

**Small-scale fishing gear used in the artificial reef areas,
Ranong Province, Thailand**

by

P Aksomboon

*Fishing Gear Development Unit,
Andaman Sea Fisheries Development Centre,
Department of Fisheries, Thailand*

16. INTRODUCTION

Artificial reefs (AR) were installed in Ranong Province for a variety of reasons:

- They would effectively prevent trawlers from operating within the 3 km coastal belt and would reduce operational costs of patrolling the regulated coastal fishery areas.

They would be an effective tool to conserve living resources.

They would effectively extend suitable breeding and living grounds for demersal species.

They would be a submerged fish aggregating structure, enabling small-scale fisherfolk living near the artificial reef areas to increase their income by catching more fish with reduced effort.

The objectives of the study were:

- To identify changes in the composition of fishing gear, methods of operation and gear population, as a result of the installation of artificial reefs in Ranong.
- To determine the effect of artificial reefs on the traditionally used gear in the area.
- To examine the options for introducing suitable gear for small-scale fisherfolk to operate near the artificial reef.
- To carry out experimental/test fishing with selected fishing gear to determine technical viability.

17. METHODOLOGY

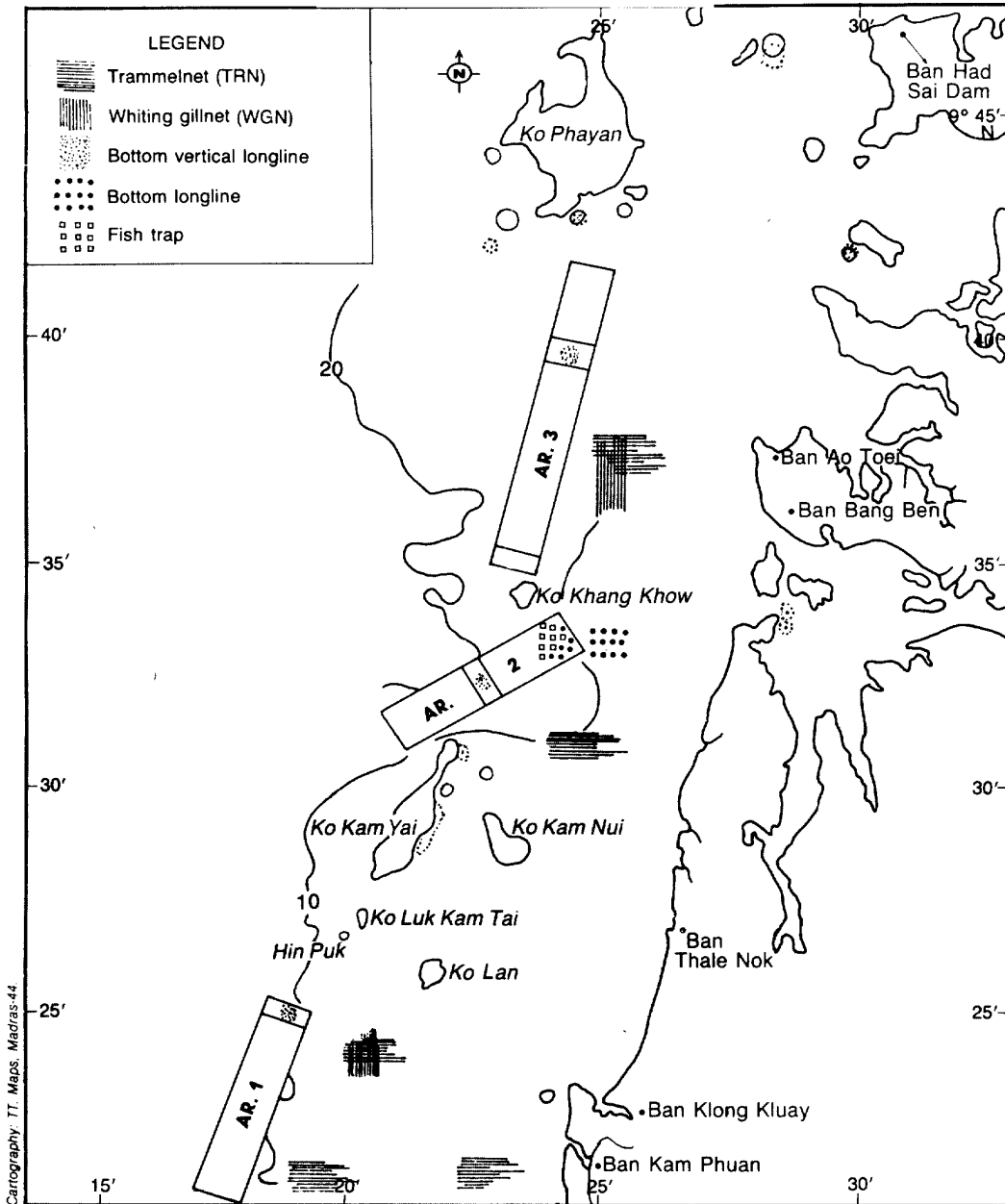
17.1 Fishing gear survey

Information on types, numbers, cost, material etc. of fishing gear was collected by interviewing fisherfolk. Data obtained from this survey was compared with data obtained from a survey conducted by the Department of Fisheries in 1987 (DOF, 1987), prior to installation of artificial reefs.

