STUDY REPORT
OF THE
REGULAR COURSE TRAINEES
AND SPECIAL TRAINEES
IN
FISHING TECHNOLOGY AND RESOURCE CONSERVATION
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SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
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Study Report of the Capture and Fishing Technology of Myanmar

1. Introduction.

The Union of Myanmar is endowed with the rich natural resources including sustainable arable land, vast and under exploited marine resources. Myanmar is one of the Southeast Asian Countries situated between Latitude 9° 30′ N and 28° 31′ N. Myanmar has a long coastline about 2831.84 kilometers with continental shelf area 228781 square kilometers. the EEZ extend the seaward to the distance of 200 nautical miles from the baseline. It is about 486,000 square kilometers.Fishery resources of our Myanmar are very widely known in Southeast Asia. There are a large quantities of fishes and shrimps resources within the EEZ, which has been an important role of the livestock and Fishery sector in Myanmar.

2. Policy and Objectives.

Sectoral policies and principle objectives of Livestock and Fisheries Sector are :

1. To promote all round development in the livestock and fishery sector.
2. To increase meat and fish production for domestic consumption and share the surplus with neighboring countries.
3. To encourage the expansion of aquaculture.
4. To upgrade the socio-economic status of livestock and fisheries communities.

3. Myanma Marine Resources.

The fisheries sector is considerably important in Myanma economy as fish constitutes a major source of animal protein in the diet of the people. The country is endowed with rich and varied marine and inland fisheries resources with a production (potential sustainable yield) of about 1.05 million metric tons per year from marine resources only. About 73 percent of total production come from marine fisheries, another 27 percent come from freshwater frisheries. Current status of exploitation amount to only 0.61 million metric tons leaving a large potential for further development.

4. Previous Resources Surveys.

A number of surveys conducted since 1968 in the marine water of Myanmar. Most of the survey are Exploratory nature and oriented to study the marine fish resources. In 1980 during the R.V Dr Fridtjof Nansen survey period, through an acoustic study of the pelagic stock was estimated. The resources survey terminal report occured (1984) estimation was 310,000 to 550,000 tons as potential yield. The last survey is **"the first joint Meaner-Thai fishery exploratory survey"** by **FRT. Chulabhorn** during 3rd Nov: 1989 to 9th Jan: 1990. That survey carried out the pelagic and demersal resources and other oceanographic survey also.

The species that are presently exploited and mainly consists of the demersal fishes and shallow water esturine species and also some midwater species. The most commercial or abundantly exploited species are as follow which constitutes about 72.84 % of the Total production from demersal trawl fishing. The species below are capture of the trawl fishing.

Scientific name	Local name
1. Nemipterus japonicus	Japanese threadfin bream.
2. Cynoglosus semifaciatus	tounge sole.
3. Johnius carouna	caroun croaker
4. Leiognathus sp.	pony fish.
5. Ilisha elongata	ilisha shad.
6. Arius caelatus	engraved cat fish.
7. Arius thallassinus	giant cat fish.
8. Arius maculatus	spotted cat fish.
9. Osteogeniosus militaris	soldier cat fish.
10. Chrysochir aureus	reeve's croaker.
11. Opisthopterus tardoore	tardoore.
12. Upeneus sulphurus	sulphur goat fish.
13. Thryssa sp.	thryssa.
14. Saurida elongata	brushtooth lizard fish.
15. Loligo sp.	long barrel squid.
16.Coilia dessumieri	gold spotted grenadier anchovy.
17. Lepthuracanthus savala	savalani hairtail.
18. Lactarius lactarius	false travelly.
19. Apogon sp.	apogon.
20. Otolithes ruber	tiger toothed croaker.
21. Terapon jarbua	jarbua terapon.
22. Stolephorus indicus	indian anchovy.
23. Dussumeria acuta	rainbow sardine.
24. Decapterus macrosoma	round scad.
25. Pennahia macrophthalmus	big eye croaker.
26. Pampus argenteus	silver pomfret.
27. Chirocentrus dorab	dorab wolf herring.
28. Megalepis cordyla	hard tail scad.
29. Priacanthus tayenus	purple spotted big eye.
30. Polynemus sextarius	black spot threadfin.
31. Sepia sp.	cuttle fish.
32. Tetrodon sp.	puffers fish.
33. Pentaprion longimanus	longfin mojarra.
34. Pomadasys maculatus	blotched grunt.
35. Formio niger	black pomfret.
36. Psettodes erumei	indian halibut.
37. Congresox talabon	yellow pike conger.
38. Dasyatis kuhlii	bluespotted stingray.
39. Caranx ignobalis	yellow fin jack.
40. Sphyraena jello	pickhandle burracuda.
41. Sharks	shark.

42. Scomberomorus guttatus	indo-pacific king mackerel.
43. Harpodon nehereus	bambay duck.
44. Pomadasys hasta	linded silver grant.
45. Scomberomorus commerson	narrow barred spanish mackerel.
46. Platycephalus indicus	bartail flat head.
47. Aleps djeddaba	djeddaba crevalla.
48. Epinephalus sp.	spiny cheek grouper.
49. Terapon puta	smallscaled terapon.
50. Polynemus indicus	indian threadfin.
51. Lutjanus johnii	john's snapper.
52. Sillago sihama	silver sillago.
53. Sardinella gibbosa	gold strip sardinella.
54. Carangoides chrysophry	long nose trevally.
55. Carangoides malabaricus	malabar trevally.
56. Drepana puntata	spotted sickle fish.
57. Saurida undosquamis	Lizard fish.

The other species out of the above mentions, are caught by purse seine. Sometime we caught as a by-catch or as a incidental catch of the bottom trawl, shrimp trawl, drift net or trammel gill net. And they caught also cephalopods, shark and rays as a by-catch.

The species below are targeted fishes of the purse seine fishing.

Scientific name	**Local name**
1. Hilsa ilisha	hilsa shad.
2. Rastrelliger kanaguta	indian mackerel.
3. Rastrelliger brachysoma	short body mackerel.
4. Dussumeria acuta	rainbow sardine.
5. Decapterus macrosoma	round scad.

Major shrimp species exploited are as follows:

Scientific name	**Local name**
1. Penaeus monodon	giant tiger shimp.
2. Penaeus semisulcatus	green tiger, flower shrimp.
3. Penaeus merguiensis	white, banana shrimp.
4. Penaeus penicillatus	redtail, white shrimp.
5. metapenaeus affinis	pink, jinga.
6. metapenaeus brevicornis	yellow shrimp.
7. metapenaeus dosbsoni	golden, kadal shrimp.
8. metapenaeus monoceros	pink, speckled shrimp.
9. Parapenaeopsis sculptilis	rainbow shrimp.
10. Parapenaeopsis stylifera	sharp rostrum, kiddi shrimp.

Among them Penaeus monodon is the most valuable and hence targeted species. The catch composition of the giant tiger shrimp,white shrimp ,pink shrimp and other are shown in pie chart month by month.

5. Marine Fisheries.

In Myanmar it can be classify into three region. They are Onshore fisheries,Inshore fisheries and offshore fisheries.

Onshore fisheries , where exist in the tidal mud flats and swamps caused by the ebb and flew. There were smallscale fisherfolk, who exploited that region with the indigenous fishing mechanism.

Inshore fisheries, it exist in the shallow water , 12 miles from the shore line or territorial sea or where shore line is visible and duration of fishing period is within one day. That area is mainly exploited by artisanal and smallscale fishermen using locally constructed small powered vessel with simple fishing gears.

Offshore fisheries, that area is beyong the visiblity of shore line and 12 miles offshore . The main targeted species are pelagic,mid water and demersal species. To exploite this areas requires large power vessel and advance fishing gears.

It can be divided three coast line region, upper potion Rakhine Coast, Middle Delta area and lower part is called Taninthayi Coast. The shelf area of Rakhine coast is 36619 sq kilometers, Delta area is 105367 sq kilometers, and the Taninthayi coast is 84701 sq kilometers.

6. Fishing Technology.

In Myanmar, The most famous and currently used the fishing gears are trawl fishing gear, purse seine fishing gear and the other fewly used are drift net, trammel gill net and traditional fishing gears .

(A). <u>Trawl Fishing.</u>

We can classify the trawl fishing to four kinds of categories.

1. Surface trawl (2 boats type)
2. Mid water trawl (1 boat and 2 boats type)
3. Bottom trawl (1 boat and 2 boats type)
4. Other towing net (beach seine, boat seine etc:)

it can be subdivide into three groups:

1. Bottom bean trawl.
2. Bottom otter trawl.
3. Bottom pair trawl.

But , in Myanmar we used the smooth bottom otter trawl, according to the our nature of marine topography situation, it can be modified again into 2 subgroups:

1. Smooth bottom otter stern trawl and
2. Rough bottom otter stern trawl.

Trawl net is basically a large bag made up of polyethylene netting which is drawn along the sea bed to scoop up on a near the bottom sea bed. It operating characteristic can be adjusted for use on various type of the bottom and for many species of fishes.

This net is a large bag shaped net, wide and one end, the mouth leading to the body of the net which tapers to the closed end, where the fish that enter through the mouth are trapped in the cod end.

The mouth of net is oval shape when viewed from the front.The two wings stretching out to increase the swept area, because of the two otter board and to guide fishes in the net's path down to the cod end.

Around the upper edge of the mouth, runs the head rope to which a number of floats, called Head rope are attached and around the bottom of the mouth is called ground rope which is fixed with weight or chains.The effectiveness of the head rope's floats and weighted ground rope, the trawl net mouth open vertically.

If the fishing ground is rough, it is need to use the iron,wooden, or rubber bobin (roller),its can assit to pass the net over the rough bottom.

The horizontal spread of the mouth is attained by the otterboard towed infront of the net set at an angle of attack to the towing direction, so it happened the outward force necessary to spread the wings to which are fastened.the otter board must be connected separated from them by a length of wire called the sweep line. The sweep line are connected to otterboard by backstrop and to the net by a bridle arrangement.

In Myanmar all the trawlers used the smooth bottom otter stern trawl net.

a.1. Trawl Fishing of Myanmar.

a.1.1. Type of Trawl Fishing Gear and fishing vessel.

Most of the fishing vessels of Myanmar are trawler are iron and wooden body stern trawlers.Their are government own and private own.The horse power their specifications of some trawlers are shown in table (1). The type of trawl net is smooth bottom otter stern trawl net type.

Table (1). **Specifications of the Myanmar Trawlers & Purse seiner.**

Vessel	Length	Breadth	Draft	G.T	Main Engine H.P	Body	Capaci-ty (viss)
DOF (2)	75.16ft	20.25ft	9ft	115.95	425	Wood	28000
DOF (3)	75.00ft	21.50ft	10ft	90.36	425	Wood	28000
DOF (9)	63.83ft	20.33ft	9ft	78.114	425	Wood	28000
DOF (11)	40.3mtr	7mtr	7ft	365	1500	Iron	20Tons

a.1.2. Equipment.

The equipment of stern trawler are radar, echosounder, fish-finder, hauling witches, hanging block or guiding block, capstan winch, power block and at stern two gallows are installed the both side of the vessel.

a.1.3. Season.

The trawl fishing season is all the season but the close seasons,June, July, August,(Rainny Season). Normally trawlers usually stay at sea, with out return back.

a.1.4. Fishing method and operation.

When the vessel arrived their desire fishing ground the gear is to be prepare for shooting, the vessel steams along the desire course, in to the wind. If the condition of the fishing ground, water depth, and fish school information are good or desirable, the cod end is thrown out and the working rope retied in their correct position on the head line and wings. By this way the net streamed from the stern and then sweep line run out. At that time otter boards are connected to the warp rope and unlocked from the gallow, all is ready for setting.

This duration may be accomplished by releasing the winch brakes simultaneously, so allowing the otter board to drop into the sea and it spread and can observe the warp line spereading satisfactorily or not and thewarp line must be released to the desire length. Normally they released the warp line 3 or 4 times of the depth of the water.

