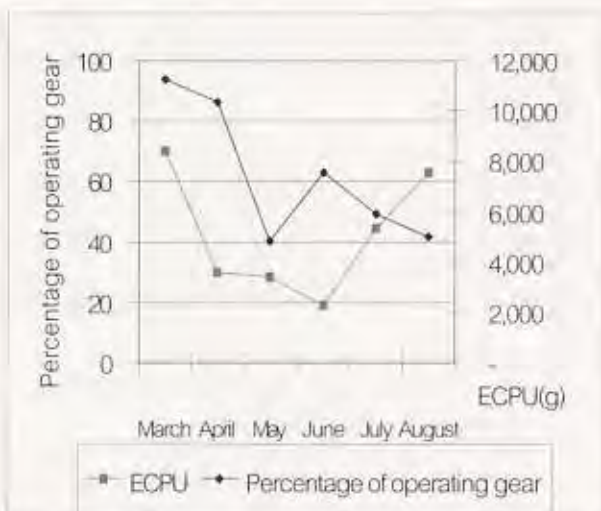


Fig. 8. The percentage of operating gear and the ECPU of crab gill net.

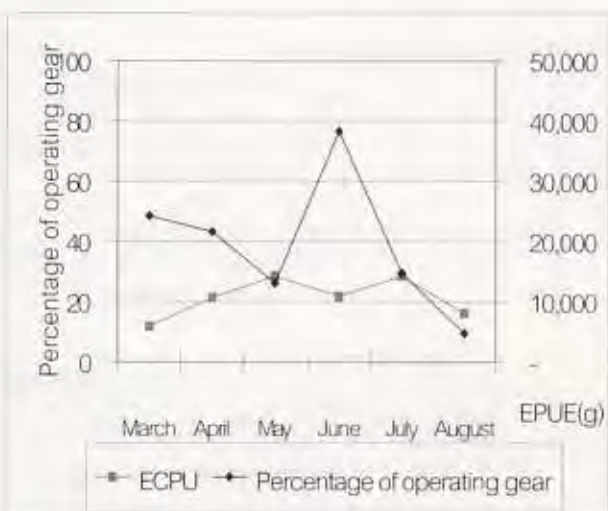


Fig. 9. The percentage of operating gear and the ECPU of indo-pacific mackerel gill net.

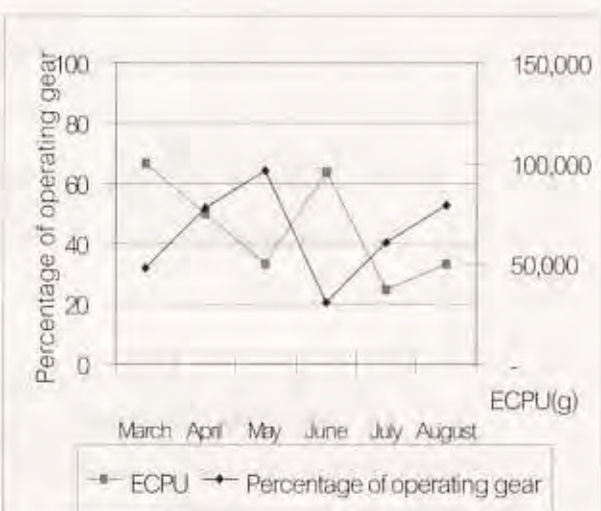


Fig. 10. The percentage of operating gear and the ECPU of mullet gill net.

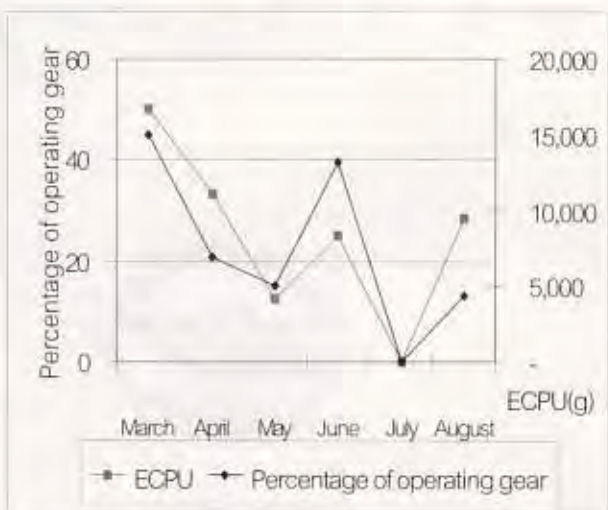


Fig. 11. The percentage of operating gear and the ECPU of sand whiting gill net.

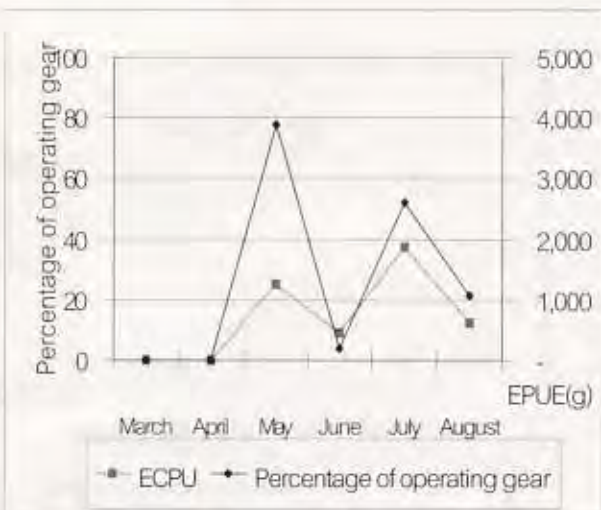


Fig. 12. The percentage of operating gear and the ECPU of shrimp trammel net.