17.2 Fishing gear trials

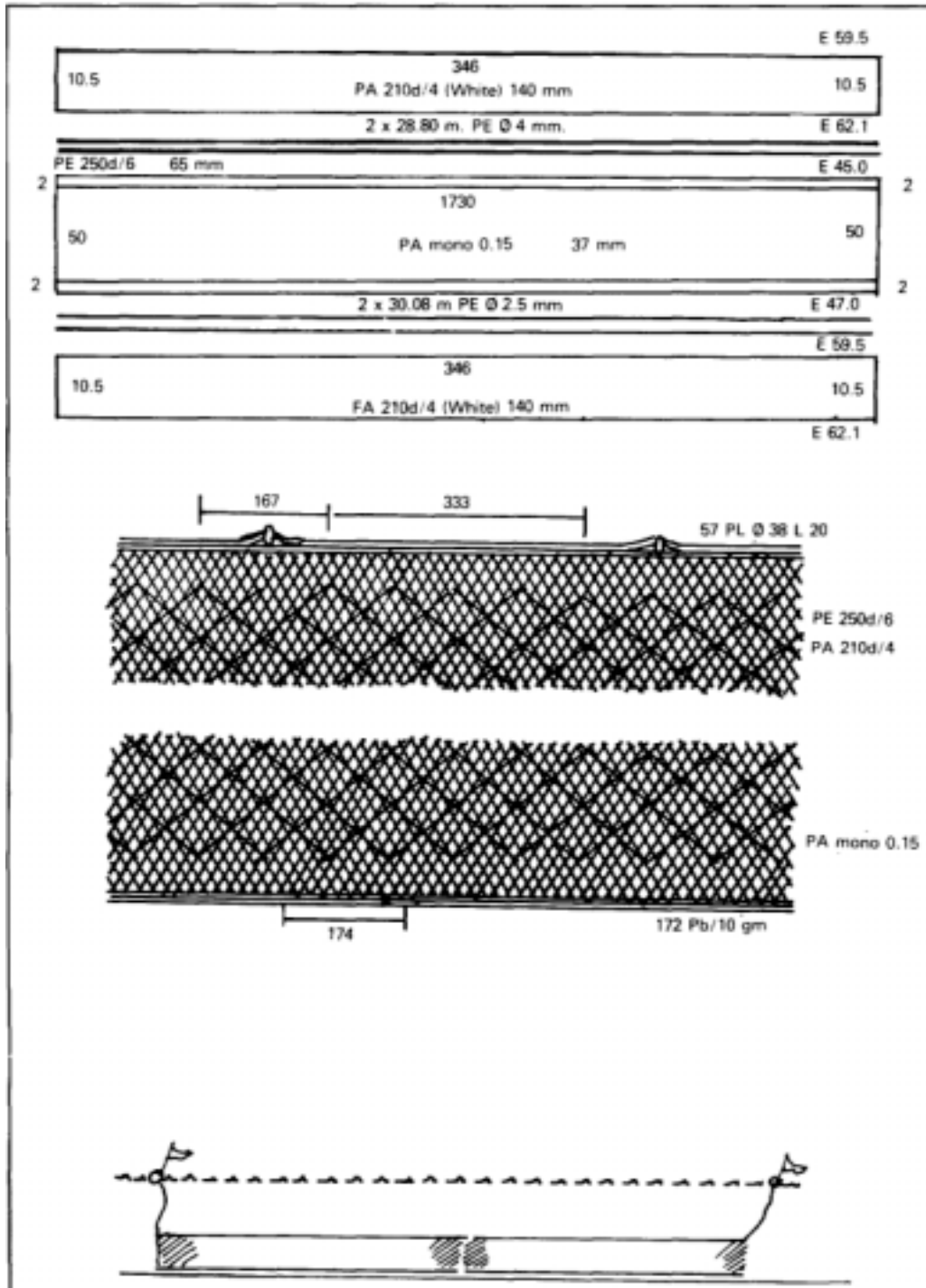
Five fishing gear, including the trammelnet, whiting gillnet, bottom vertical longline, bottom longline and fish trap were selected for trials to determine their efficiency in the artificial reef areas. The bottom vertical longline, bottom longline and fish trap were selected as they were expected to be more suitable in artificial reef areas than the bottom drift gillnet. The trammelnet was selected to confirm its efficiency at catching shrimp and for further development of the net. The whiting gillnet was selected to study its efficiency when its depth was reduced as a measure of reducing cost. The trials were carried out at the sites shown in Figure 25.

Fig 25. Fishing grounds for experimental gear at artificial reefs (ARs) in Ranong Province, Thailand