When hauling time the otter boards are hove up to the gallows and left hanging on the warp, being clamped if necessary to prevent slamming. The two sweep line were wound by winch to the ground rope. After the ground rope, wings, and the bellies of the trawl, also are hauled up to the stern and cod end is pulled to the fore deck emptying all of the catch.

a.1.5. Captures.

The capture of the marine fishes and monthly capture of the marine fishes are shown in table (2),(3) (4) and Fig (13). It can observe the decreasing capture of Meaner month by month according to the capture data. The good catch rate of the giant tiger shrimp Pennies monsoon is in October, but later on decrease sharply, in December and February a little rise again. But The catch rate of the Pink shrimps are low in October and in December increase again after December the catch is decrease. The condition of monthly capture of marine fishes and shrimps are shown in figure(1). And also can observe the monthly catch composition in percentage of the shrimps in figure (2), (3),and (4). In figure (5) , the percentage composition of shrimps in the month October '96 to March '97 is shown.

Product of Fish & Prawn (Myanmar)

Table.(2).

Years	Fresh water Fisheries	Marine Fisheries	Total
74-75	130	355	485
84-85	147	497	644
88-89	120	561	681
89-90	143	586	729
90-91	143	588	731
91-92	167	590	757
92-93	194	597	791
93-94	214	602	816
94-95	220	603	823
95-96	226	606	832
96-97	156	296	452

Table (3).

Monthly Catch of Shrimps by Trawlers.

Shrimp	Oct'96	Nov'96	Dec'96	Jan'97	Feb'97	Mar'97
Tiger	1941	188	873	239	522	315
White	2250	933	405	97	80	239
Pink	3626	4158	7418	5316	4549	5444
Other	8059	4589	3733	2088	1449	4350
Total	15876	9868	12429	7740	6600	10348

Table (4).

Monthly Catch of Marine Fishes by Trawlers

	Oct'96	Nov'96	Dec'96	Jan'97	Feb'97	Mar'97
Qual: fish	122972	76236	74814	35114	41555	69841
Tras: fish	109038	66361	48847	26594	34509	68106
Total	232010	142597	123661	61708	76064	137947

Table (5).

Family Wise Catch Analysis Table (DOF-3, Cruise 2/97-98)
(date 31-7-97 to 28-3-97)

Family name	Catch (kg)	Percentage
Arridae	879	5.02
Carangidae	606	3.46
Clupeidae	482	2.75
Leiognathidae	593	3.38
Lutjanidae	6	0.03
Mullidae	2136	12.2
Muraenesocidae	38	0.21
Nemipteridae	1367	7.8
Polynemidae	203	1.15
Pomadasyidae	84	0.47
Sciaenidae	2330	13.31
Scombridae	24	0.13
Synodontidae	1859	10.61
Stromatidae	692	3.95
Trichiuridae	2670	15.25
Dasyatidae & Shark	31	0.17
Cynoglossidae	185	1.05
Miscellaneous	3320	18.96
Shrimps	450	2.51
Total	**17952**	

And another way we can observe the decreasing of the Marine fish resources by analyzing the data of the 3 months catch. We can clearly seen the decreasing the fish resources in month of February '97. But at the time of catch decreasing among the all species, we can see the catch rate of some species are increased, the family Sciaenidae. It can observe at the figure (6). The catch composition of marine fishes (family wise) are shown at the figure (7).

(B). Purse Seine Fishing.

The purse is one of the most advanced typed of fishing gears for surrounding fish school used for catching pelagic fishes such as sardine, anchovy, mackerel, hard-tail scad, bonito and skipjacks. Targeted fish are pelagic fishes. The purse seine consist of pieces of rectangular netting which are connected each other side by side. The upper edge of the net are attached with floats and lower portion or sinker line with sinkers, attached with the purse ring. The purse line are running through the purse rings

The bunt or codend part of the net is generally located at the end of one of the wings. The bunt part is located at 2/5 of the length of the net from the left side wing, except in case of two boat type purse seine where the bunt part or codend is located in the middle.

Purse seine fishing methods are always improved, now a day the most purse seiners are equipped with the fish finder, sonar, scanning sonar,echosounder, radar, and some have a net hauler, power block, wireless instruments, fishing luring lamps, current meter, etc:..

We can classify the purse seine fisheries as follow:

1. one boat sardine purse seine fishery.
2. Two boats sardine purse seine fishery.

3. One boat horse mackerel and mackerel purse seine fishery.

4. Two boats horse mackerel and mackerel purse seine fishery.

5. One boat skip jack and tuna purse seine fishery.

6. Two boats skip jack and tuna purse seine fishery.

According to the point of view of the operation, and also according to the targeted species, it can be classified many kinds of purse seine, viz anchovy purse seine, sardine purse seine, bonito purse seine, coconut leaf shelter purse seine, light raft purse seine, etc:.

Base on their structure, they are divided into two groups:

b.1. With purse line.

The purse seine net with purse line is use for catching various pelagic fishes, depend on the meshes size, structure of the net method. It can divided two type again;

1. One boat type purse seine. and
2. Two boats type purse seine. (in Myanmar did not use this type.)

b.2. Without purse line.

The purse seine net without purse line is a surrounding net for catching anchovy, sardine, it is a smallscale fishery. The shallow area about 2-12 meters in depth near the coast or an island, it is like abeach seine net.

b.3. Purse Seine Fishing of Myanmar.

b.3.1. Type of Purse Seine Fishing Gear and fishing vessel.

Most of the myanmar purse seiners are wooden vessels. Some of the purse seiners has equipped with fish-finder, echosounder. Fish luring lamps but they did not used under water lamp.. Most of the master fishermen of Myanmar are like to use the traditional method by visual observation method, is still in use.

The purse seiners without fishfinder, they carried out the operation for several days around the full moon. The purse seiners with fishfinder can engage the fishing activity the whole year except during the close season and close area. Myanmar purse seiners are one boat type,which had installed with the purse line hauling winches, capstan winches, and also used the manpopwer about 40 crews members to haul it up.

In Myanmar, The fishing grounds which they operated are mostly shallower than 40 meter in depth. They caught the pelagic fishes as mackerel, round cad, pomfret, sardine, Ilisha species etc,.

b.3.2. Construction of the purse seine net.

The length and the depth of the purse seine net is varies to the size of the fishing boat, the fishing method, and the detection method of fish school. The mesh size also depends on the targeted fish.1-1.5 inches are suitable to catch sardine, mackerel,round scad, etc.,2.5-3.7 inches meshes net is good to catch bonito, skipjack, etc,.If you like to catch anchovy you need a minow net. Most of Myanmar purse seinenet's mesh size is 1 inche. The shape of the nets are basically the the same. The name of the parts of the purse seine are :

b.3.2.1. The webbing.

Cod end or bunt or bag.

This part is important part of the net where the fish collect in the final step of the fishing operation before being scooped into the the fish hole. This part should be strong, so the materials of the webbing used for this part must thicker than the other part.The bunt is located at the a point 2/5 of the net length and it is 20-30 meters deep. upper part of the bunt, the bigger floats must be attached to the float line, about 50-100 pieces of float. P.E.net 380d/9 or 380d/12 with a mesh size 1 or 0.75 inches is used for this part.

Net under the bunt.

The upper edge of this section is jointed to the bunt while the lower edge jointed to the lower selvage. The mesh size of this part is the same as that of the wing or body part, but twine size are bigger than that of the wing part. They usually used 1 inche mesh size and nylon No 210d/9 twine size.

Wing net or body net.

This is the largest part of the net, called the wing or body net for surrounding the fish school. Especially since the part located near the bunt should be bigger than that of the other. In Myanmar purse seine, some are 225 meters, sometime 300 meters long. They connected about 50 pieces, one pcs is 4.5 meters in length.In this part, there are many size of twine for webbing, 210d/4, 210d/6, 210d/ 9, are used. To catch the mackerel, big eye scad, hardtail scad etc; usually they used the 1 inch mesh size.

b.3.2.2. Selvage.

Selvage acts like a frame to prevent the body net and the bunt, being damaged during operation. So the larger size and stronger webbing twine should be used, it can divided into three groups.

Upper selvage.

The upper selvage is jointed to the float line while the lower edge is jointed to the body net and bunt part The mesh size used for the selvage is usually the same as that of the body net 1 inch or slightly bigger. The length of the selvage is equal to the length of the body net and bunt, while the meshes depth should be about 6-35 meshes

The lower selvage.

The lower edge is joined to the sinker line. The webbing materials and twine size are the same as those of upper selvage. However the mesh size of the lower selvage is not the same as that of the body netting, it is 2 inches meshes size.

In this part. Similarly the length of the lower selvage is equal to the body net, and the depth is 6-30meshes.

Side selvage.

The side selvage or side net is jointed to the wing net on one side and on the other it is attached to the side line. Usually the depth of this part should be less than that of the net by 3-3.5 times. Most of the purse seine net used PE webbing with a twine size and mesh size equal to that of the upper selvage. The number of meshes widths used varies from 20-35 or sometime ever 100-150 meshes.

b.3.2.3. Line or Rope.

Float line.

The float line is made up of two rope "S" twist and "Z" twist, 8-10 mm dia PE rope. One rope is inserted into the meshes of the upper edge of the selvage while the other rope has the floats and is attached to each other with mending twine.

Sinker line.

This sinker line is made up of the same things and way.As the same method of the float line one piece is inserted through the meshes of the edge of lower selvage while the other piece with lead sinkers, is attached to it with twine.

Side line.

The same materials and size of float line is used for side line both "S"and "Z" twist.One is inserted into the meshes of edge of the side selvage while the other is attached to the first rope. There are also plastic rings 0.5 cm thick, dia inside 3 cm, which are attached to the side line. The interval between ring is 1.5-2.5 meters along the side line.

Hand rope.

The 10-12mm dia PE rope is used for hand rope, which is pulling the side net by passing it through the plastic rings when hauling the purse seine net.

Braidle Rope.

The 6-12mm dia PE rope is used. One end of this rope is tied to the sinker line while the other end is tied to the purse ring. The length of this rope is 3-20 meters.

Usually the bridle rope has a ring on one end and is fastened to the sinker line at the other. There are two kinds of materials, one is synthetic fiber such as PE and kusmona, and the other is iron chain. The former is mainly used for conventional japanese purse seines and is about 10-18mm in dia and the latter is mainly used for modern large one boat purse seines for tuna and skip jack. The 124-240mtr chain are used.

Auxillary float line.

This float line is only for the big size net to pull up the float line. Sometimes The crews jump down into the sea to fasten the float line with this line, and then they pulled it up slowly. There are plastic rings, 0.8cm thick inside 3 cm dia .Between the two rings interval is 1.5-2 mtr. The PE rope is 10-12 mm and 20-30 mtrs in length, which is inserted through the plastic rings and the end is fastened to the float line.

Purse line.

During the operation, this line is use to close the bottom part of the purse seine net. This line is inserted through the purse rings, and pulled at both ends. It must be thick and strong and not twist, during the operation. Usually PE braided rope, 20-40 mm dia is used.

b.3.2.4.Floats.

Floats are long and flat type, No.3 ,which are attached to the float line over the wing or body on both sides. Over the bunt float no.9 at least 50 are attached, sometimes rubber or plastic cylindrical in shape floats are used to prevent sinking when big school of fish is in the bunt, and also used as a marker 8-10 inches dia 1-3 floats.

b.3.2.5. Sinkers and purse ring.

Sinkers.

Sinkers are used to weight for the net rapidly sinking. They weigh 0.5-1kg/each, attached to the braidle rope over the purse rings. If small purse rings is used, they weigh less then 1 kg, two sinker are attached. Making 1-3kg at the area of both wings. If big ring are used extra weight is not needed.

Purse rings.

Normally purse ring must be non-rust materials.(eg. brass,stainless steel, iron covered with zinc.) Inside dia is 6-9 cm, thickness 1-2 cm, intervals between each rings 2.3-2.5 mtr. some purse seine net have a rope ring inside 30 cm dia, sometimes PE 16-20mm. This is used for after 30-40 purse rings have been attached to pulling the the purse up on board easily.

b.3.2.6. Hang-in.