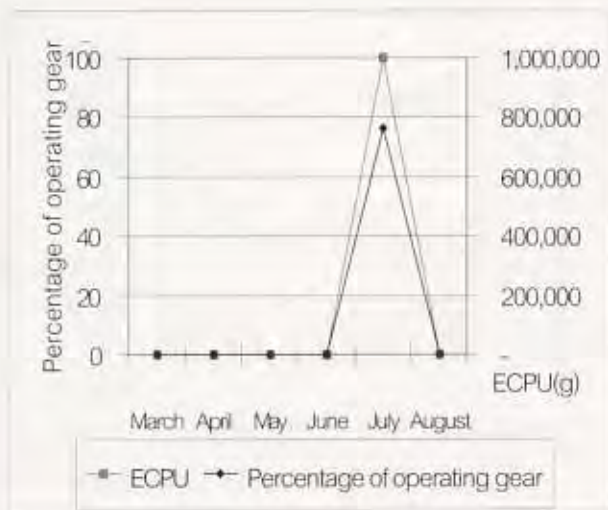


Fig. 13. The percentage of operating gear and the ECPU of jelly scoop net.

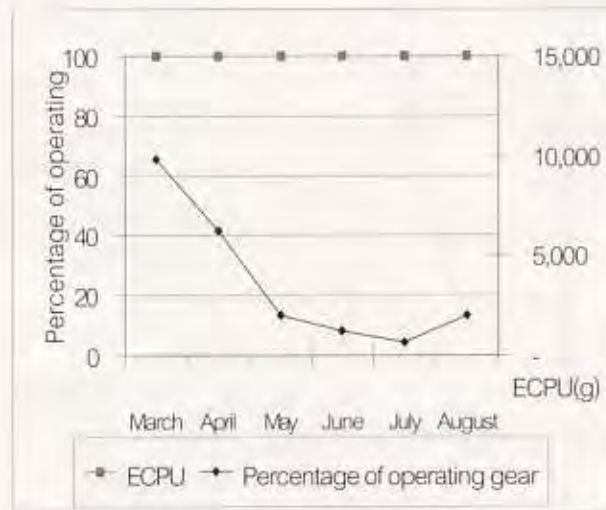


Fig. 14. The percentage of operating gear and the ECPU of squid hand-line.

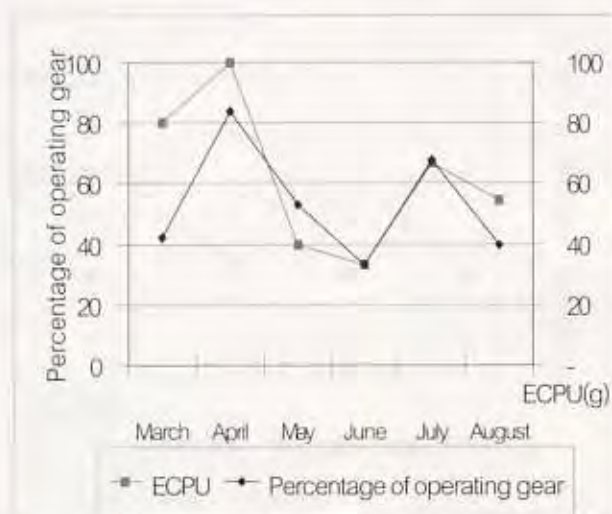


Fig. 15. The percentage of operating gear and the ECPU of collapsible crab trap.

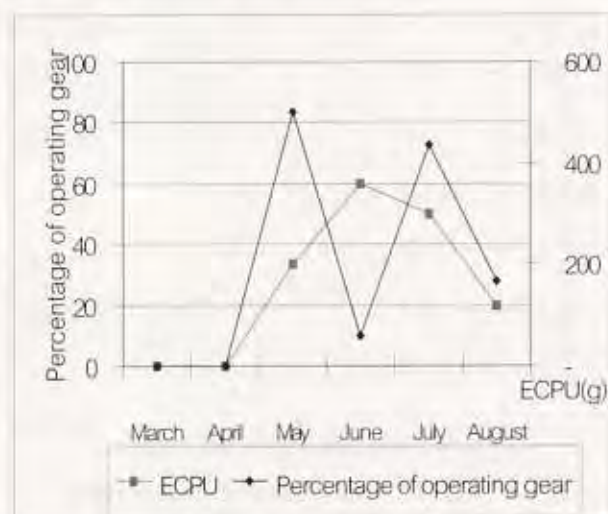


Fig. 16. The percentage of operating gear and the ECPU of grouper trap.

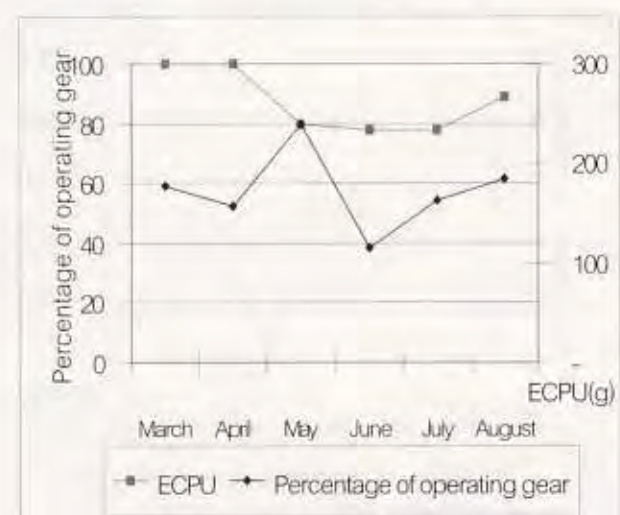


Fig. 17. The percentage of operating gear and the ECPU of squid trap.