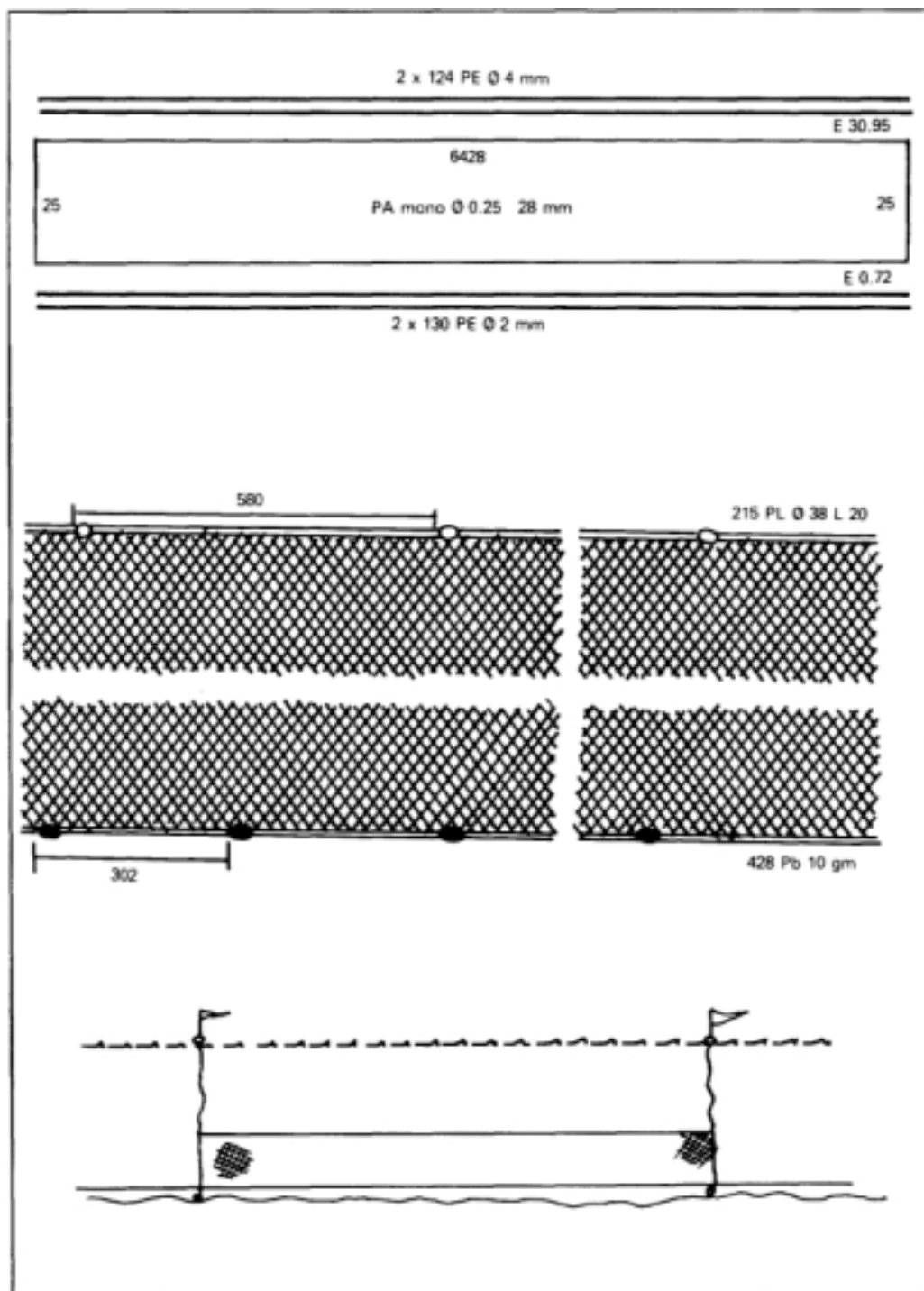
Trammelnet (Figure 26). This gear is commonly used in shrimp fishing. The inner net, 3.7 cm. mesh size, is of monofilament nylon of diameter 0.15 cm, whereas the outer net, 14 cm. mesh size, is of multifilament 210d/4 nylon. The hanging ratio of the inner net is 0.45 on the float line, while the hanging ratio of the outer net is 0.59. Fishing operations were carried out during the day by placing the net across the tide and allowing it to drift with the tide for 30 minutes to one hour before hauling.

Fig 26. Trammelnet specifications



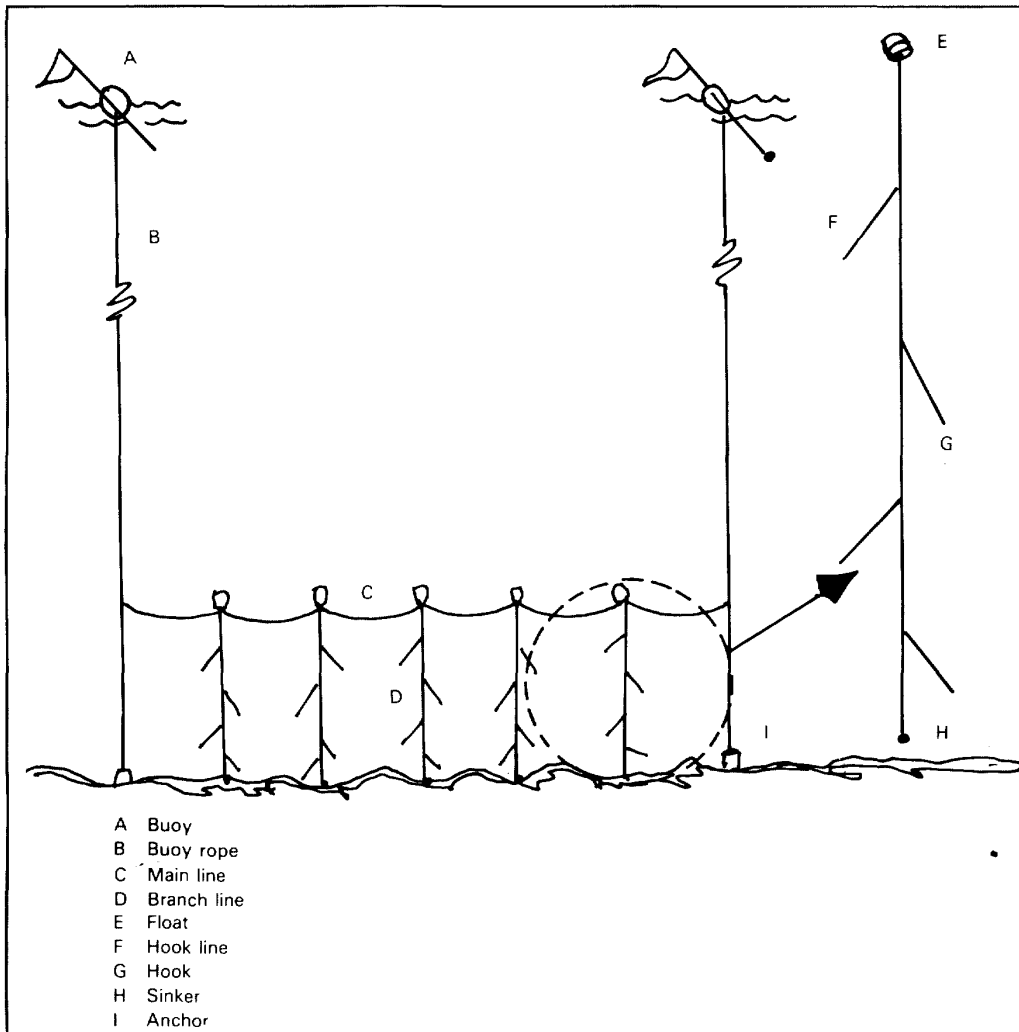
Whiting gillnet (Figure 27). The netting, 2.8 cm mesh size, is of 0.25 mm diameter monofilament nylon. The hanging ratio is 0.31 on the float line and 0.28 on the sinker line. Fishing operations were carried out during the day. The net was shot across the tide and allowed to drift with it for one hour, before hauling.