Normal hang in of the purse sein net is about 20-30% in the upper part of the net and 10-20% in the lower part.If the purse seine which is hauled up by power block, should have a smaller hang-in.

b.3.2.7. Equipments.

For purse seine operation, below items are needed,

1. Portable spotlight or flashlight to check the fish school during night time.
2. Two extra sinkers (35-50)kg to use as aweight attached the purse rings at the end of both wings during operation to ensure not to open widely.
3. Light raft or light buoy to use as a marker during the night time operation. It is tied to the end of the float line of the left wing.
4. A big hook made of iron with 3-4 mtr handle is used for hooking the net.
5. Luring lamp raft which is made of iron frame packed with foam,it can set the three gas cylinder lamps.
6. Gas cylinder lamps.
7. Scoop net that is to scoop the fish from the bunt.

b.4. <u>Season.</u>

In Myanmar the purse seiners can be operated throughout the year,but they do not operate during the monsoon and the close season, June, July and august.

b.5. <u>Fishing method and operation.</u>

After arrival to the fishing ground, the master fisherman looking for the fish school around the place, by the direct observation method with binocular lens, when a fish school is found, it need to know the direction of the current, wind and the movement of the fish school.

There are two fish detecting methods and fish luring methods.

Traditional visual obseration method.

Normally the fisherman like to search the fish school in the early morning or in the evening before sunset and also in the moon lit night To find the fish school by looking for the following things.

In the day time,

(1) Changes of the water colour.

(2) Jumping fishes.

(3) Flocks of the fishes.

In the night time.

(1) Observeing the plankton luminescences of the swiming fish school.

Modern method using Fish-finder, radar,sonar echosounder etc;

(2) Using the fish-finder,sonar,echosounder etc;

This method is used more advanced fish detecting machine like, scanning sonar, fish-finder, echosounder,radar etc; so they can observe the movement of the fish school easily and they can operate the night time.

b.5.1. Fish Luring method.

(1) Luring by lift raft (gas cylinder lamp)

(2) Luring by mercury lamp.

b.5.2.Fishing Operation.

When the fisherman found a fish school, sail toward the school,then stop while he consider the species, size of the school, swimming speed, direction, current, wind direction, depth etc;.

Usually the fish school swimming against the wind. The position is under the wind far from fish school. The vessel must move with full speed while releasing the net to surround the fish school in a circular shape. The speed of the vessel must be reduced when about three quarter of the net length has been released. When they meet, the one end the marker is hooked up and pulls the top of the wing net to the boat. The vessel must be maintained well position. After the both side of the purse line willbe passed through the two pullys at the bow, to winch drums on both side of the wheel house. Then the purse line is winch up on both side.

Fish can not come near the end of the net where is still opening, because of the engine noise. After all the crews member pull the net up on both side while shaking the net to chase fish down in to the bunt. Then the crews must help pulling up on the starboard side. At that time all the fish will go down and concentrate at the bunt.

The float line must be lifted over the bunt, up by the boom to prevent the fish escape the fishes. Finally the fish are scooped from the bunt and kept in the fish hole.

(C). <u>Others.</u>

The other fishing gears are drift net, trammel gillnet, small cast net, small lift net as artisanal fishing gears with small boats.

7. Captures

The monthly capture of marine fishes and shrimps are shown at the table (3 & 4) their length distribution are shown in the figures below.

Length frequency of Pampus argenteus	Fig-8
Length frequency of Chrysochir aureus	Fig-9
Length frequency of Hilsa ilisha (Purse seine)	Fig-10,11,12.

8. Conclusion.

The situation of Myanma fishing technology is now developing because the responsible athorities are trying to upgrade sector by sector with the help of the welltrain persons, researchers, fisheries biologists, Fishing technologists, etc;. We need to introduced the more advance fishing technology which we have learned from SEAFDEC training centre , to the communities of the fishermen and we have to share the knowledges of fishing technologies through our country also.

Reliable and timely data on all the aspects of the fisheries are needed for the development of implementation selective fishing gear, subsequent monitory of fishery management. National capability to collect the data and the information should be development. It is the essential thing which is to enhance the capability of the country in monitoring control and management to the our resources.

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3. Masatsuma Normura and Tomeyoshi yamazaki, JICA Tokyo (1975). Fishing Technique. 206 pp.
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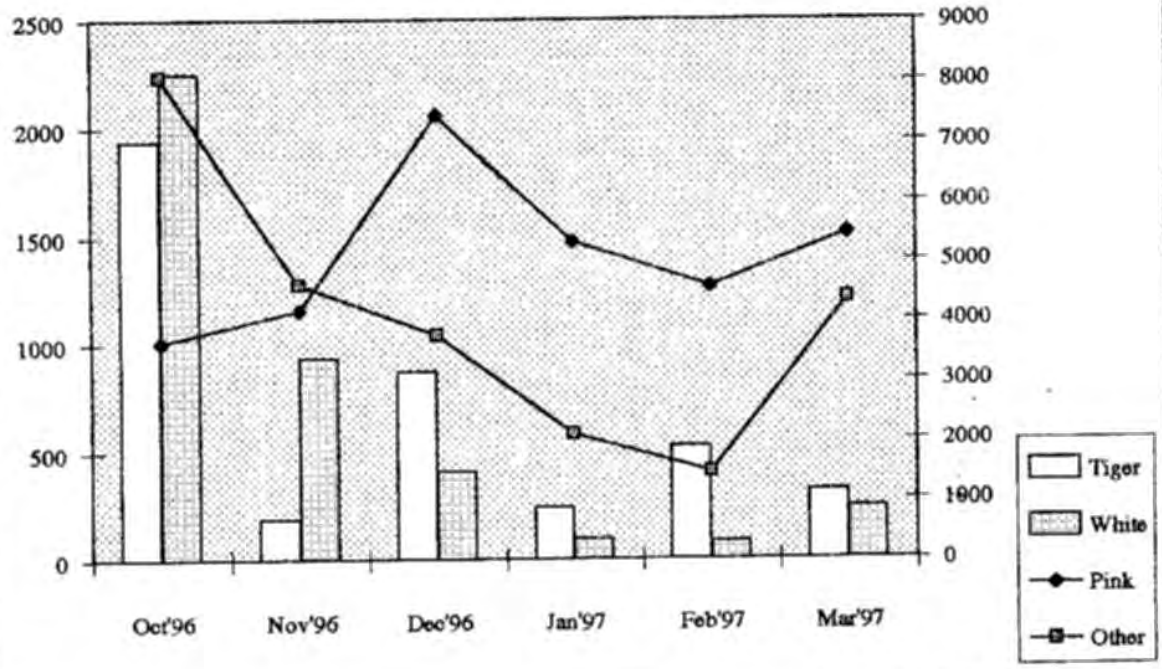
7. Hiroyuki Yanagawa (1992) Marine Capture in the South China Sea Area from 1984 to 1988. Facts & Figures; SEAFDEC, TD.
8. Pouchamarn Wongsanga and Hiroyuki Yanagawa, (1992). Fisheries in the South China Sea from 1984 to 1988, Facts & Figures; SEAFDEC, TD.

Fig.(1)

Monthly Marine Shrimp Capture



Monthly Capture of Marine Fishes

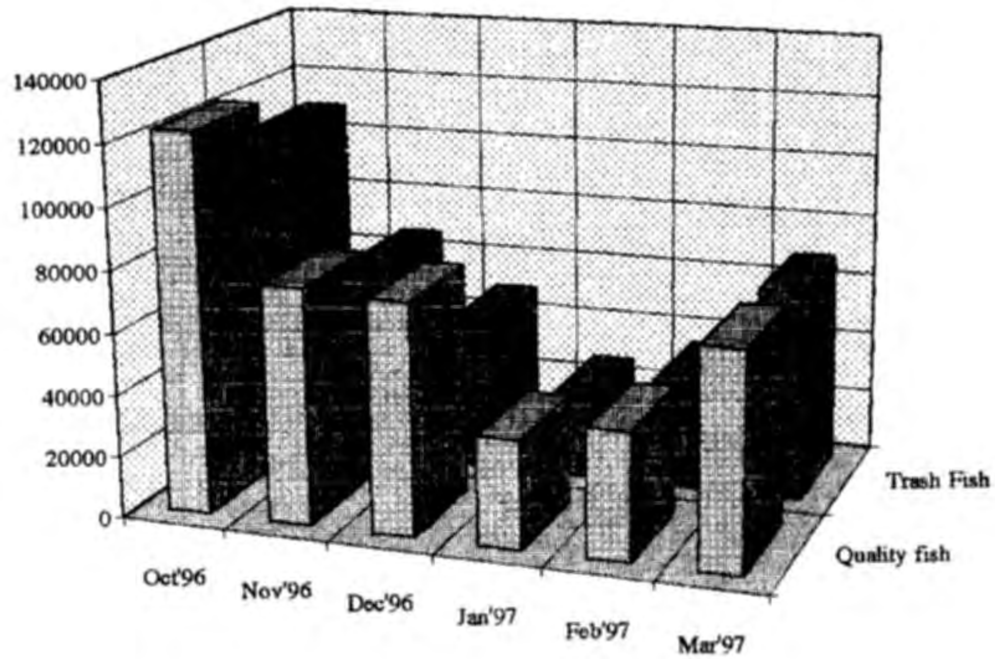
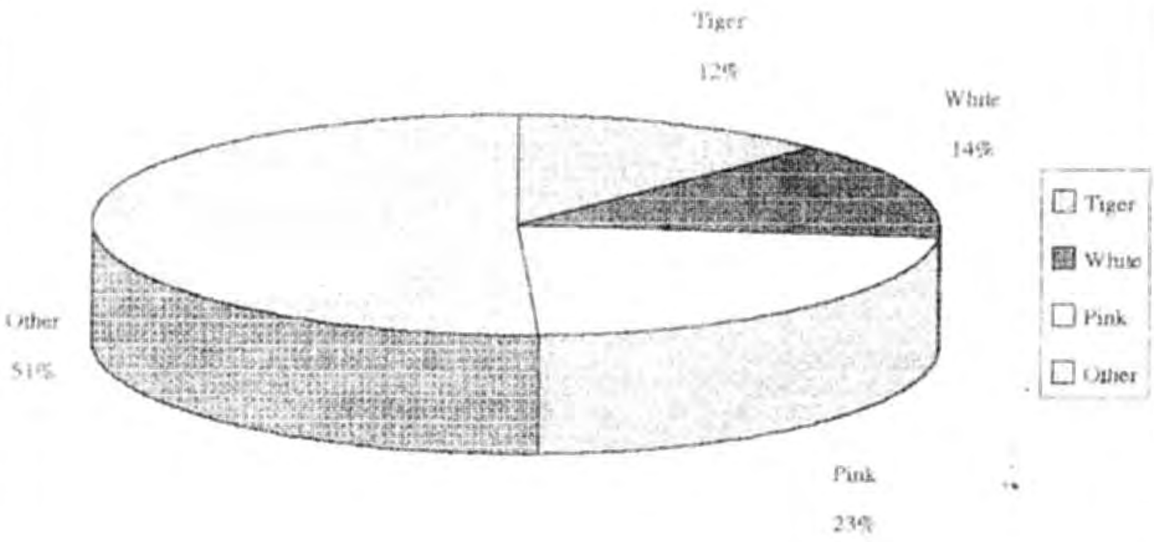


Fig.(2)

Capture ratio of shrimps in Oct'1996.



Capture ratio of shrimps in Nov'1996.

