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# SEAFDEC Training Department

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

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## SMALL-SCALE FISHERIES IN THE KO MAN GROUP AREA, EASTERN COAST OF THE GULF OF THAILAND:

Fishing Gear and Marine Catch at Six Fishing  
Villages with Special Reference to  
the Ban Krachae-Kungkraben Fishing Villages

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and

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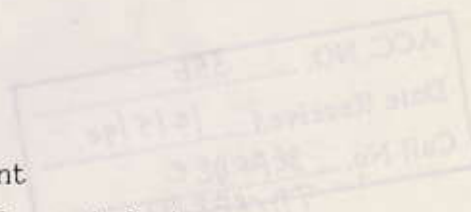
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## INTRODUCTION

Analysis of the Thai marine capture fishery showed that the catch of small-scale fisheries accounted for 16.5% of the total catch (SEAFDEC, 1988), but fishermen belonging to small-scale fisheries accounted for 79.8% of the total fishermen engaged in marine capture fishery in Thailand in 1985 (DOF, 1986). Therefore, it is of prime importance to clarify the status of the country's small-scale fishery in order to implement effective management and developmental programmes. Sources of the data used in this paper were first obtained in 1982 and 1984. However, the results in most cases, are still valid today and provide a valuable source of basic information on small-scale fisheries on the eastern seaboard of the Gulf of Thailand.

The problems of small-scale fisheries should be differentiated from those of capital-intensive, commercial, and large-scale fisheries. Also, as management data collection in small-scale fisheries is hindered by the numerous remote landing points and by the many diversified gears in operation (Saila and Roedel, 1979), it is necessary to conduct research from many points of view to solve the problems. This research is aimed at identifying the status of small-scale fishing gear, which was one of the elements to be identified for better management and development of small-scale fisheries.

Guidelines or definitions of so-called small-scale fisheries vary from country to country because of the different conditions of the small-scale fisheries. Therefore, it is necessary to give a clear definition of what constitutes small-scale fisheries in Thailand. We have not attempted a full definition of this term in this paper as the conditions applied to so-called small-scale fisheries have been gradually changing. However, the authors have given a tentative definition for small-scale fishing gear in the Ko Man Group area, while recognizing the necessity of a clear definition which they should be able to submit in the near future.



In this paper, the status of both the small-scale and non small-scale fishing gear which are defined here were based on data for Ko Man Group area collected in 1984. The marine catch of the Ban Krachae-Kungkraben fishing villages is taken from 1982 data, and was analyzed from buying records at that time. The present status of small-scale fishing gear is based on some data compiled from small-scale fishing villages in Ko Man Group area, on the east coast of the Gulf of Thailand in 1989.

#### MATERIALS AND METHODS

Data on the number of fishing gear used in this study were obtained from two sources: data of 1984 from the Fisheries Statistic Unit, Department of Fisheries, Thailand, and data of 1982 from Small-scale Fisheries Development Working Group, Marine Fisheries Division, DOF, Thailand. Catch and effort data at the Ban Krachae-Kungkraben Fishing villages were obtained from the buying records of the fish dealer operating in the two fishing villages in 1982, as compiled by the Small-scale Fisheries Development Working Group (MFD, DOF, Thailand). For data collection from small-scale fishing gear, it is difficult to estimate the number of units of gear exactly. This is because small-scale fishing gear changes by season and by year, and single fisherman usually possess a variety of fishing gears. The locations of six fishing villages and the survey area of this work are shown in Fig. 1.