Fig 27. Whiting gillnet specifications



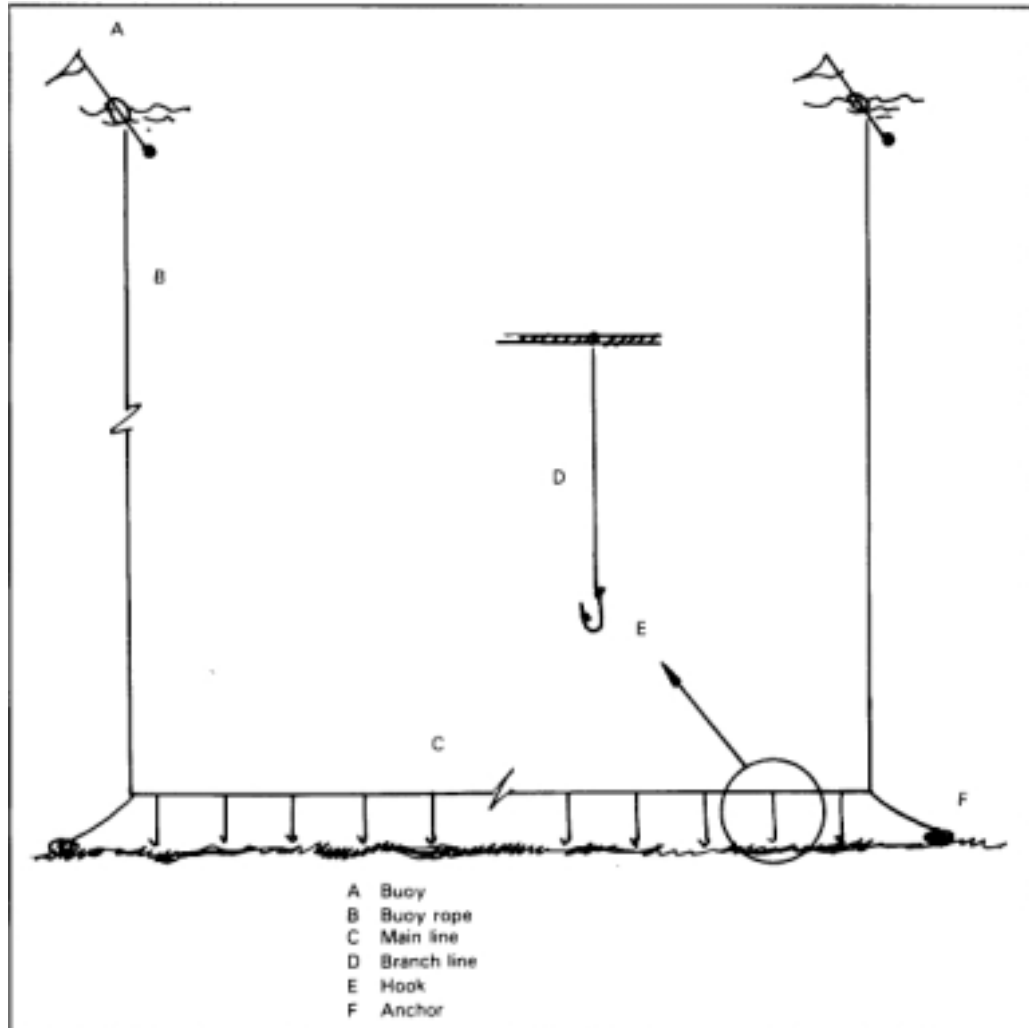
Bottom vertical longline (Figure 28). The main line of this gear is of 5.5 mm. vinylon and the branch line is of 210d/60 nylon. The interval between each branch line is 15 m. Each branch line is 5 m long and to it are connected four 60 cm-long hook lines at 1 m intervals. Nylon monofilament No. 60 (0.74 mm) is used for the hook line which is connected to a No. 8 hook. The branch lines are stored in specially designed boxes made of wood and plastic plates with a rubberized rim around the top. Three branch lines are stored per box, each separated by a thin sheet of canvas.