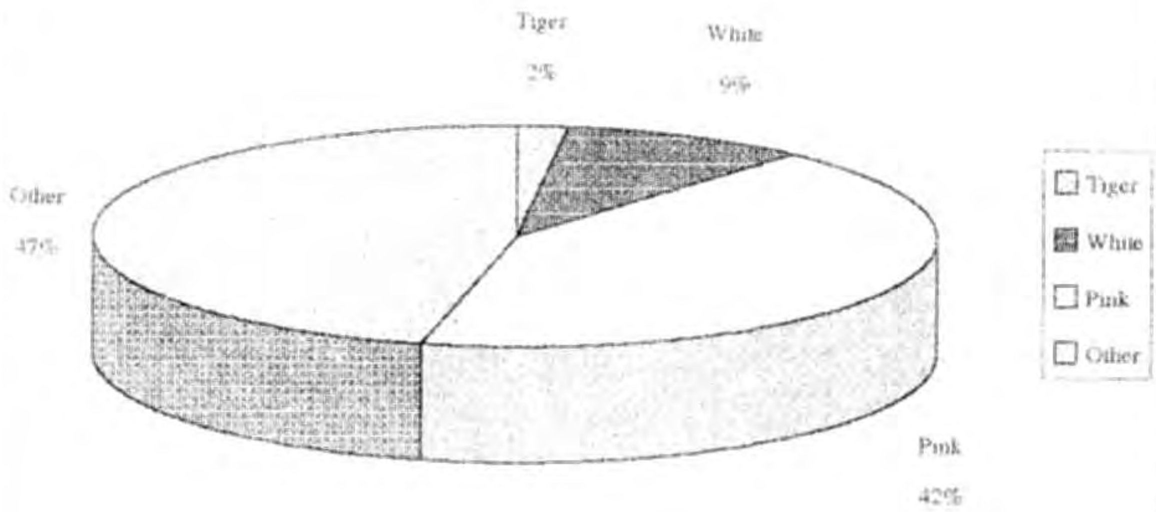
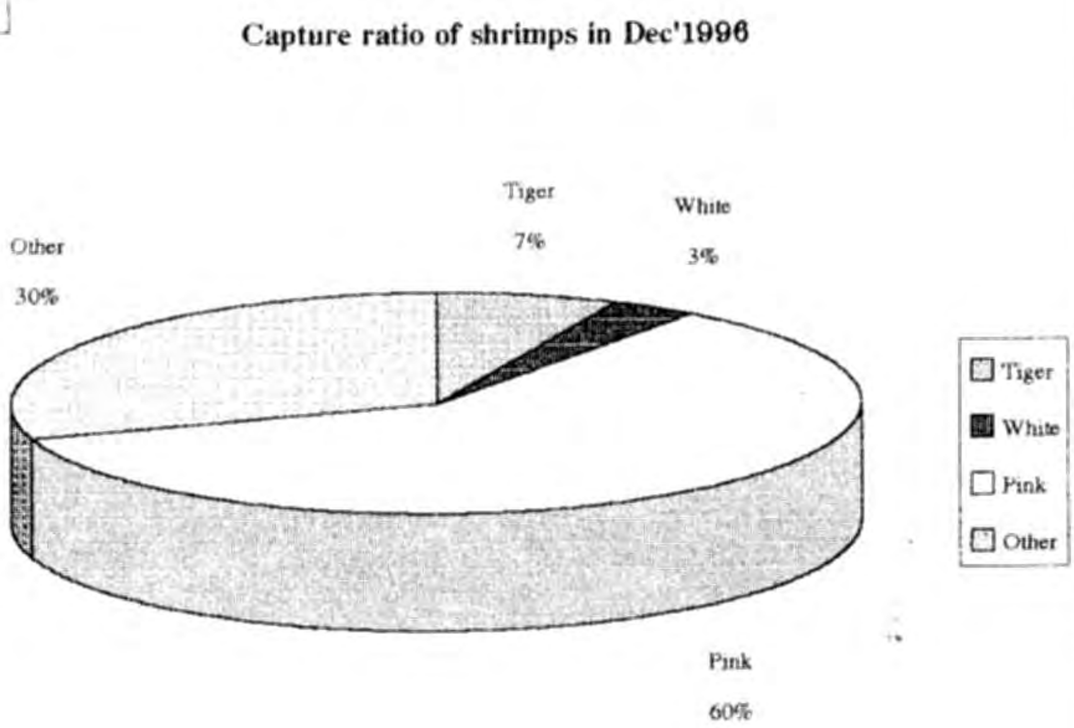


fig.(3)


Capture ratio of shrimps in Dec'1996
Tiger
7%
White
3%
Other
30%
Pink
60%
Tiger
White
Pink
Other

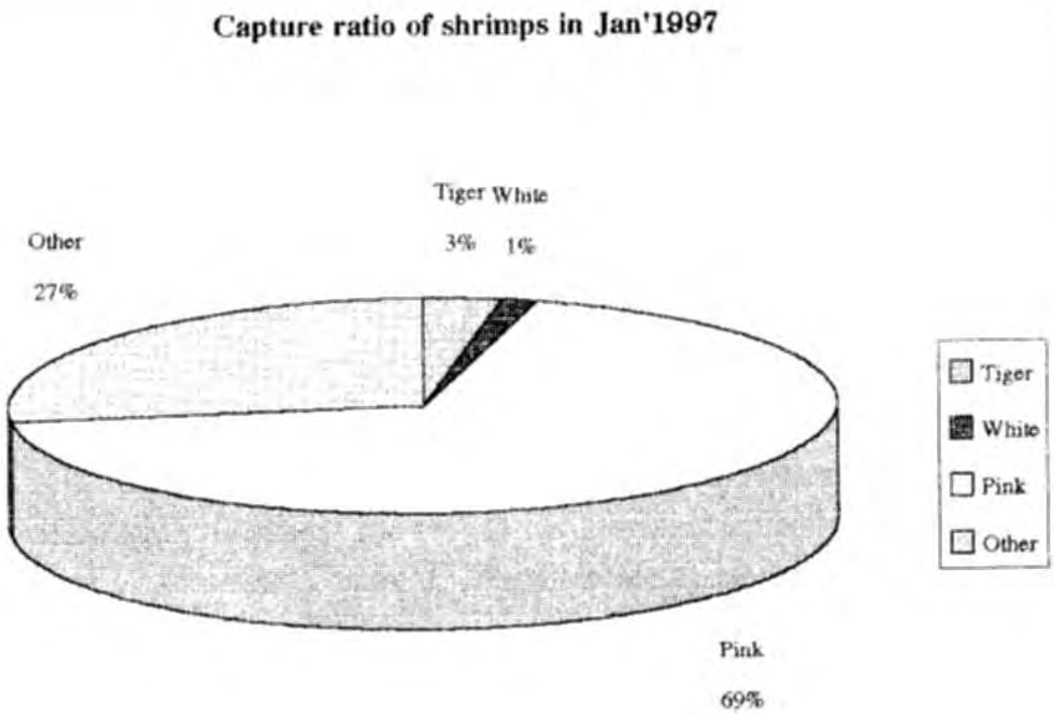

Capture ratio of shrimps in Jan'1997
Tiger White
3% 1%
Other
27%
Pink
69%
Tiger
White
Pink
Other

Fig.(5)

Species composition of shrimps

Oct'96- Mar'97.

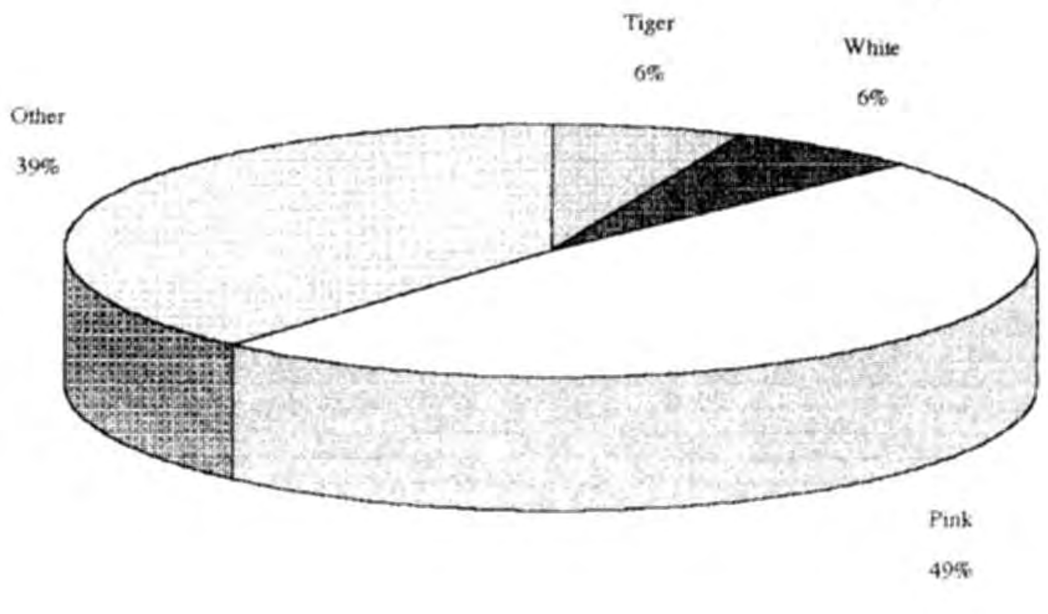


Fig.(6)

Monthly Capture of Marine Fishes

(Family wise)

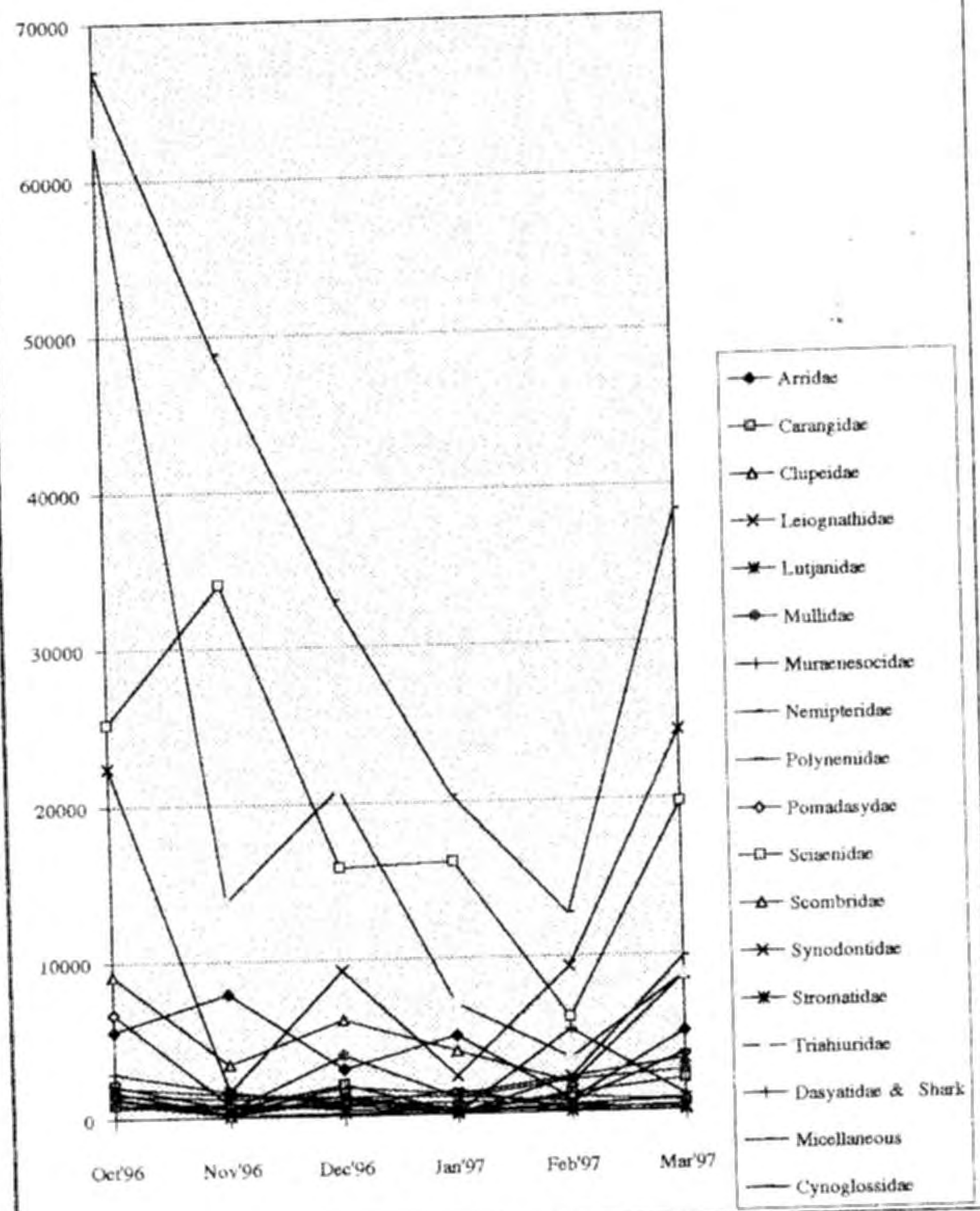


Fig.(7)