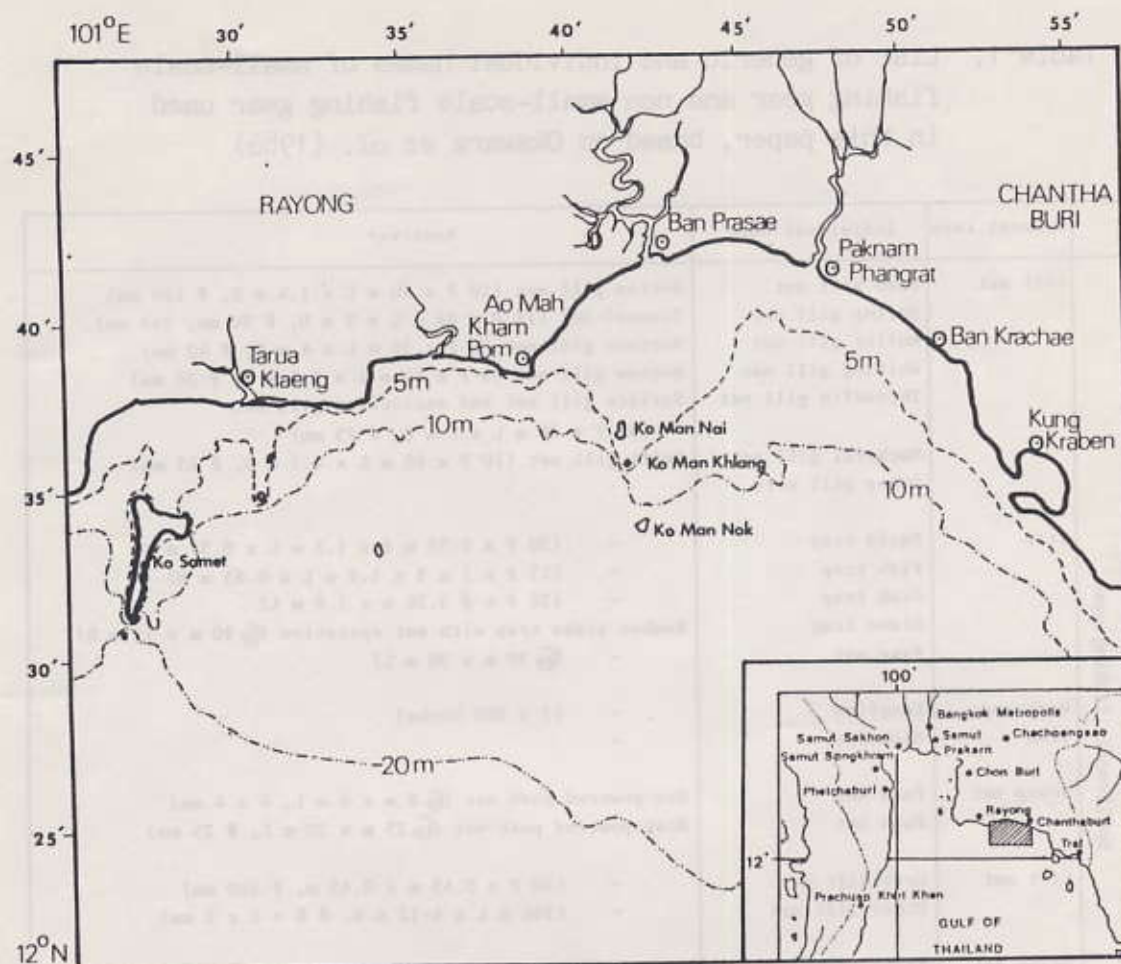


Fig. 1 Locations of six small-scale fishing villages, Ko Man group area, eastern coast of the Gulf of Thailand.

There are many kinds of fishing gear in Thailand, and the names given to this gear vary, depending on the areas and target species. The authors have arranged the names of fishing gear used in this paper (Table 1) based on Okawara *et al.* (1986). Detailed information of the fishing gear can be obtained from this reference.

Table 1. List of generic and individual names of small-scale fishing gear and non small-scale fishing gear used in this paper, based on Okawara *et al.* (1986)

	General term	Individual name	Remarks*
Small-scale fishing gear	Gill net	Crab gill net	Bottom gill net (10 P x 90 m L x 1.4 m D, # 120 mm)
		Shrimp gill net	Trammel-net (12 P x 28 m L x 2 m D, # 50 mm, 245 mm)
		Mullet gill net	Surface gill net (4 P x 36 m L x 4 m D, # 40 mm)
		Whiting gill net	Bottom gill net (5 P x 60 m L x 1.5 m D, # 30 mm)
		Threadfin gill net	Surface gill net and encircling gill net (35 P x 36 m L x 7 m D, # 75 mm)
		Mackerel gill net	Drift gill net (10 P x 60 m L x 4.5 m D, # 45 mm)
		Other gill nets	-
	Trap	Squid trap	- (30 P x 0.57 m B x 1.2 m L x 0.57 m H)
		Fish trap	- (15 P x 1 m B x 1.9 m L x 0.85 m H)
		Crab trap	- (20 P x # 0.26 m x 1.0 m L)
		Stake trap	Bamboo stake trap with net operation (C 90 m x 12 m D)
		Fyke net	- (C 30 m x 30 m L)
	Hook-and-line	Longline	- (3 x 200 hooks)
		Handline	-
	Scoop net	Push net	Man-powered push net (C 8 m x 6 m L, 4 x 4 mm)
		Push net	Boat-powered push net (C 25 m x 20 m L, # 25 mm)
	Lift net	Crab lift net	- (30 P x 0.45 m x 0.45 m, # 100 mm)
		Other lift net	- (260 m L x 4-12 m H, # 8 + 2 x 2 mm)
Non small-scale fishing gear	Seine net	Beach seine	- (260 m L x 4-12 m H, # 8 + 2 x 2 mm)
	Cast net	Small cast net	- (C 15 m x 6 m L, # 25 mm)
	Gill net	Spanish mackerel gill net	Drift gill net (35 P x 36 m L x 7 m D, # 57 mm)
	Surrounding net	Anchovy purse seine	- (400 m L x 30 m D, # 8 x 8 mm)
	Cast net	Squid net	Stick-held cast net (C 36 m x 12 m L, # 25 mm)

\*P, piece; L, length; D, depth; #, mesh size; C, circumference;  
 4 x 4 mm, mesh size of minnow net (square mesh);  
 # 8 + 2 x 2 mm, 8 mm mesh size and 2 x 2 mm mesh size minnow net.

The authors based their definitions for small-scale fishing gear on the following criteria:

- (1) Fishing gear which is operated by less than five men (up to four men). 1\*
- (2) Fishing gear which is operated on a less than five tonne boat (10 meters long). 2\*
- (3) Fishing gear which is operated for less than three days (up to two days). 3\*

The term "small-scale fishing gear" was applied if the fishing gear generally fit all three conditions. Others are referred to as "non small-scale fishing gear" in this paper.

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Our definitions were also based on the following observations:

- 1\* Households consisting of three to six persons accounted for 70% of the marine capture fishery in Rayong Province. So, the man-power used to operate small-scale fishing gear was defined as less than five.
- 2\* This term includes non-powered, outboard-powered and inboard-powered boats of less than five tonnes. (These accounted for 64% of the fishing boats in use in Rayong Province).
- 3\* Days of operation are working days for operation of the fishing gear; e.g., in the case of traps, when a day's trip is spent setting and another (hauling) the traps, we count two days of operation (one day for setting and one day for hauling, and no count is made for gear days of traps on the fishing grounds).



## RESULTS

### 1. Fisheries at six fishing villages

In the Ko Man Group area, many kinds of small-scale fishing gear and some non small-scale fishing gear were operated. In 1984, a total of 1,208 sets of small-scale fishing gear were operated and only 43 sets of non small-scale fishing gear (Table 2).

In the small-scale fishing gear, gill nets (544 sets; 45%) were dominant, followed by scoop (push) nets (354 sets; 29%), traps (174 sets; 14%) and hooks-and-lines (90 sets; 8%). Cast nets were fewer and lift nets and seine nets (beach seines) fewer still.