Fig 28. Bottom vertical longline arrangement



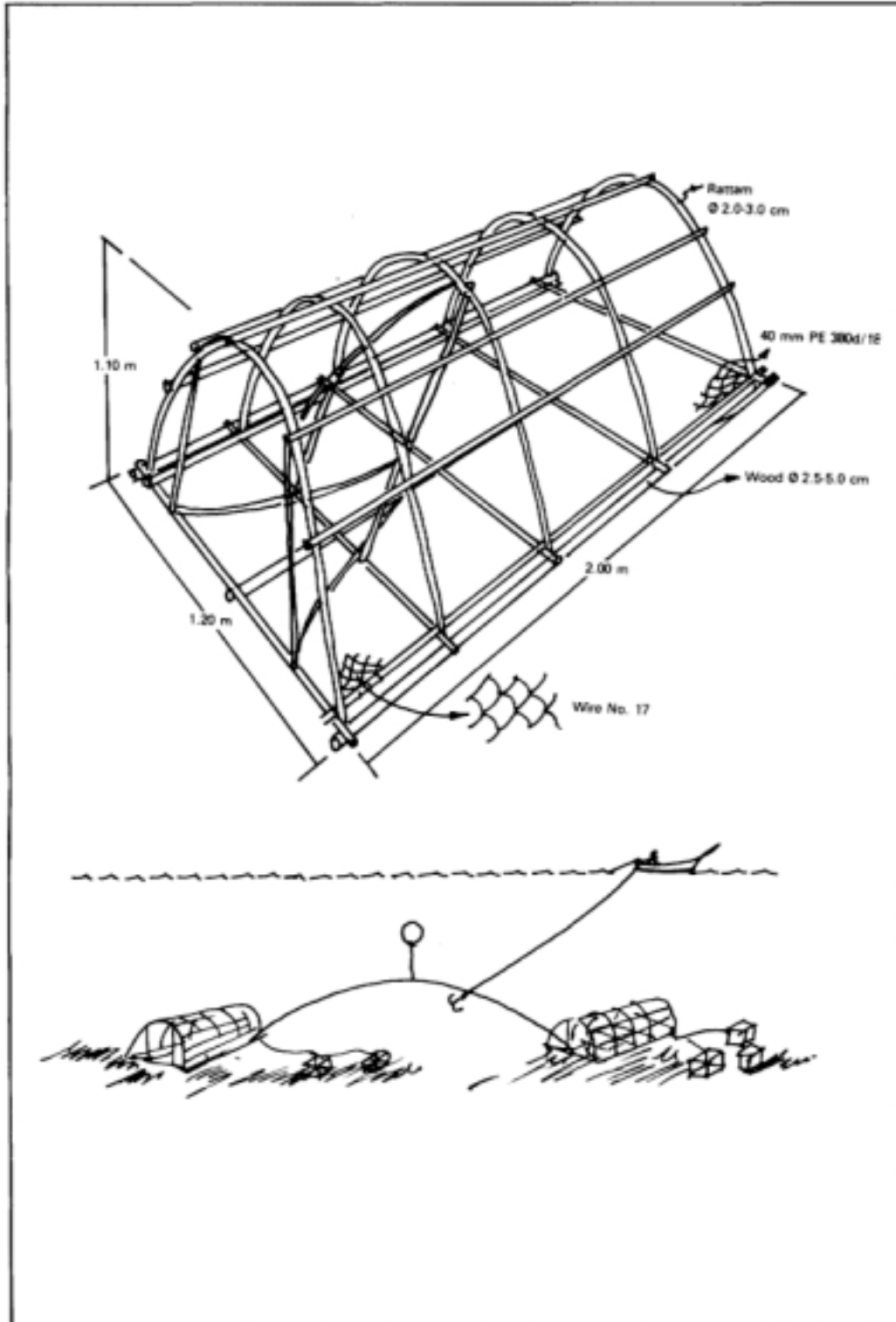
Bottom longline (Figure 29). The main line of this gear is 4 mm vinylon, while the branch line is 380/36 polyethylene. The interval between branch lines is 2.5 m. Hook No. 5 is used on the branch line.

Fig 29. Bottom longline arrangement



Fish trap (Figure 30). This is a semi-cylindrical trap. The frame is made of wood and rattan covered with wire netting (wire No. 17). The entrance is wedge-shaped. The size of the trap is 2 m long, 1.2 m wide and 1.1 m high. No bait is required for the fishing operation..

Fig 30. Fish trap specifications



17.3 Fishing gear demonstration.

Based on the successful results of trials, suitable gear were demonstrated to the fisherfolk in the fishing villages adjacent to the artificial reef areas. Training was provided on making and operating the gear.

18. RESULTS

18.1 Fishing gear survey

The survey on fishing gear was carried out in six villages around the artificial reefs in Muang and Kapur Districts of Ranong Province in February 1992. Twentyfour (24) types of fishing gear (see Table 11 below and Table 12 on facing page) were found in the area and the major gear were trammelnet, crab gillnet, whiting gillnet, squid trap, grouper trap and scoopnet. Comparison with data from a survey conducted in 1987, by DOF (DOF, 1987), showed an increase in the number of gear types (7) after the installation of artificial reefs. The new gear recorded are gillnet (for threadfin, mackerel and sardine), stick-held castnet (for squid), crab trap, trollingline, bottom

Table 11: Type and number of fishing gear in six fishing villages around the three artificial reefs in Ranong Province in 1987 and 1992

Type of fishing gear	<i>Ban Thale Nork</i>		<i>Ban Kam Phuan</i>		<i>Ban Kiong Kluyay</i>		<i>Ban Bang Ben</i>		<i>Ban Ao Toei</i>		<i>Ban Sai Dam</i>		<i>Total</i>	
	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992	1987	1992
Trammelnet	4	-	22	80	40	60	3	15	5	40	28	90	102	285
Crab gillnet	-	-	-	10	-	-	-	20	-	40	3	100	3	170
Whiting gillnet	-	-	5	65	15	-	2	15	-	40	-	50	22	170
Threadfin gillnet	-	-	-	4	-	2	-	2	-	-	-	-	0	8
Mackerel gillnet	-	-	-	10	-	5	-	-	-	-	-	-	0	15
Sardine gillnet	-	-	-	5	-	-	-	-	-	-	-	3	0	8
Mullet gillnet	-	1	-	-	-	-	1	-	-	10	35	-	36	11
King mackerel gillnet	-	-	-	-	-	-	-	-	-	-	15	-	15	0
Pomfret gillnet	-	-	-	-	-	-	-	-	-	-	12	-	12	0
Pushnet	-	-	-	2	-	-	-	2	9	10	3	-	12	14
Small otter trawl with boom	-	-	7	10	-	-	-	-	-	-	10	-	17	10
Stick-held castnet	-	-	-	10	-	-	-	-	-	-	-	-	0	10
Grouper trap	-	-	-	10	-	20	1	3	-	10	37	40	38	83
Squid trap	-	-	4	70	-	40	-	3	-	-	3	15	7	128
Crab trap	-	7	-	-	-	-	-	20	-	20	-	3	0	50
Crab liftnet	-	-	-	20	15	2	22	-	15	-	75	20	127	42
Handline	-	3	-	10	-	-	10	15	3	10	50	-	63	38
Trollingline	-	-	-	20	-	-	-	-	-	-	-	-	0	20
Bottom longline	-	-	-	-	-	-	-	-	-	1	-	-	0	1
Setnet	13	-	-	-	-	1	-	-	-	-	8	-	21	1
Small set bagnet	-	-	-	5	30	30	-	-	-	-	-	-	30	35
Set bagnet	-	-	-	-	30	-	-	2	-	-	-	3	0	5
Scoopnet	19	25	9	20	-	-	25	30	8	40	2	10	63	125
Shrimp castnet	-	-	-	20	-	-	-	15	-	-	-	-	0	35
Total	36	36	47	371	100	160	64	142	40	221	281	334	568	1264

longline, set bagnet and shrimp castnet. Trammelnet, crab gillnet, whiting gillnet, pushnet, grouper trap, squid trap, small set bagnet and scoopnet appeared to have increased in numbers considerably. Mullet gillnet, king mackerel gillnet, pomfret gillnet, small otter trawl with boom, crab liftnet, handline and setnet had, on the other hand, decreased in number.