Family Wise Composition of Marine Fishes

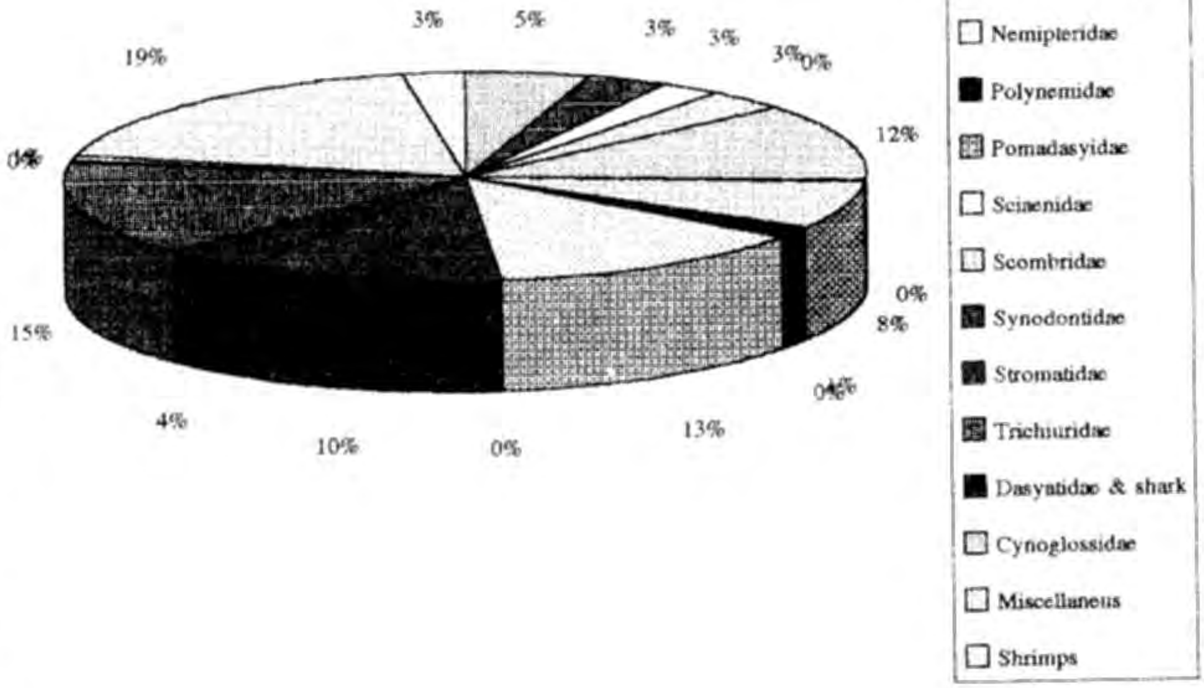


Fig.(8)

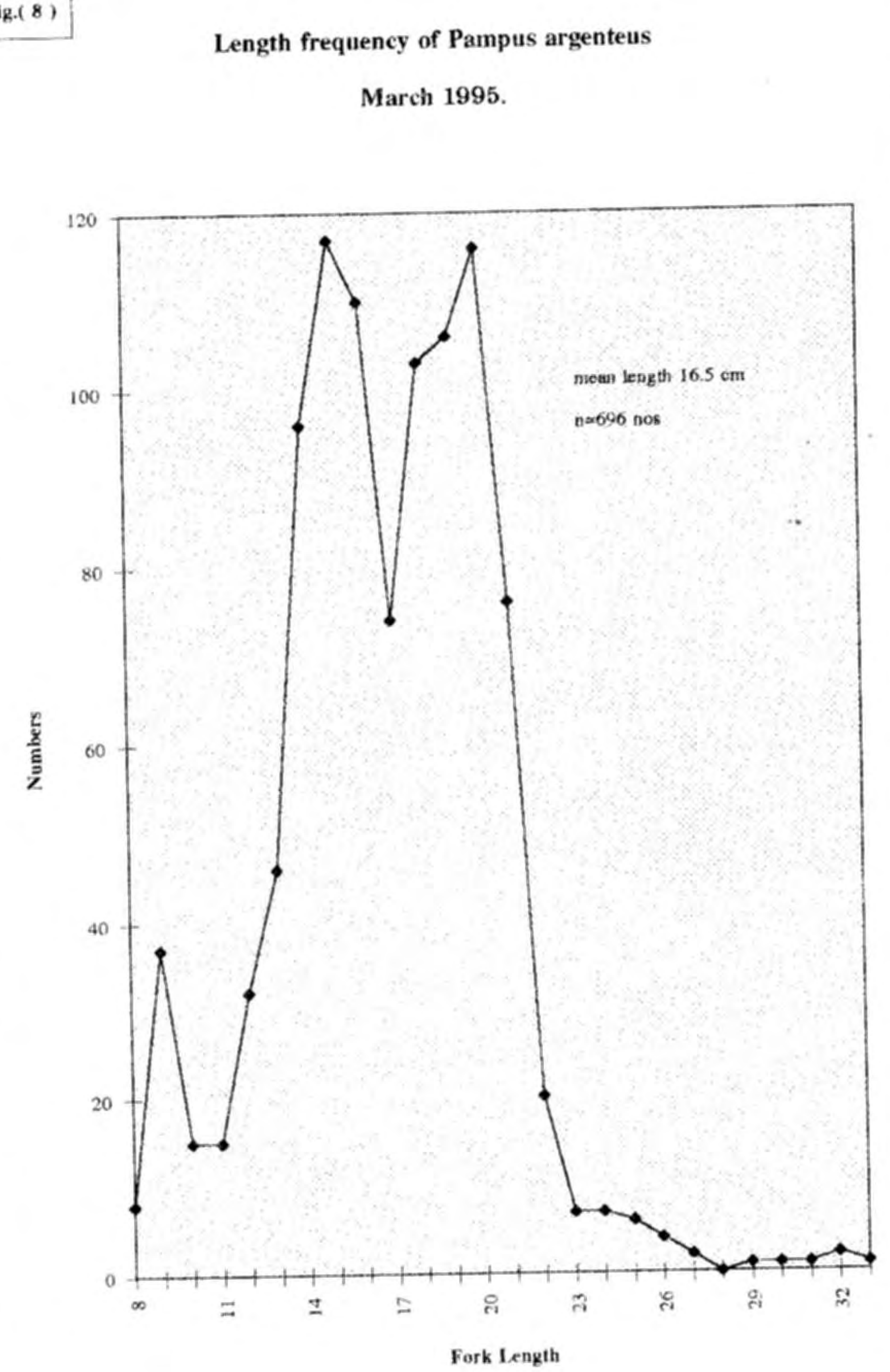

Length frequency of Pampus argenteus
March 1995.
120
100
80
60
40
20
0
Numbers
mean length 16.5 cm
n=696 nos
8
11
14
17
20
23
26
29
32
Fork Length

Fig.(9)

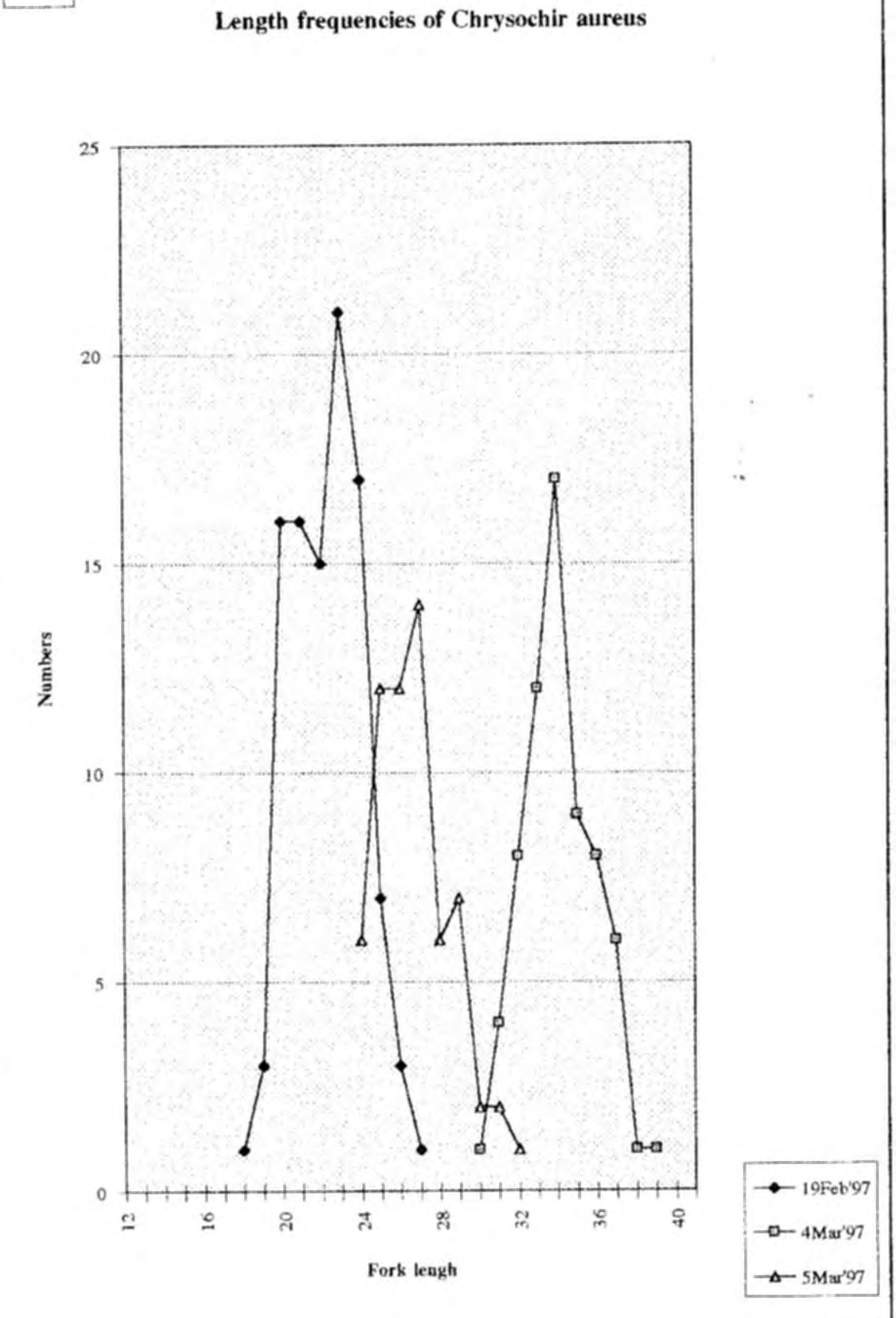

Length frequencies of Chrysochir aureus
Numbers
25
20
15
10
5
0
12
16
20
24
28
32
36
40
Fork lengh
19Feb'97
4Mar'97
5Mar'97

Fig.(10)