In non small-scale fishing gear, Spanish mackerel gill nets (3 sets; 7%) and anchovy purse seines (13 sets; 30%) were operated mainly at Tarua Klaeng and Ao Mahkhampom respectively. Squid net fishing (27 sets; 63%) was operated mainly by stick-held cast nets at Tarua Klaeng, Ban Prasae and Paknam Phangrat.

In Tarua Klaeng there were 173 sets (accounting for 14% of six fishing villages) of small-scale fishing gear and seven sets (16% in this area) of non small-scale fishing gear. Gill nets, traps, hooks-and-lines and scoop net operated at similar rates (20% - 30%) in small-scale fishing gear at this village. Non small-scale fishing gear at Tarua Klaeng included the Spanish mackerel gill net and squid net.

Table 2. Number and percentage of total fishing gear observed at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand. Figures in parentheses represent percentage of the total.

Fishing gear		Fishing village	Taru Klaeng	Ao Mahkam- pon	Ban Prasae	Paknam Phangrat	Ban Krachae	Kung- kraben	Whole Area
Small-scale fishing gear	Gill nets		52 ( 9.6)	58 (10.7)	22 ( 4.0)	58 (10.7)	97 (17.8)	257 ( 47.2)	544 (45.0)
	Traps		47 (27.0)	0 ( 0.0)	14 ( 8.0)	0 ( 0.0)	12 ( 6.9)	101 ( 58.1)	174 (14.4)
	Hooks-and-lines		38 (42.2)	0 ( 0.0)	15 (16.7)	0 ( 0.0)	0 ( 0.0)	37 ( 41.1)	90 ( 7.5)
	Scoop nets		35 ( 9.9)	10 ( 2.8)	0 ( 0.0)	44 (12.4)	75 (21.2)	190 ( 53.7)	354 ( 29.3)
	Others		1 ( 2.2)	0 ( 0.0)	3 ( 6.5)	0 ( 0.0)	2 ( 4.3)	40 ( 87.0)	46 ( 3.8)
	Total		173 (14.3)	68 ( 5.6)	54 ( 4.5)	102 ( 8.5)	186 (15.4)	625 ( 51.7)	1,208 (100.0)
Non small-scale fishing gear	Spanish mackerel gill net		3 (100.0)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	3 ( 7.0)
	Anchovy purse seine		0 ( 0.0)	13 (100.0)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	13 ( 30.2)
	Squid fishing		4 ( 14.8)	0 ( 0.0)	16 (59.3)	7 (25.9)	0 ( 0.0)	0 ( 0.0)	27 ( 62.8)
	Total		7 (16.3)	13 (30.2)	16 (37.2)	7 (16.3)	0 ( 0.0)	0 ( 0.0)	43 (100.0)

Ao Mahkhampon village had 68 sets (6% of six fishing villages) of small-scale fishing gear and 13 sets (30% in this area) of non small-scale fishing gear. Of gill nets and scoop nets operated, gill nets dominated with 85% in small-scale fishing gear. Non small-scale fishing gear operated at Ao Mahkhampon was the anchovy purse seine.

Ban Prasae had 54 sets (4% of six fishing villages) of small-scale fishing gear and 16 sets (37% in this area) of non small-scale fishing gear. Gill nets accounted for 41%, followed by hooks-and-lines (28%) and fyke nets (22%) in small-scale fishing gear. Non small-scale fishing gear in this village was the squid net. Ban Prasae is a home town of modern tuna purse seiners. Also, mackerel purse seines, Thai purse seines and trawls have operated at Ban Prasae for many years.

Paknam Phangrat had 102 sets (8% in six fishing villages) of small-scale fishing gear and seven sets (16% in this area) of non small-scale fishing gear. Gill nets and scoop nets accounted for 57% and 43% respectively in small-scale fishing gear at this village. Non small-scale fishing gear here was the squid net. Paknam Phangrat is a shrimp trawler base.

Ban Krachae had 186 sets (15% of six fishing villages) of small-scale fishing gear and no non small-scale fishing gear. Gill nets and scoops nets dominated and they accounted for 52% and 40 % respectively at this village.

Kungkraben had 625 sets (52% in six fishing villages) of small-scale fishing gear and no non small-scale fishing gear. Gill nets dominated with 41%, followed by scoop nets (30%) and traps (16%). There were fewer hooks-and-lines and cast nets in small-scale fishing gear at this village.



## 2. Small-scale fishing gear at six fishing villages as of 1984

### 2.1 Gill net

Six types of gill nets, i.e., crab gill net, shrimp gill net, mullet gill net, whiting gill net, threadfin gill net and mackerel gill net were operated in this area (Table 3). Among them, the shrimp gill net was dominant, followed by crab gill net and mullet gill net. These three types of gill net accounted for 85% of the total.

There were 186 shrimp gill nets observed and they were mostly operated at Paknam Phangrat, Ban Krachae and Kungkraben. Kungkraben alone accounted for 73%. A total of 173 crab gill nets were operated at all six fishing villages. Crab gill nets dominated at Kungkraben with 34% of the subtotal. 106 mullet gill nets were operated at five of the fishing villages. There were none at Ao Mahkhampon. Mullet gill nets dominated at Kungkraben with 51% of the subtotal.

Mackerel gill nets (36 sets), threadfin gill nets (19 sets) and whiting gill nets (7 sets) only accounted for 11% of the total gill nets in this area. Other types of gill nets (17 sets) were even less prevalent.