Gear used in the six villages had increased from 568 units in 1987 to 1264 units in 1992. Significant changes were evident in the Ban Kam Phuan, Ban Bang Ben and Ban Ao Toei.

It should be noted, however, that changes in types and numbers of the fishing gear were not due only to the presence of the artificial reef. There were other factors, such as the increasing number of fisherfolk, increasing prices and demand and the adoption of new technologies.

Table 12: Specifications of fishing gear, their average life and approximate cost in six villages near the ARs in Ranong Province

<i>Type of fishing gear</i>	<i>No. of fishing gear in six villages</i>		<i>No. of hooks/ No. of traps/ No. panels/set</i>	<i>Hook size/ Trap size/ Mesh size (cm)</i>	<i>Avg. lift (year)</i>	<i>Appx. cost (bht) per panel or piece</i>
	<i>1987</i>	<i>1992</i>				
Trammelnet	102	285	8-10/2-3	14 x 3.7 x 14	3-4*	300
Crab gillnet	3	170	20-40	10	1-3*	120
Whiting gillnet	22	170	6-10/1-3	2.8-3	2-3	450
Threadfin gillnet	.	8	8-10	5	3	1400
Mackerel gillnet	.	15	8-10	4.7	2-3	1000
Sardine gillnet	.	8	10	2.5-3	1-2	950
Mullet gillnet	36	11	10	3.5	1-2	800
King mackerel gillnet	15	.	15-30	8.7	3	800
Pomfret gillnet	12	.	10	11.2	2-3	400
Pushnet	12	14	1-2	2-4		1200-3000
Small otter trawl with boom	17	10	1-2	2-6		1800-4000
Stick-held castnet	.	10		2.5-3.2	1-2	10000-15000
Grouper trap	38	83	20-40	27 x 55 x 23	6*	60
Squid trap	7	128	20-100	75 x 100 x 70	2-4*	50-70
Crab trap	.	50	20-50	30 x 50 x 27		50
Crab liftnet	127	42	20-40	10	2-4	20
Handline	63	38	1-5	No.14 - No.2		30-100
Trollingline	.	20	1-5	No.8/U		50
Bottom longline	.		100-200/5-10	No.5		500-750
Setnet	21			2.5-4		2500-3000
Small set bagnet	30	35		0.2-3		1000
Set bagnet	.	5		1.5-5	1-2	3000
Scoopnet	63	125		0.2	3-5*	300
Shrimp castnet	.	35		2.5-3	2-3	700

- month

18.2 Fishing gear trials

Fishing gear trials were performed during May 1992 - May 1993 (refer Figure 25) and the following results were recorded

Trammelnet: Fifteen fishing operations were conducted at ARs 1,2 and 3 in May and August 1992; one at AR1, another at AR2 and 13 at AR3. Due to poor performance at AR1 and AR2, trials were concentrated close to AR3. The results showed relatively better performance at AR3 (Table 13) with a total catch rate of 257 g/panel, of which 95.6 g (37.22%) were shrimp (most of it *Penaeus merguensis*). The average total length of the shrimp was 14.04 cm (11.00 - 16.40 cm). The trials showed that the area close to AR3 has encouraging possibilities, but further trials for longer periods are necessary to establish economic feasibility.

Table 13: Species composition of marine animals caught by trammelnet at AR1, AR2 and AR3

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Date	8/5/92	9/5/92	22/8/92	22/8/92	23/8/92	22/8/92	23/8/92	24/8/92	24/8/92	23/9/92	23/8/92	23/8/92	24/8/92	24/8/92	24/8/92
Place	AR 2	AR 1	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3	AR 3
Depth	13	8	10	10	11	11	11	10	10	5	5	5	6	6	6
No. of panel	10	10	30	10	30	10	10	10	10	10	30	10	10	10	10
<i>Penaeus merguensis</i>	-	-	75	140	2170	1280	2635	1150	910	1300	700	630	35	100	250
<i>P.monodon</i>	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-
Other shrimp	-	-	-	10	175	70	310	200	160	15	70	-	10	-	-
Blue swimming crab	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Threespot swimming crab	-	-	-	-	-	150	-	-	-	45	-	-	-	65	-
Mantis shrimp	20	40	-	-	20	-	-	10	-	-	-	-	-	-	40
Mule male	130	50	85	-	-	-	-	-	-	20	80	30	-	-	-
<i>Selaroides (eptolepis)</i>	50	-	-	35	-	-	-	-	-	-	-	-	-	-	-
<i>Anodontostoma chacunda</i>	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ephippus orbis</i>	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-
<i>Scomberomorus</i> sp.	-	-	-	-	-	-	-	-	-	-	-	130	-	-	-
<i>Scoraberoides</i> sp.	-	-	-	-	-	-	-	-	-	-	40	-	-	-	-
<i>Rastrelliger</i> sp.	200	-	55	-	155	-	180	-	60	1050	530	40	480	-	395
<i>Sillago</i> sp.	40	-	-	40	20	-	-	-	-	-	-	-	-	-	-
<i>Polymenus</i> sp.	-	-	-	-	35	-	-	-	-	-	30	-	-	-	-
<i>Pomadasyys kaakan</i>	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-
<i>Aris</i> sp.	-	-	-	80	20	-	-	-	-	15	-	-	-	-	-
<i>Nemipterus</i> sp.	330	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ilisha</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-
<i>Trichiurus</i> sp.	-	-	-	75	1135	70	2030	550	700	-	150	-	-	-	-
<i>Terapon</i> sp.	-	-	100	380	2200	40	-	-	-	-	-	-	-	-	-
<i>Siganus</i> sp.	30	10	-	-	20	-	-	-	-	-	-	-	-	-	-
<i>Thryssa</i> sp.	-	-	40	105	830	10	50	10	460	555	70	10	350	-	100
<i>Gerres</i> sp.	80	100	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Dasyatis</i> sp	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Apogon</i> sp.	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sardine</i>	400	-	-	-	-	-	30	100	-	-	-	-	-	-	10
<i>Croaker</i>	-	-	55	190	2860	470	120	100	1150	100	50	-	30	50	80
<i>Slipmouth</i>	780	30	720	195	140	20	110	150	15	10	15	-	15	-	-
<i>Flathead</i>	110	10	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sole</i>	-	-	-	-	-	-	15	10	10	-	-	-	-	-	-
Total	3080	240	1130	1250	9780	2110	5520	2280	3465	3110	1785	880	1020	225	865