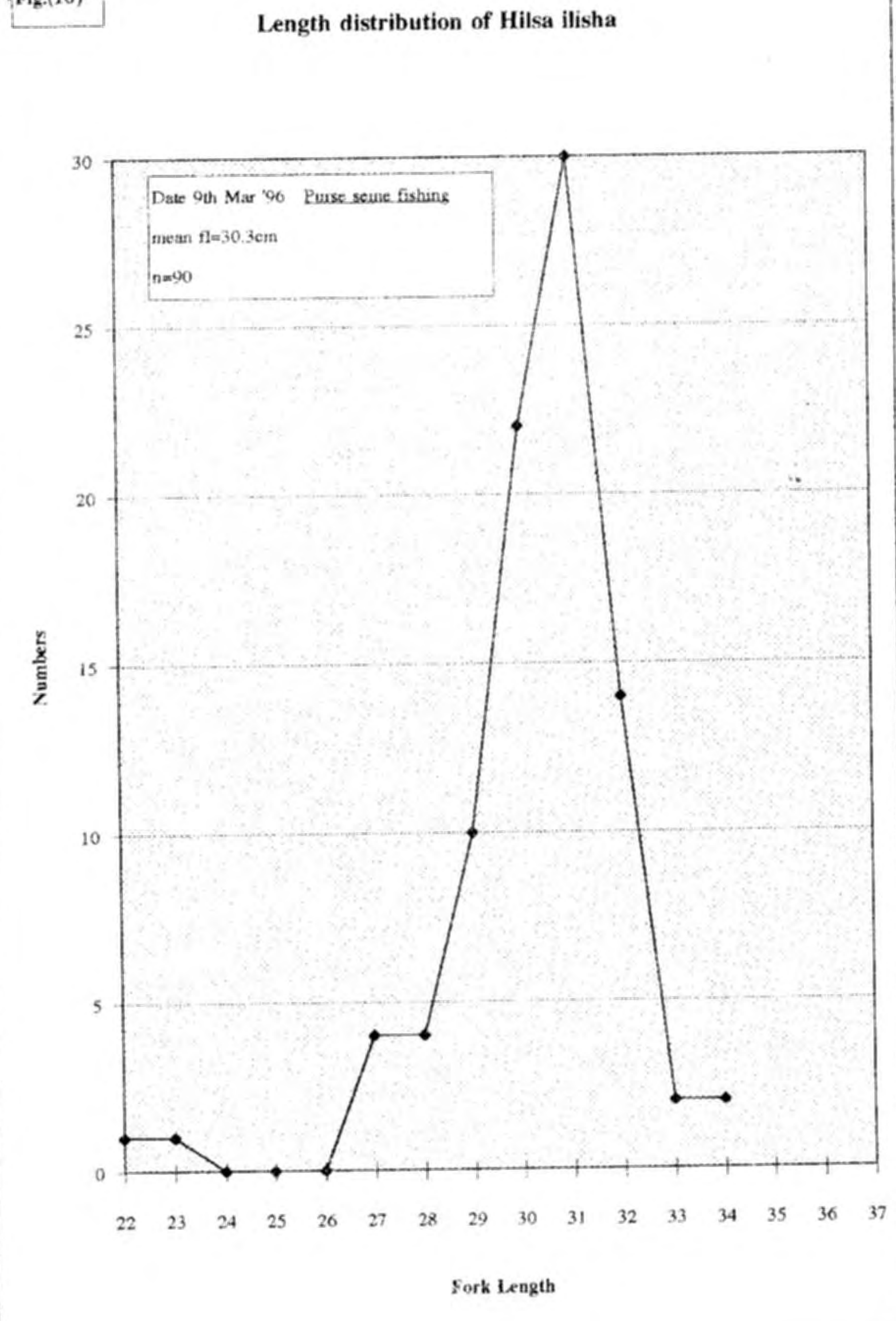

Length distribution of Hilsa ilisha
Date 9th Mar '96 Purse seine fishing
mean fl=30.3cm
n=90
Numbers
30
25
20
15
10
5
0
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
Fork Length

Fig.(11)

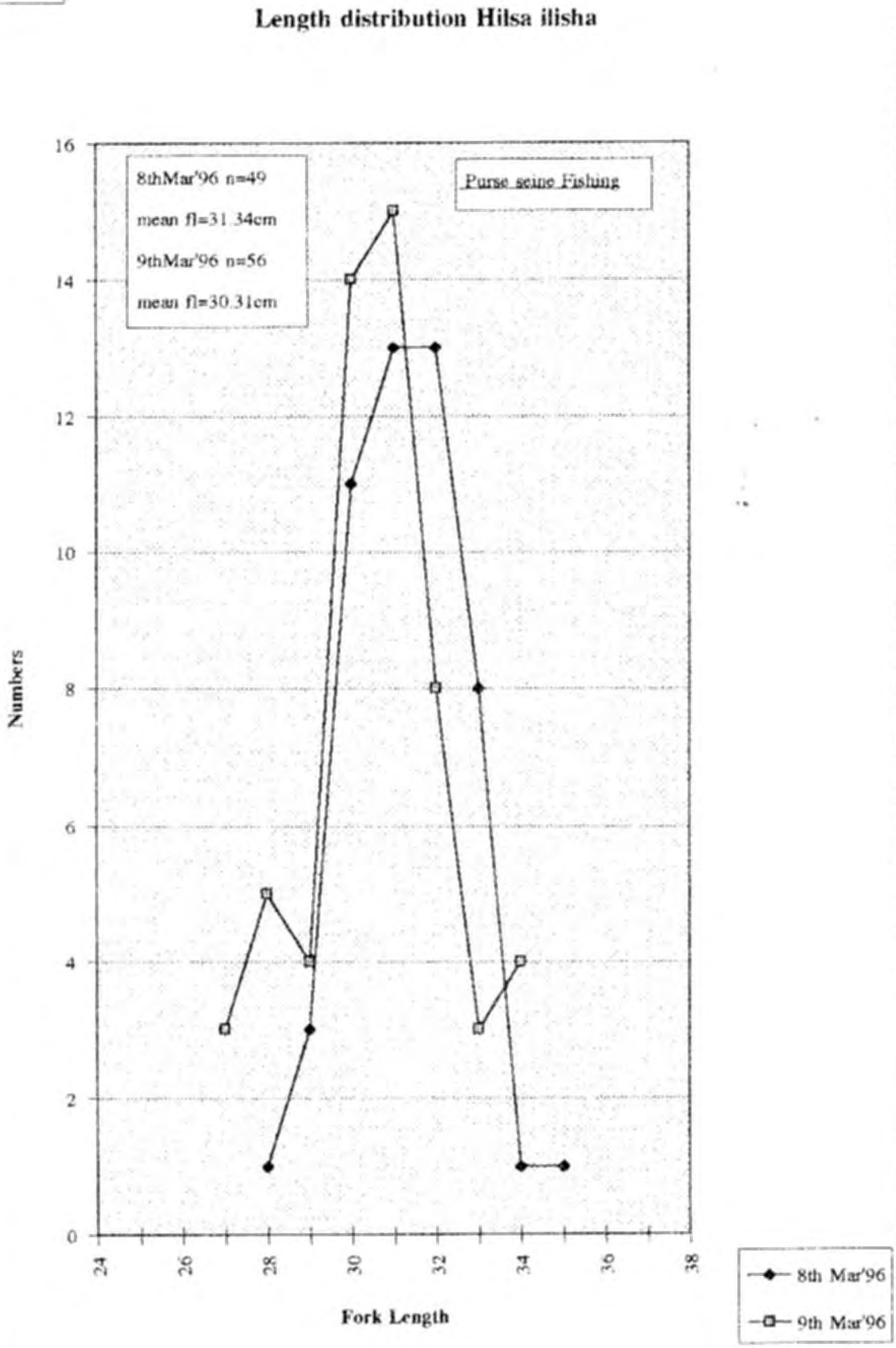

Length distribution Hilsa ilisha
8thMar'96 n=49
mean fl=31.34cm
9thMar'96 n=56
mean fl=30.31cm
Purse seine Fishing
Numbers
Fork Length
8th Mar'96
9th Mar'96
0
2
4
6
8
10
12
14
16
24
26
28
30
32
34
36
38

Fig.(12)

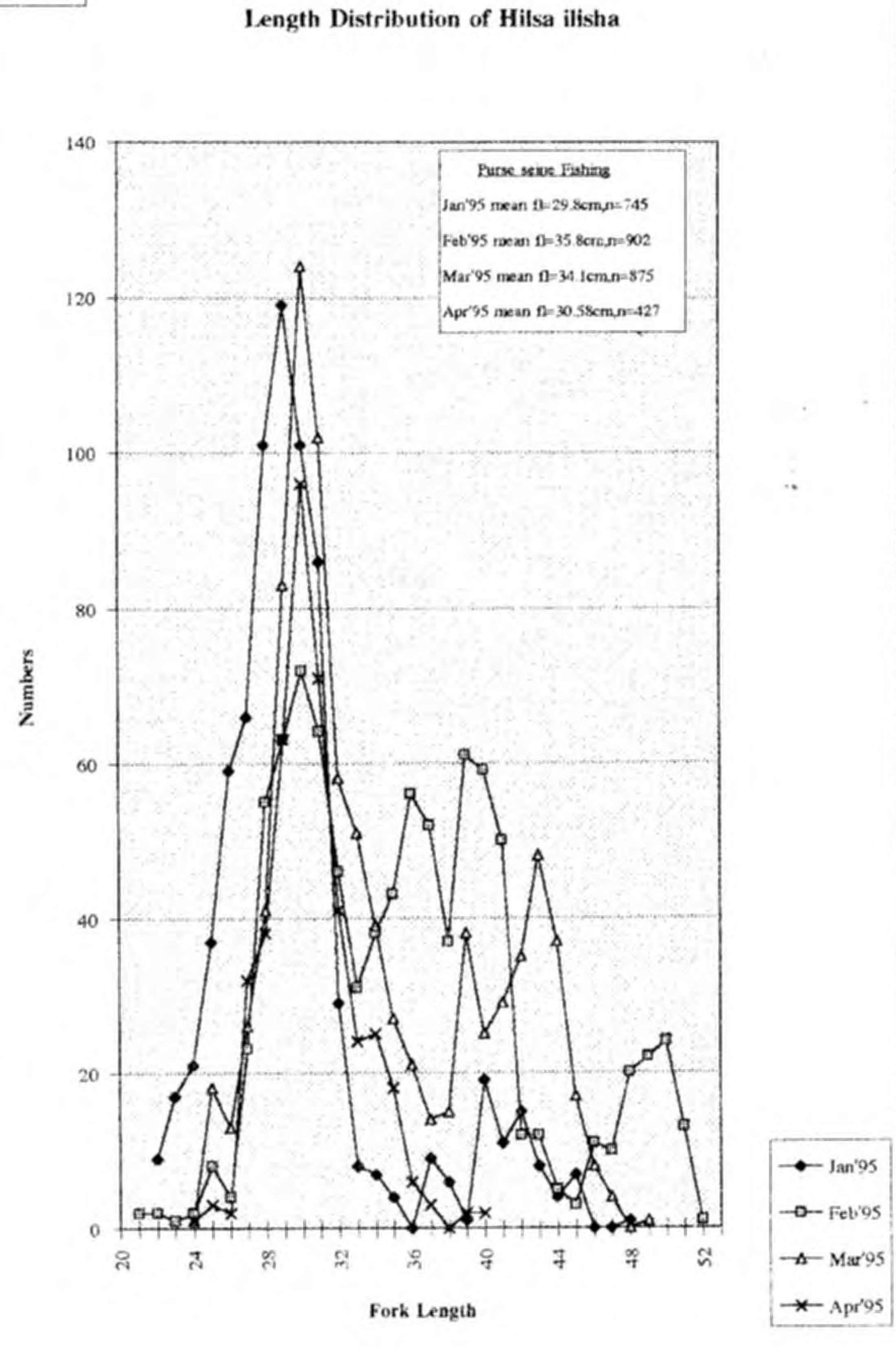
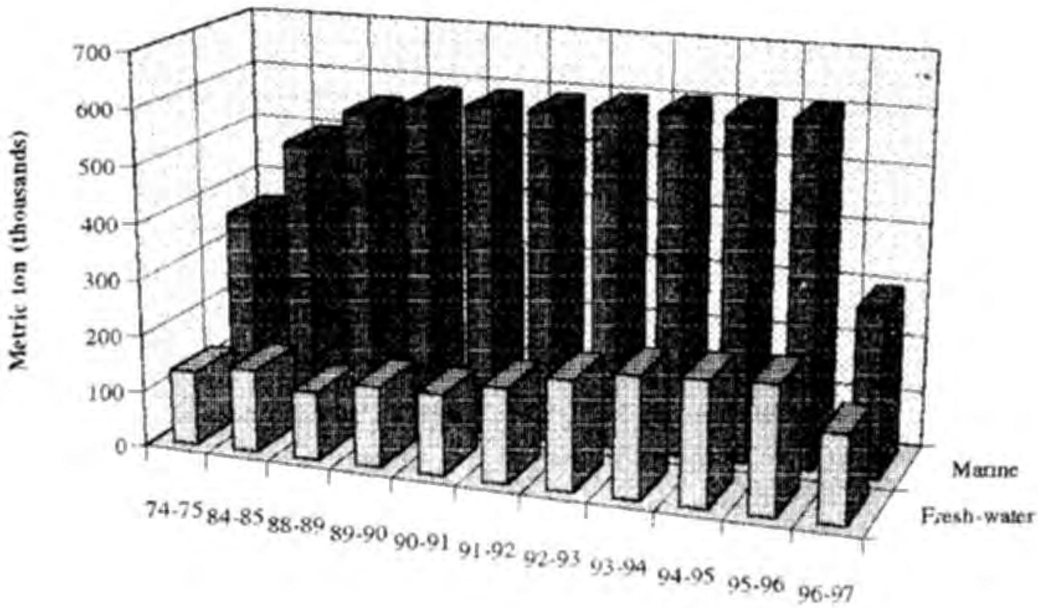