Table 3. Number of gill nets which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear \ Fishing village	Tarua Klaeng	Ao Mah- Khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kung- kraben	Whole Area
Crab gill net	135	29	4	12	40	58	173
Shrimp gill net	0	0	0	12	39	135	186
Mullet gill net	10	0	3	34	5	54	106
Whiting gill net	2	0	0	0	5	0	7
Threadfin gill net	6	0	0	0	3	10	19
Mackerel gill net	0	29	3	0	4	0	36
Other gill nets	4	0	12	0	1	0	17
Total	52	58	22	58	97	257	544

## 2.2 Trap

Five kinds of trap: the squid trap, fish trap, crab trap, stake trap and fyke net were operated in this area (Table 4). Among them, squid trap was dominant with 56% of total traps.

There were 98 squid traps observed, and operated at Tarua Klaeng and Kungkraben. Kungkraben accounted for 80% of subtotal of squid traps. There were 29 fish traps in all, operated at

Tarua Klaeng (25 sets) and Kungkraben (4 sets). There were 18 crab traps operated at Tarua Klaeng (2 sets), Ban Prasae (2 sets) and Kungkraben (14 sets). In 1984 there were 13 stake traps operated at Ban Krachae (12 sets) and Kungkraben (1 set). However, there is no operation of stake trap at present (1989). There were 16 fyke nets operated at Ban Prasae (12 sets) and Kungkraben (4 sets).

Table 4. Number of traps which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear	Fishing village							Whole Area
		Tarua Klaeng	Ao Mah-khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kungkraben	
Squid trap		20	0	0	0	0	78	98
Fish trap		25	0	0	0	0	4	29
Crab trap		2	0	2	0	0	14	18
Stake trap		0	0	0	0	12	1	13
Fyke net		0	0	12	0	0	4	16
Total		47	0	14	0	12	101	174



### 2.3 Hook-and-line

A total of 90 sets of hook-and-line were operated in this area (Table 5). There was only one set long-line at Ban Prasae, the rest were handlines. These handlines were operated at Tarua Klaeng (38 sets), Ban Prasae (14 sets) and Kungkraben (37 sets).

Table 5. Number of hooks-and-lines which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear	Fishing village	Tarua Klaeng	Ao Mah-khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kungkraben	Whole Area
Longline		0	0	1	0	0	0	1
Handline		38	0	14	0	0	37	89
Total		38	0	15	0	0	37	90

### 2.4 Scoop net

The scoop nets operated in this area were all push nets. A total of 354 sets of push nets were divided into man-powered nets and boat-powered nets (Table 6). Man-powered nets dominated with 72% of subtotal of push nets.

There were a total of 256 man-powered push nets operated at five of the fishing villages. There were none at Ban Prasae. Man-powered push nets dominated at Kungkraben with 48% of the sub-total, followed by Ban Krachae and Paknam Phangrat. A total of 98 boat-powered push nets were operated at Tarua Klaeng, Ban Krachae and Kungkraben. Kungkraben accounted for 69% of these.

Table 6. Number of scoop (push) nets which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear	Fishing village							Whole Area
		Tarua Klaeng	Ao Mah-khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kungkraben	
Push net (Man-powered)		25	10	0	44	55	122	256
Push net (Boat-powered)		10	0	0	0	20	68	98
Total		35	10	0	44	75	190	354

## 2.5 Other small-scale fishing gear

Other kinds of small-scale fishing gear are shown in Table 7. Lift nets were operated at Ban Prasae (3 sets of crab lift net) and Ban Krachae (1 set of crab lift net and one other lift net). There was only one beach seine, which was one of seine nets operated at Tarua Klaeng. A total of 40 sets of small cast net were operated only at Kungkraben.

Table 7. Number of other small-scale fishing gear which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear \ Fishing village	Tarua Klaeng	Ao Mah- Khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kung- kraben	Whole Area
Crab lift net	0	0	3	0	1	0	4
Other lift nets	0	0	0	0	1	0	1
Beach seine	1	0	0	0	0	0	1
Small cast net	0	0	0	0	0	40	40
Total	1	0	3	0	2	40	46

### 3. Non small-scale fishing gear

Non small-scale fishing gear, i.e., Spanish mackerel gill net, anchovy purse seine and squid net were also operated in this area (Table 8).



Table 8. Number of non small-scale fishing gear which were operated at six small-scale fishing villages, Ko Man Group area, eastern coast of the Gulf of Thailand.

Fishing gear \ Fishing village	Tarua Klaeng	Ao Mah-khampom	Ban Prasae	Paknam Phangrat	Ban Krachae	Kungkraben	Whole Area
Spanish mackerel gill net	3	0	0	0	0	0	3
Anchovy purse seine	0	13	0	0	0	0	13
Squid net	4	0	16	7	0	0	27
Total	7	13	16	7	0	0	43

The three Spanish mackerel gill nets were operated at Tarua Klaeng. There were 13 anchovy purse seines operated at Ao Mahkhampom. Squid net fishing using mainly stick-held cast nets was carried out at Tarua Klaeng (4 sets), Ban Prasae (16 sets) and Paknam Phangrat (7 sets). No non small-scale fishing gear was operated at Ban Krachae and Kungkraben.

#### 4. Marine catch of Ban Krachae and Kungkraben as of 1982

##### 4.1 Catch by main fishing gear and by species group

At the two villages, Ban Krachae-Kungkraben, a marine catch of 117,060 kg was recorded in 1982 (Table 9). Catch by squid traps dominated at 68,100 kg (58% of total catch), followed by crab gill nets at 42,760 kg (37%). Thus, these two kinds of gear accounted for 95% of total catch.

Table 9. Catch (by weight) by major fishing gear at the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of the fish dealer at the two fishing villages. There was only one fish dealer at the Ban Krachae-Kungkraben fishing villages during this survey.