Note: Average total length of *P. merguensis* is 14.04 cm. (11.0 - 16.4 cm). Price of *P. merguensis* is 95-105 baht/kg.

Whiting Gilinet: One fishing operation was performed at AR1 and four at AR3 in May 1992. The results (Table 14) indicate that performance at AR1 was relatively poor compared to that at AR3, where there was a total catch rate of 589.4 g/panel, of which 305 g (51.75%) were whiting (*Sillago* sp.). The trials should, however, be extended over a longer period at AR1 before conclusions are drawn on the viability of establishing this fishery at AR1.

Table 14: Species composition of marine animals caught by whiting gillnet at AR1 and AR3

No.	1	2	3	4	5	
Date	10/5/92	10/5/92	11/5/92	12/5/92	13/5/92	
Place	AR1	AR3	AR3	AR3	AR3	
Depth	8	11	11	11	11	
No. of panels	8	4	4	4	4	Total
<i>Sillago</i> sp.	30	850	3630	170	230	4910
<i>Atule</i> mate	60	-	-	-	-	60
<i>Selaroides leptolepis</i>	110	-	-	-	20	130
<i>Sphyræna</i> sp.	-	-	-	190	240	430
<i>Carangoides</i> sp.	-	-	10	-	-	10
<i>Scolopsis</i> sp.	-	-	50	-	-	50
<i>Terapon</i> sp.	-	-	30	-	-	30
<i>Gerres</i> sp.	-	40	70	-	10	120
<i>Saurida</i> sp.	-	40	190	20	-	250
<i>Nemipterus</i> sp.	70	10	-	-	-	80
<i>Thryssa</i> sp.	-	-	-	200	100	300
<i>Apogon</i> sp.	20	-	-	-	-	20
Croaker	-	-	60	-	-	60
Flathead	-	30	40	50	-	120
Goatfish	-	80	790	50	50	970
Sole	20	-	30	80	-	130
Sardine	20	-	150	-	-	170
Slipmouth	360	260	30	-	20	570
Goby	50	80	-	20	-	150
Leatherjacket	10	-	220	1250	40	1520
	750	1390	5300	2030	710	10180

Note: Average total length of whiting is 14.86 cm. (12.1 - 20.4 m.)

Price (baht/kg.) of whiting is 35 baht.

Bottom vertical longline: Nine fishing operations were conducted at ARs 1, 2 and 3. The average catch rate per box of hooks (12 hooks) was 81.6 g (Table 15). Most of the catch was commercially valuable and included species such as snapper, grouper, emperor and silver grunt. But economic viability of the new fishery at all three ARs is still not conclusive.

Table 15: Species composition of marine animals caught by bottom vertical longline at AR1, AR2 and AR3

No.	1	2	3	4	5	6	7	8	9										
Date	7/5/92	8/5/92	9/5/92	10/5/92	11/5/92	12/5/92	27/2/93	27/12/93	21/4/93										
Place	AR3	AR2	AR1	AR1	AR1	AR1	AR2	AR2	AR2	Total									
Depth	12	20	13	13	1	13	21	14	13										
No. of hooks (box)	15	5	5	10	10	8	10	10	10										
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.							
<i>Lutjanus vitius</i>	1	400	-	-	-	-	-	-	-	-	-	400							
<i>Ephinephelus lauvina</i>	-	-	-	1	130	-	-	-	-	-	2	750							
<i>E. bleekeri</i>	-	-	-	1	70	-	1	300	-	-	1	350							
<i>E. fasciatus</i>	-	-	-	-	1	290	-	-	-	-	-	290							
<i>E. erythrus</i>	-	-	-	-	1	350	1	180	-	1	240	3							
<i>Lethrinus</i> sp.	-	-	-	-	1	550	-	-	-	-	-	550							
<i>Pomadesys kaakan</i>	-	-	-	-	-	-	1	550	1	700	1	550							
<i>Arius</i> sp.	-	-	-	-	-	-	2	380	-	-	-	2							
Conger eel	-	-	-	-	-	1	150	-	-	-	-	150							
Total	1	400	0	2	200	3	1190	3	630	5	1680	2	940	2	900	2	830	20	6770

Note: Price — *E. tauvina* 40 baht/kg; *E. bleekeri* 30 baht/kg.

Bottom longline: Eight fishing operations were conducted at AR2 in November and December 1992 and in January, February and April 1993. Six species of fish were caught and the major catch was of shark and skate (Table 16). The results were **encouraging, but additional trials are required** for a full fishing season to establish economic viability.