Length Distribution of Hilsa ilisha
Purse seine Fishing
Jan'95 mean fl=29.8cm,n=745
Feb'95 mean fl=35.8cm,n=902
Mar'95 mean fl=34.1cm,n=875
Apr'95 mean fl=30.58cm,n=427
Numbers
Fork Length
Jan'95
Feb'95
Mar'95
Apr'95
0
20
40
60
80
100
120
140
20
24
28
32
36
40
44
48
52

Fig.(13)

Production of Fish & Prawn (Myanmar)



STUDY REPORT

ON

GLOBAL POSITIONING SYSTEM (GPS)

IN MALAYSIA

BY

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WEST MALAYSIA.

FOR

THE REGIONAL TRAINING COURSE IN FISHING TECHNOLOGY AND RESOURCE CONSERVATION

(16 JUNE - 15 DECEMBER 1997)

TRANING DEPARTMENT
SOUTH EAST ASEAN FISHERIES DEVELOPMENT CENTER
(SEAFDEC)
PHRASAMUTCHEDI, SAMUTPRAKAN,
10290 THAILAND


SISTEM
LOKASI
BUMI
(GPS-Global Positioning System)
N 35 25.940
E139 49.268
JABATAN PERIKANAN MALAYSIA
Jabatan Perikanan,
Kementerian Pertanian Malaysia,
50628 Kuala Lumpur

GLOBAL POSITIONING SYSTEM (GPS)

1. INTRODUCTION

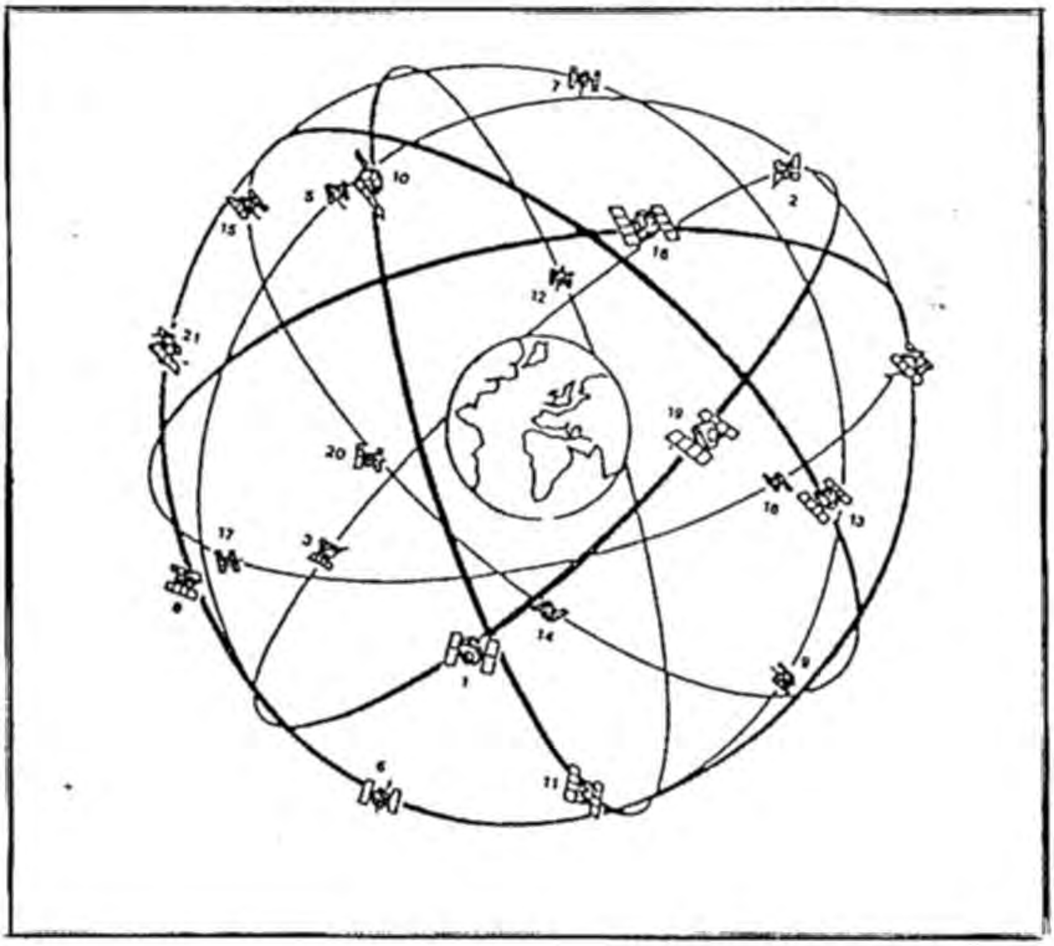
In Malaysia there are so many kinds of new modern equipments used by the fishermen like GPS, Scanning Sonar, Echo Sounder, Wireless and etc. GPS is a new modern equipment that already widely use by the fishermen.

GPS is a navigation system, the basic of radio satelite for finding and getting the position either on land or in the sea through 24 hours services. GPS used 24 satelite station to surround the planet every 11 hours 56 minutes in one round. The operation of GPS can be used in all condition of weather. (See Fig. 1.1)

2. PRINCPLES OF GPS

The position of GPS can be found through the calculation of a distance from 2 satelite that ray of light taken by satelite to antenna with speed of 3,000km/sec. However, if has different time between ship and satelite, this not mean the correction of time should be done. By this third satelite is to be use to determine the different time. (See Fig. 1.2)

FIG. 1.1



THE ARRANGEMENT OF THE SATELITE THAT ORBIT TO THE EARTH.

GLOBAL POSITIONING SYSTEM (GPS)

1. INTRODUCTION

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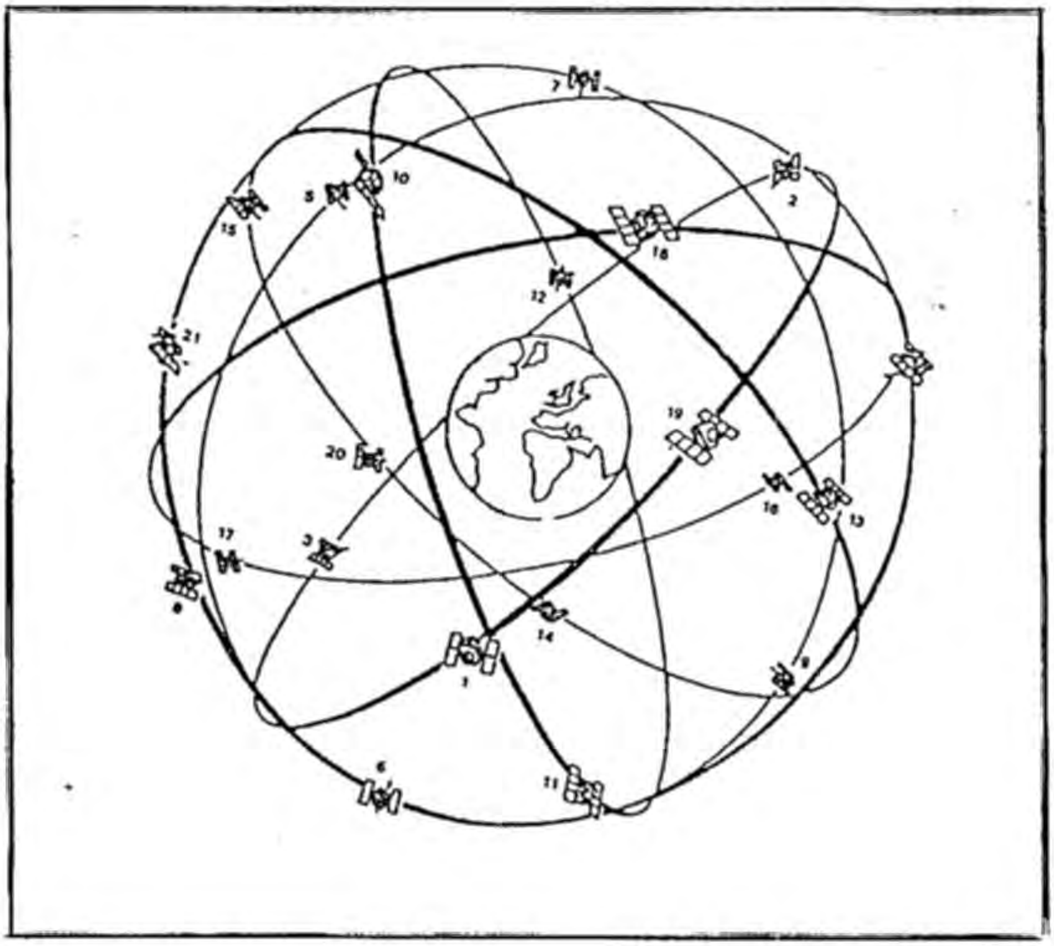
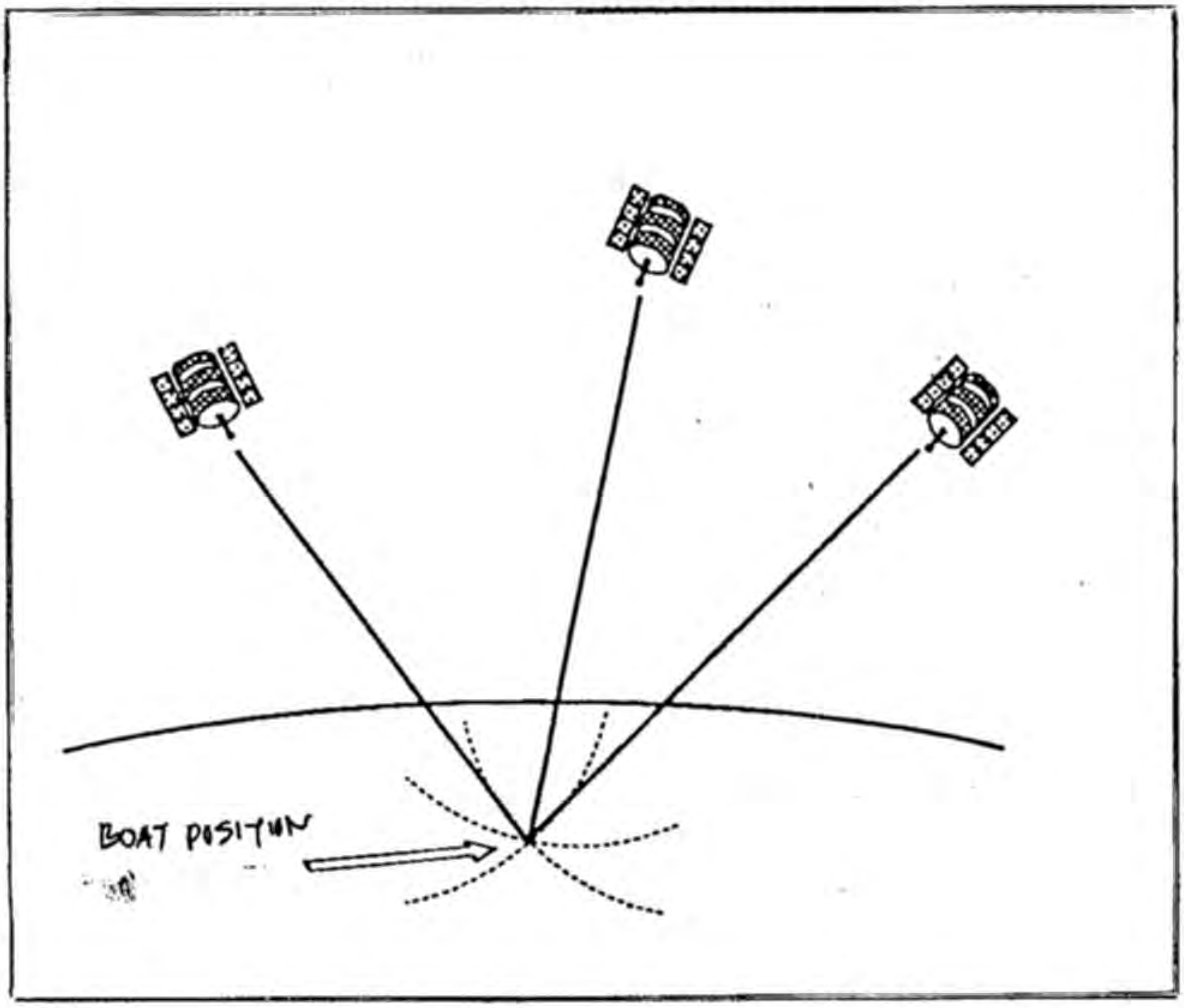
FIG. 1.1