Fishing gear \ Catch	Kg	%	Operating period
Crab gill net	42,757.3	36.53	January to December
Shrimp gill net	2,959.1	2.53	March to December
Mullet gill net	48.1	0.04	August and October
Whiting gill net	2,746.2	2.35	April, May and Sep. to Dec.
Threadfin gill net	104.2	0.09	March, April and Sep. to Dec.
Mackerel gill net	82.3	0.07	October and November
Squid trap	68,104.5	58.18	January to June and Aug. to Dec.
Handline	258.2	0.22	April, May and Aug. to Dec.
Total	117,059.9	100.00	-

In catch by species group (Table 10), bigfin reef squid (*Sepioteuthis lessoniana*) by squid traps dominated (59,210 kg; 51%), followed by blue swimming crab (*Portunus pelagicus*) by crab gill nets (42,760 kg; 37%) and cuttlefish (*Sepia* spp.) by squid traps (8,900 kg; 8%). Two kinds of prawn, i.e., banana prawn (*Penaeus merguensis*) and giant tiger prawn (*Penaeus monodon*) were caught by shrimp gill nets, and totaled 2,880 kg and 3.5 kg respectively.

Table 10. Catch by major species groups at the Ban Krachae-Kungkraben fishing villages in 1982.  
Data from the buying records of fish dealer at the two fishing villages.

Catch Species group	Kg	%	Fishing gear
Blue swimming crab	42,757.3	36.53	Crab gill net
Banana prawn	2,876.1	2.46	Shrimp gill net
Giant tiger prawn	3.5	0.00	Shrimp gill net
Wolf herring	79.5	0.07	Shrimp gill net
Mullet	48.1	0.04	Mullet gill net
Whiting	2,746.2	2.35	Whiting gill net
Fourfinger threadfin	104.2	0.09	Threadfin gill net
Indian mackerel	82.3	0.07	Mackerel gill net
Bigfin reef squid	59,208.3	50.58	Squid trap
Cuttlefish	8,896.2	7.60	Squid trap
Cobia	115.6	0.10	Handline
Spanish mackerel	105.1	0.09	Handline
Barracuda	9.0	0.00	Handline
Red snapper	5.4	0.00	Handline
John's snapper	2.6	0.00	Handline
Others	20.5	0.02	Handline
Grand total	117,059.9	100.00	
Total fish	3,318.5	2.83	
Total crab	42,757.3	36.53	-
Total prawn	2,879.6	2.46	
Total squid	68,104.5	58.18	



Of fish caught by several types of fishing gear, about ten species were caught, totaling 3,320 kg (only 3% of total catch). Whittings (*Sillago sihama* and *S. maculata*) by whiting gill nets was dominant (2,750 kg) and accounted for 90% of total fish catch. Several kinds of fish were caught by handlines, e.g., cobia (*Rachycentron canadus*), Spanish mackerels (*Scomberomorus* spp.), barracudas (*Sphyraena* spp.), red snappers (*Lutjanus* spp.), John's snapper (*Lutjanus johni*) and others, but catch quantity was less. Also, a few wolf herring (*Chirocentrus dorab*) were caught by shrimp gill net, fourfinger threadfin (*Eleutheronema tetradactylum*) by threadfin gill net, mullets (*Mugil* spp.) by mullet gill net and Indian mackerel (*Rastrelliger kanagurta*) by mackerel gill net.

#### 4.2 Monthly catch and effort data

Catch and effort data of crab gill nets, shrimp gill nets, whiting gill nets and squid traps were recorded monthly at the Ban Krachae and Kungkraben group during the year 1982.

##### Crab gill net

Target species of the crab gill net was blue swimming crabs. Crab gill nets were operated year-round, although less operations took place during June and July (Table 11).

The peak number of 37 fishing boats was in November, followed by December with 36 boats. The peak numbers of operating days per boat were in March and November, with 30 days/boat respectively. So, the dominant number of operating days was in November, with 1,103 days.

From September to December, each month showed a total catch of over 4,000 kg, with the peak in November (7,920 kg).

Table 11. Monthly catch and effort data by crab gill net in the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of fish dealer at the two fishing villages.

Item	Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
No. of fishing units (boats)		27	9	13	13	13	13	4	21	26	22	37	36	234
No. of days		378	221	392	338	242	13	18	340	512	629	1,103	893	5,079
Total catch in Kg		2,721.6	2,330.0	3,820.1	3,007.3	2,109.1	192.5	255.2	3,843.4	5,752.9	4,200.3	7,919.1	6,605.8	42,757.3
CUE (Kg/boat/day)		7.2	10.5	9.7	8.9	8.7	14.8	14.2	11.3	11.2	6.7	7.2	7.4	8.4
Blue swimming crab (Kg)		2,721.6	2,330.0	3,820.1	3,007.3	2,109.1	192.5	255.2	3,843.4	5,752.9	4,200.3	7,919.1	6,605.8	42,757.3



### Shrimp gill net

Target species of shrimp gill net was banana prawn; fewer giant tiger prawn and wolf herring were caught. Shrimp gill nets were operated from March to November (Table 12).

The peak number of fishing boats in operation was in August, with 38 boats, followed by July (33 boats) and September (32 boats). The peak number of operating days per boat was also in August with 14 days/boat, followed by April and July with 10 days/boat each. So, the dominant number of operating days was in August, with 519 days.

From July to September, each month showed over 450 kg in total catch with the peak in July (767 kg). Giant tiger prawn was caught only in October and November with 2.5 kg and 1.0 kg respectively. Wolf herring was caught from August to November (2.4 kg to 37.9 kg).



Table 12. Monthly catch and effort data by shrimp gill net in the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of fish dealer at the two fishing villages.