Table 16: Species composition of marine animals caught by bottom longline at AR2

No.	1		2		3		4		5		6		7		8		Total	
Dale	18/11/92		19/11/92		19/11/92		4/12/92		5/12/92		18/1/93		28/2/93		22/4/93			
Place	AR2		AR2		AR2		AR2		AR2		AR2		AR2		AR2			
Depth	21		21		21		11		11		21		20		21			
No. of hooks (box)	600		600		600		600		600		600		500		500			
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Pomadesys																		
<i>kaakan</i>	13	19680	3	3560	10	11050	-	-	-	-	4	5000	10	14400	7	9750	47	63440
<i>Luijanus johni</i>	1	900	-	-	-	-	-	-	-	-	-	-	1	700	-	-	2	1600
<i>L. malabaricus</i>	2	1780	1	950	1	800	-	-	-	-	-	-	1	800	1	750	6	5080
Ephinephelus																		
<i>tauuina</i>	-	-	-	-	-	-	-	-	-	-	2	3000	-	-	-	-	2	3000
Carcharhinus																		
<i>albimarginatus</i>	2	4900	3	8400	2	5600	1	2600	2	4600	-	-	3	7900	2	5200	15	39200
Skates	1	14000	-	-	1	8000	15	132000	12	117000	3	30000	3	25000	1	11000	36	337000
Total	19	41260	7	12910	14	25450	16	134600	14	121600	9	38000	18	48800	11	26700	108	449320
Note: Price (baht/kg.)																		
			<i>P. kaakan</i>	25														
			<i>L. johni</i>	30														
			<i>L. malabaricus</i>	25														
			<i>E. tauuina</i>	40														
			<i>C. albimarginatus</i>	4														
			Skates	6														

Fish trap: Five fishing operations were conducted at AR2 in November 1992 and during April/May 1993. The results showed a high catch rate (Table 17). Average catch per trap was 6955.7 g. Most of the catch were commercially valuable fish, such as grouper, snapper etc.

Table 17: Species composition of marine animals caught by fish trap at AR2

No.	1		2		3		4		5		Total	
Date	19/11/92		8/4/93		18/4/93		23/4/93		1/5/93			
Date of hauling	28/11/92		18/4/93		23/4/93		1/5/93		18/5/93			
Place	AR2		AR2		AR2		AR2		AR2			
Depth	20		21		21		21		21			
No. of panels	1		2		2		2		2			
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
<i>Pomadesys kaakan</i>	-	-	3	4000	1	1300	3	4700	4	6200	11	16200
<i>Luijanus johni</i>	-	-	2	1800	3	2800	5	4900	2	1700	12	11200
<i>L. malabaricus</i>	3	3300	2	2700	-	-	1	1400	-	-	6	7400
<i>Ephinephelus tauuina</i>	2	2300	-	-	1	700	1	1100	-	-	4	4100
<i>E. bleekeri</i>	1	900	1	800	-	-	-	-	1	700	3	2400
<i>Carangoides</i> sp.	3	9000	-	-	-	-	-	-	1	3300	4	12300
Skates	-	-	1	9000	-	-	-	-	-	-	1	9000
Total	9	15500	9	18300	5	4800	10	12100	8	11900	41	62600
Note: Price												
			<i>P. kaakan</i>	25 baht/kg								
			<i>L. johni</i>	30 baht/kg								
			<i>L. malabaricus</i>	25 baht/kg								
			<i>E. tauuina</i>	40 baht/kg (Live 200 baht each)								
			<i>E. bleekeri</i>	30 baht/kg								
			<i>Carangoides</i> sp.	20 baht/kg								
			Skates	6 baht/kg								

18.3 Fishing gear demonstration

The catch made by the experimental fishing gear at all three ARs is tabulated below. Some of the catch figures are encouraging.

Table 18: Catch made by experimental fishing gear at ARI, AR2 and AR3

Fishing gear	Area	No. of experiments	No/set	Total catch (g)	Total catch of target species (g)	Avg. catch	Avg. catch	Percentage catch of target species
						per piece, trap box or 100 hooks	of target species per piece, trap box or 100 hooks	
Trammelnet	ARI	1	10	240	0	24	0	0
	AR2	1	10	3080	0	308	0	0
	AR3	13	10	33,420	12,435	257.08	95.65	37.21
Whiting gillnet	AR1	1	8	750	30	93.75	3.75	4
	AR3	4	4	9430	4880	589.38	305	51.75
Bottom vertical longline	AR1	4	8.25	3700	3170	112.12	96.06	85.68
	AR2	4	8.75	2670	2670	76.28	76.28	100
	AR3	1	15	400	400	26.67	26.67	100
Bottom longline	AR2	8	5.75	449,320	449,320	9767.82	9767.82	100
Fish trap	AR2	5	1.8	62,600	62600	6955.56	6955.56	100

Due to the short duration of the project, however, the establishment of economic viability, to convince the fisherfolk, could not be achieved. Demonstration of some of the methods could also not be completed. However, fish trap construction was demonstrated and net-making materials were provided to three fisherfolk in one fishing village.

19. CONCLUSIONS

- Increase in the number of fishing gear units in the villages adjacent to the artificial reef areas may not be entirely due to the installation of the artificial reefs.
- Installation of the artificial reef has deterred the operation of trawls and gillnets, though not completely.
- Environmental conditions around the artificial reef have not changed enough to cause any significant difference between the operations of each type of fishing gear.
- Trammelnet and whiting gillnet were found to be suitable for operating on the shore side of the artificial reef, especially in the AR3 area, but some changes to the depth of the nets are needed.
- Bottom longline and fish traps are suitable gear to be introduced in artificial reef areas.
- Bottom vertical longline, on the other hand, did not show encouraging results near the artificial reef.
- More extensive trials are required to establish economic viability of these methods and to encourage participation by the fisherfolk.

20. REFERENCES

- DOF. (1987). *Work plan for small-scale fisheries development in Ranong Province*. Department of Fisheries, Ministry of Agriculture and Cooperatives, Bangkok, Thailand. 62 p.
- AOSOMBOON, P. (1993). *Study on efficiency of the trammelnet*. Technical paper No. 15/1993, Andaman Sea Fisheries Development Centre, Marine Fisheries Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. Phuket, Thailand. 27 p.