Item	Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
No. of fishing units (boats)		-	-	17	26	28	24	33	38	32	21	2	-	221
No. of days		-	-	66	268	133	129	333	519	298	134	6	-	1,886
Total catch in Kg		-	-	86.1	302.1	202.1	248.9	766.7	610.1	462.0	260.2	20.9	-	2,959.1
CPUE (Kg/boat/day)		-	-	1.3	1.1	1.5	1.9	2.3	1.2	1.6	1.9	3.5	-	1.6
Banana prawn (Kg)		-	-	86.1	302.1	202.1	248.9	766.7	572.2	435.4	255.3	7.3	-	2,876.1
Giant tiger prawn (Kg)		-	-	-	-	-	-	-	-	-	2.5	1.0	-	3.5
Wolf herring (Kg)		-	-	-	-	-	-	-	37.9	26.6	2.4	12.6	-	79.5

### Whiting gill net

Target species of the whiting gill net were two species of whiting. Whiting gill nets were operated in April, May and September to December (Table 13).

The peak number of 27 boats was in September. The peak number of operating days per boat was in November (11 days/boat), and that month also had the most operating days (196 days).

Total catch in September showed the peak of 1,160 kg, followed by November with only half the amount (525 kg).

Month	Boats	Operating days	Catch (kg)	Boats	Operating days	Catch (kg)
April	1	1	10	1	1	10
May	1	1	10	1	1	10
September	27	196	1160	27	196	1160
October	1	1	10	1	1	10
November	1	11	525	1	11	525
December	1	1	10	1	1	10

Table 13. Monthly catch and effort data by whiting gill net in the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of fish dealer at the two fishing villages.

Item \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
No. of fishing units (boats)	-	-	-	1	18	-	-	-	27	19	18	4	87
No. of days	-	-	-	3	101	-	-	-	115	127	196	14	556
Total catch in Kg	-	-	-	9.3	457.8	-	-	-	1,159.8	465.5	525.2	128.6	2,746.2
CPUE (Kg/boat/day)	-	-	-	3.1	4.5	-	-	-	10.1	3.7	2.7	9.2	4.9
Whiting (Kg)	-	-	-	9.3	457.8	-	-	-	1,159.8	465.5	525.2	128.6	2,746.2



### Squid trap

Target species of squid trap were bigfin reef squid and cuttlefish. Squid traps were operated year-round, except July (Table 14).

The peak number of fishing boats was in January (53 boats), followed by February (41 boats). The peak number of operating days per boat was in February (28 days/boat); from January to April and from September to November over 20 days/boat were recorded in each month. So, the peak number of operating days was in January (1,275 days), followed by February (1,140 days).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of boats	53	41	38	35	32	30	28	25	22	20	18	15
Operating days/boat	20	28	25	22	20	18	15	12	10	8	5	3
Total operating days	1,060	1,140	950	770	640	540	420	300	220	160	90	45

Table 14. Monthly catch and effort data by squid trap in the Ban Krachae-Kungkraben fishing villages in 1982.  
Data from the buying records of fish dealer at the two fishing villages.

Item \ Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
No. of fishing units (boats)	53	41	23	10	18	2	-	15	19	23	26	31	261
No. of days	1,275	1,140	618	232	254	3	-	108	501	601	677	499	5,679
Total catch in Kg	18,782.5	14,417.5	4,189.5	1,556.8	2,774.0	33.2	-	2,075.3	6,048.1	6,449.1	6,298.1	5,480.4	68,104.5
CPUE (Kg/boat/day)	14.7	12.6	6.8	6.7	10.9	11.1	-	19.2	12.1	10.7	9.3	11.0	12.0
Bigfin reef squid (Kg)	17,794.1	13,745.1	3,994.1	1,497.9	2,715.8	33.2	-	1,656.0	3,849.6	4,493.0	5,110.2	4,319.1	59,208.3
Cuttlefish (Kg)	988.4	672.4	195.2	58.9	58.2	-	-	419.3	2,198.5	1,956.1	1,187.9	1,161.3	8,896.2

Total catch recorded three peaks, in January of 18,780 kg, followed by February (14,420 kg), and from September to December of over 5,000 kg in each month. Catch of bigfin reef squid followed the same trend as the total catch, because this species accounted for 87% of total catch. Peak catch of cuttlefish was in September, with 2,200 kg; from October to December over 1,000 kg were caught each month.

### DISCUSSION

In the Ko Man Group area, four fishing villages, Tarua Klaeng, Ao Mahkhanpom, Ban Prasae and Paknam Phangrat are in Rayong Province, and two fishing villages, Ban Krachae and Kungkraben are in Chanthaburi Province. Over 15 kinds of small-scale fishing gear and three kinds of non small-scale fishing gear were found to be operated in this area.

As for the type of small-scale fishing gear operated in all areas, man-powered push nets, shrimp gill nets and crab gill nets were dominant. Next in importance were mullet gill nets, squid traps, boat-powered push nets and handlines. Among those small-scale fishing gear, crab gill nets were operated at six fishing villages, and mullet gill nets and man-powered push nets were operated at five. Therefore, these three types of small-scale fishing gear, crab gill nets, mullet gill nets and man-powered push nets, were considered the most important small-scale fishing gear in this area.

In Rayong Province, at Tarua Klaeng, handlines were dominant, followed by crab gill nets, fish traps and man-powered push nets. Also Spanish mackerel gill nets and stick-held cast nets for squids were important as non small-scale fishing gear. The Spanish mackerel gill nets were operated only at Tarua Klaeng. At Ao Mahkhanpom, the main small-scale fishing gear was crab gill nets and mackerel gill nets. Anchovy purse seines from



non small-scale fishing gear were operated only at this fishing village. The number of anchovy purse seines at Ao Mahkhampom was 13, therefore, important fishing gear in this village was considered not only to be gill nets from small-scale fishing gear but also anchovy purse seines from non small-scale fishing gear. Ban Prasae was similar to Ao Mahkhampom, although the number of small-scale fishing gear was relatively small, that of non small-scale fishing gear was quite large. Stick-held cast nets for squid from 16 non small-scale fishing gear were operated in this village which accounted for 60% of total squid fishery. Paknam Phangrat had three kinds of small-scale gill net (mullet gill net was dominant) and also man-powered push nets, and stick-held cast nets for squid from non small-scale fishing gear.

Ban Krachae and Kungkraben, in Chanthaburi Province, had no non small-scale fishing gear. At Ban Krachae, man-powered push nets, crab gill nets and shrimp gill nets were dominant. Kungkraben accounted for half the total small-scale fishing gear in this area. Shrimp gill nets and man-powered push nets were dominant.

One of the aims of this work was to study catch conditions in this area. However, marine catch data were available only for the Ban Krachae-Kungkraben group. Therefore, the authors studied and recorded the data at this group first, then applied their findings to the whole area.

In considering the importance of the fishing gear in the Ko Man Group area, it is relevant to consider not only quantity but also value of the catch. The value of each species revealed wide variations, yet we could not obtain information on the market price of each species in the group area. So, for the purpose of this paper the price data of the Bangkok Fish Market (FMO, 1982) was adopted, and the figures were processed by a simple index for comparisons to be made (Table 15).

Table 15. Calculated price coefficients of species (group) based on the price at Bangkok Fish Market in 1982. The base price 1.00 was based on the mean prices of 57.94 Baht/kg.

Species group		Price coefficient	Remarks
Fish	Wolf herring	0.388	Fishes  (Vertebrates)
	Mullet	0.708	
	Whiting	0.834	
	Fourfinger threadfin	0.863	
	Indian mackerel	0.104	
	Cobia	0.725	
	Spanish mackerel	1.208	
	Barracuda	0.518	
	Red snapper	1.294	
	John's snapper	1.294	
	Others	1.008	
Crab	Blue swimming crab	0.532	Crustaceans (Invertebrates)
Prawn	Banana prawn	2.848	Crustaceans (Invertebrates)
	Giant tiger prawn	2.848	
Squid	Bigfin reef squid	0.465	Molluscs (Invertebrates)
	Cuttlefish	0.518	

Table 15 shows the calculated price coefficient (the base price 1.00 was the mean of all prices, i.e., 57.94 Baht/kg) of each species or species groups based on the FMO (Fish Marketing Organization) Bulletin. Table 16 and 17 show the modified values (catch in kg x price coefficient), these modified values show the importance of each fishing gear and each species group.

As for the ratios of catch quantity by fishing gear in the Ko Man Group area, squid traps accounted for 58% and crab gill nets for 37%; therefore these two gears accounted for 95% of the total catch. On the other hand, the modified value of the squid traps accounted for 49% of the total, crab gill nets 35%, shrimp gill nets 13% and whiting gill nets 3%. The most important fishing gear in the group therefore, can be considered to be squid traps, followed by crab gill nets. Shrimp gill nets are also considered important from the point of view of the modified value.

Table 16. Modified value of catches by fishing gear at the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of fish dealer at the two fishing villages.

Catch Fishing gear	Modified value	%	Remarks (Species group)
Crab gill net	22,746.9	34.58	January to December
Shrimp gill net	8,231.9	12.52	March to December
Mullet gill net	34.1	0.05	August and October
Whiting gill net	2,290.3	3.48	April, May and Sept. to Dec.
Threadfin gill net	89.9	0.14	March, April and Sept. to Dec.
Mackerel gill net	8.6	0.01	October and November
Squid trap	32,140.1	48.85	January to June and Aug. to Dec.
Handline	245.9	0.37	April, May and Aug. to Dec.
Total	65,787.7	100.00	-



On the composition of the major groups of marine organisms, invertebrates accounted for 97% (molluscs 58%, crustaceans 39%) of the total catch and fish accounted for only 3%. From the point of view of the modified value of catch composition, invertebrates also accounted for 96% of the total, but in this case molluscs accounted for only 49% (9% less than the total catch quantity) and crustaceans accounted for 47% (an 8% increase), because prices for crustaceans (especially shrimps) were higher than molluscs.

As some fishing gear caught only certain of species, it was necessary to consider the importance of catch by species. Bigfin reef squid accounted for 51%, followed by blue swimming crab with 37%, in catch quantity in the group area. From the point of view of the modified value, bigfin reef squid with 42% can still be considered the most important species (despite the 9% reduction against total catch quantity), this was followed by blue swimming crab (35%; 2% reduced), banana prawn (12%; 10% increased against total catch quantity) and cuttlefish (7%; 0.6% reduced). Of fish species, whittings caught by whiting gill nets were the most important from the points of view both of catch quantity and the modified value in the Ko Man Group area.

Species (Group)	Quantity (kg)	Modified Value (HK\$)	Catch by Gear
Bigfin reef squid	14,500	2,100.00	Hand net
Blue swimming crab	12,500	1,875.00	Hand net
Banana prawn	1,200	1,200.00	Hand net
Cuttlefish	700	490.00	Hand net
Whiting	1,000	1,000.00	Whiting gill net
Shrimp	1,000	1,000.00	Hand net
Molluscs	1,000	1,000.00	Hand net
Crustaceans	1,000	1,000.00	Hand net
Other fish	1,000	1,000.00	Hand net
Total	30,000	10,000.00	

Table 17. Modified value of species groups at the Ban Krachae-Kungkraben fishing villages in 1982. Data from the buying records of fish dealer at the two fishing villages.

Catch Species group	Modified value	%	Fishing gear
Blue swimming crab	22,746.9	34.58	Crab gill net
Banana prawn	8,191.1	12.45	Shrimp gill net
Giant tiger prawn	10.0	0.02	Shrimp gill net
Wolf herring	30.8	0.05	Shrimp gill net
Mullet	34.1	0.05	Mullet gill net
Whiting	2,290.3	3.48	Whiting gill net
Fourfinger threadfin	89.9	0.14	Threadfin gill net
Indian mackerel	8.6	0.01	Mackerel gill net
Bigfin reef squid	27,531.9	41.85	Squid trap
Cuttlefish	4,608.2	7.00	Squid trap
Cobia	83.1	0.12	Handline
Spanish mackerel	127.0	0.19	Handline
Barracuda	4.7	0.01	Handline
Red snapper	7.0	0.01	Handline
John's snapper	3.4	0.01	Handline
Others	20.7	0.03	Handline
Grand total	65,787.7	100.00	
Total fish	2,699.6	4.10	
Total crab	22,746.9	34.58	-
Total prawn	8,201.1	12.47	
Total squid	32,140.1	48.85	

Given that the Ban Krachae-Kungkraben Group was considered as representative of this area, it was felt necessary to get more information for the operating area of each gear by each fishing village because of variations in the fishing gear composition. However, this fishing area for small-scale fishing gear is not extensive, so, resources for small-scale fishing gear in this area can be presumed as stated below.

Blue swimming crab caught by crab gill nets, banana prawn by shrimp gill nets, and bigfin reef squid and cuttlefish by squid traps were considered important resources for small-scale fishing gear in Ban Krachae-Kungkraben area. On the other hand, the fish catch was small, but prices of certain species, especially Spanish mackerel and snappers, were higher. Of fish, therefore, whittings were the most important fish resource from the point of view of catch quantity, whereas snappers were considered important from the point of view of price. Groupers and parrot fishes, which are high-priced, were not recorded at the Ban Krachae-Kungkraben group, but these two species groups were recorded to be caught by fish traps and handlines around the artificial fish reefs in Rayong Province (Sinanuwong *et al.*, 1986). As fish traps and handlines were operated at other fishing villages in Rayong Province, these species groups were also considered to be important fish resources for small-scale fishing gear in this area. Three types of non small-scale fishing gear were operated at certain villages, and their catch of anchovies, Spanish mackerels and squids were considered important resources for non small-scale fishing gear in this area.

A more detailed discussion about the resources in this area will follow when data collected on the operation area of each fishing gear and catch quantity by other fishing gear apart from those found at the Ban Krachae-Kungkraben fishing villages. Also, data from several years will be necessary for further analysis. Because data from the buying records only can be obtained, full information on the fishermen's activities cannot be represented.



Seasonal variations of four main kinds of fishing gear are shown in Table 11-14. Three types, with the exception of the shrimp gill net, were operated less frequently in June and July because these two months are affected by the strong Southwest Monsoon. However, shrimp gill nets were operated during this time because of the coastal setting of the gear. Therefore, shrimp gill nets can be considered very important fishing gear throughout the year, and especially so during the period of the Southwest Monsoon (usually from March to September).

We calculated CPUEs (kg/boat/day) of four fishing gear, but as catch quantity and effort were not considered, it is necessary to formulate a suitable method to be applied to these small fishing villages.

#### SUMMARY

1. Fishing gear at six fishing villages in Ko Man Group area, eastern coast of the Gulf of Thailand as of 1984 were described. All fishing gear was separated into small-scale fishing gear and non small-scale fishing gear in this area for the purpose of this paper. Over 15 kinds of small-scale fishing gear and three kinds of non small-scale fishing gear were operated. The main small-scale fishing gear and non small-scale fishing gear operated in each fishing village are described on the basis of two sources together with the latest information as follows.

- (1) Tarua Klaeng — Main small-scale fishing gear were handlines, crab gill nets, fish traps and man-powered push nets, and non small-scale fishing gear were Spanish mackerel gill nets and stick-held cast nets for squids.

- (2) Ao Mahkhampon — Main small-scale fishing gear were crab gill nets and mackerel gill nets, and non small-scale fishing gear was anchovy purse seines.
  - (3) Ban Prasae — Main small-scale fishing gear were hand-lines and fyke nets, and non small-scale fishing gear was stick-held cast nets for squids. Ban Prasae is one of the home towns of modern tuna purse seiners in the Gulf of Thailand.
  - (4) Paknam Phangrat — Main small-scale fishing gear were man-powered push nets and mullet gill nets, and non small-scale fishing gear was stick-held cast nets for squids. Paknam Phangrat is one of the shrimp trawler bases in the area.
  - (5) Ban Krachae — Main small-scale fishing gear were man-powered push nets, crab gill nets and shrimp gill nets; there was no non small-scale fishing gear.
  - (6) Kungkraben — Main small-scale fishing gear were shrimp gill nets, man-powered push nets and squid traps (the total number of small-scale fishing gear at this village accounted for 52% in this area).
2. The importance of the fishing gear and species group at the Ban Krachae-Kungkraben fishing villages as of 1982 were examined on the basis of catch quantity and modified value.
- (1) Squid traps and crab gill nets were considered important fishing gear from points of view of both catch quantity and modified value in this area.
  - (2) Shrimp gill nets were also considered important fishing gear from the point of view of modified value.

- (3) Bigfin reef squid ( *Sepioteuthis lessoniana* ), blue swimming crab ( *Portunus pelagicus* ) and cuttlefish ( *Sepia* spp.) were considered important species groups from points of view of both catch quantity and modified value.
  - (4) Banana prawn ( *Penaeus merguensis* ) was also considered an important species from the point of view of modified value.
  - (5) Whittings ( *Sillago sihama* and *S. maculata* ) caught by whiting gill nets were the most important fish species from the points of view of both catch quantity and the modified value.
  - (6) In non small-scale fishing gear, Spanish mackerel gill nets, anchovy purse seines and stick-held cast nets for squids were operated. And achoolies, Spanish mackerels and squids were considered important resources for non small-scale fishing gear.
3. Seasonal variations of the four main fishing gear; crab gill nets, shrimp gill nets, whiting gill nets and squid traps at the Ban Krachae-Kungkraben fishing villages were shown. Also, calculated CPUEs of above four fishing gear were shown.



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