THE ARRANGEMENT OF THE SATELITE THAT ORBIT TO THE EARTH.

FIGURE 1·2



DETERMINE OF THE BOAT POSITION

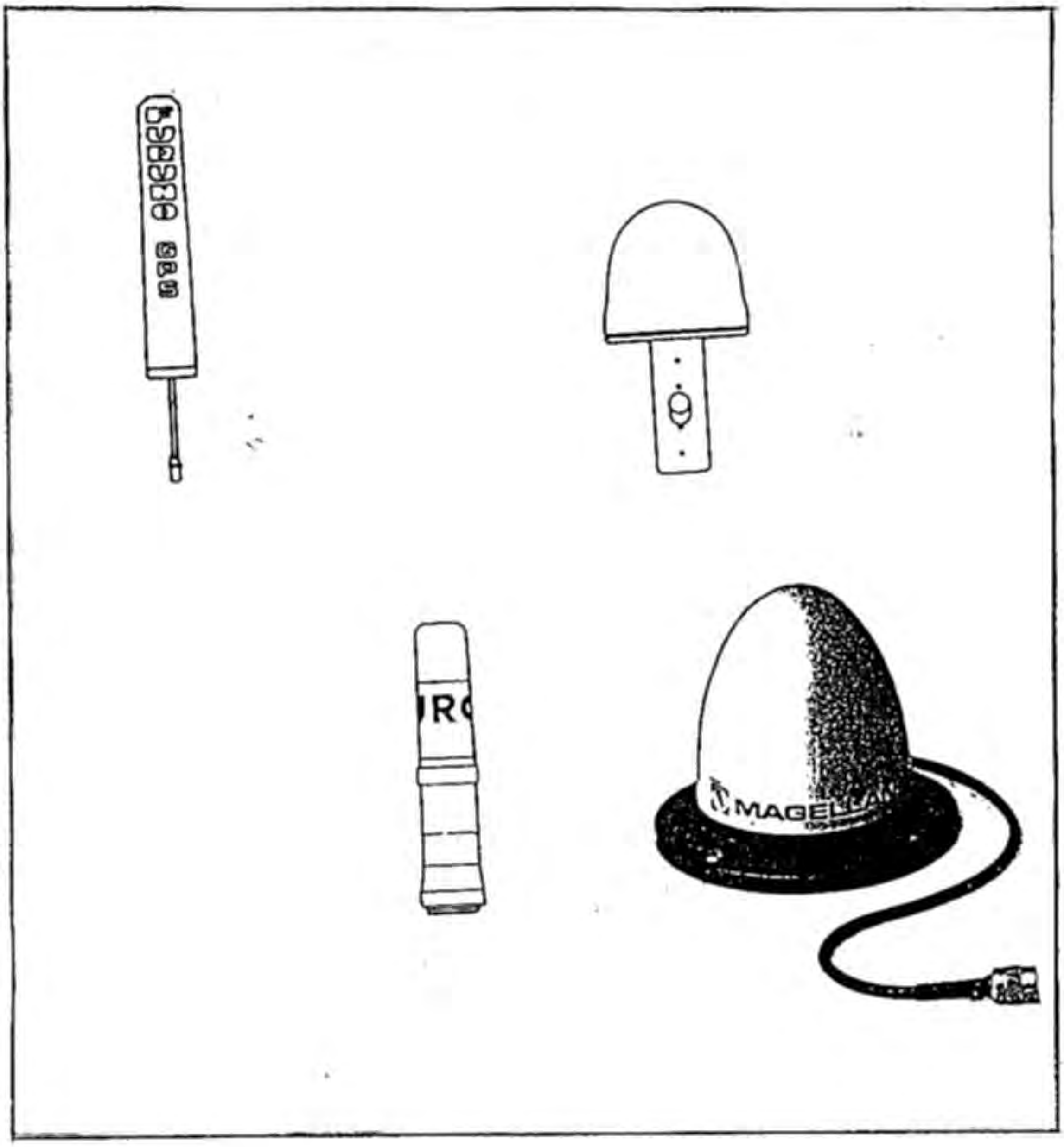
Through the expression above, nowadays most of the fishermen understand about the important of GPS. So is it very popular been used among the fishermen in Malaysia. Further more it will be given back some benefit to the fishermen because by using GPS the fishermen can save the amount of diesel and time. For example, the sailing time can reduce about 3 - 5 hours per trip for the deep sea fishing because GPS can show directly in the screen the way point to the fishing ground and if the track is not in a right manner the alarm will ring.

3. MAIN PARTS OF GPS

3.1. Antenna Unit

The antenna received the information from the ray of light of the satelite which is nearest and all this information to be send to the receiver unit. (See Fig. 2.1)

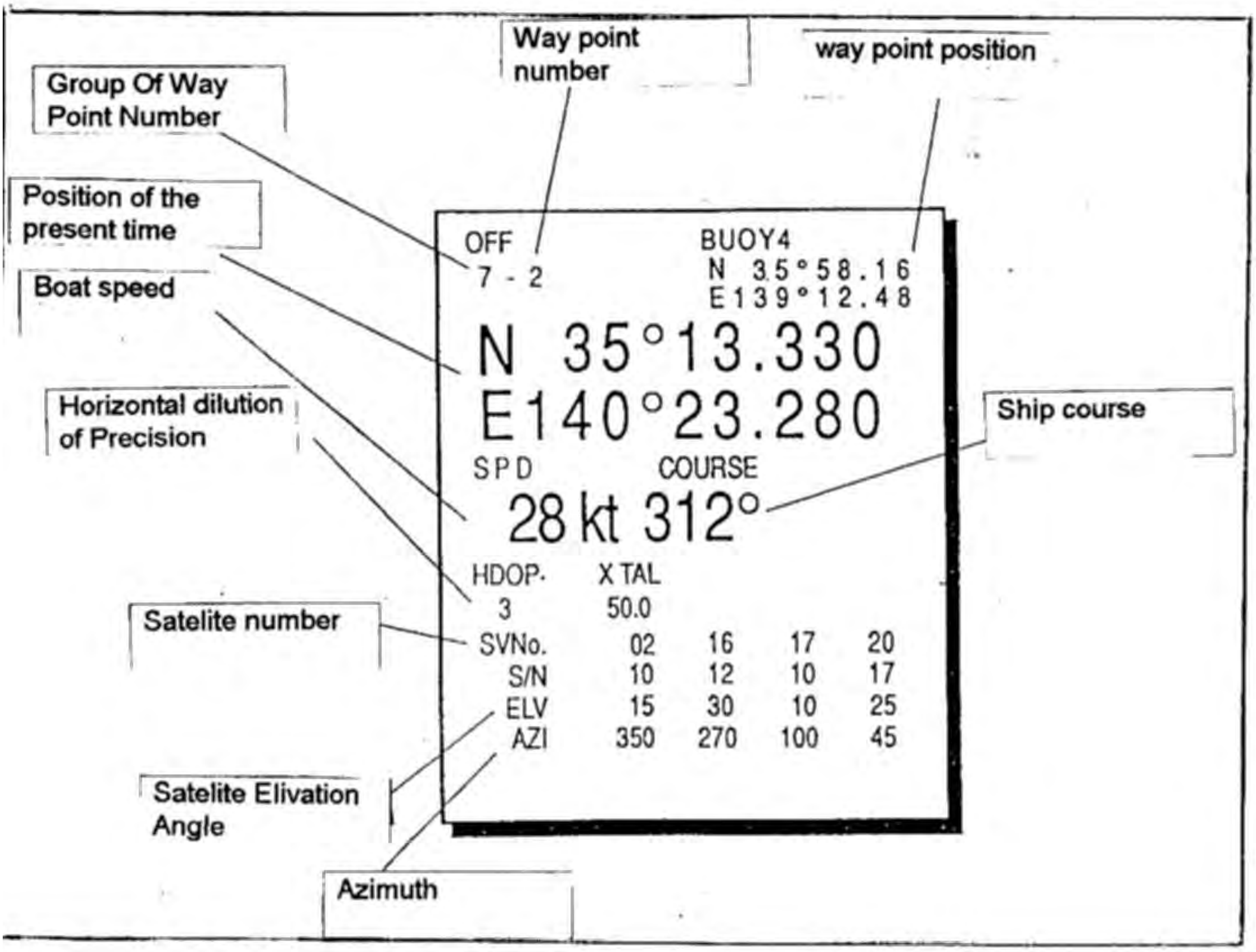
FIGURE 2-1



ANTENNA UNIT

3.2. Receiver Unit

This unit collect and process the data of navigation that found out from the satelite and record is the GPS screen as shown below (See Fig. 2.2)



3.3. Types Of GPS

Bil.	Types	Model	Price
1.	**KODEN**	**KGP 910** **KGP 910A** **KGP 911** **KGP 912** **GTD 2000** **GTD 2010** **GTD 2200**	**R M 4 , 0 0 0 -** **RM 6,000** **RM 9,000 -** **RM 14,000.**
2.	**FURUNO**	**GP 50** **GP 50 MRK II** **GP 50MRK III** **GP 1250** **PS 8000**	**RM 3,500 -** **RM 5,500.** **RM 7,000 -** **RM 11,000.**
3.	**SEIWA**	**CHART 700**	**RM 8,000.**
4.	**GARMIN**	**120**	**RM 3,000 -**
5.	**Micrologic**	**ADMIRAL 250**	**RM 4,500.**
6.	**JRC/JLR**	**6000**	
7.	**N A V MASTER**		

4. The Function Of GPS

The function of GPS is to determine:-

4.1. The position of latitude and longitude.

a) The position of latitude will be written as the example N 05° 40.00'.
b) The position of longitude will be written as the example E 101° 00.00'.

4.2. Course/Speed/Distance.

To show the ship position at the present time(N 35° 13.330'/E 140° 23.280'), position to way point(N 35° 58.16'/E 139° 12.48'), name and way point number(BUOY 4), during ship course (COURSE 312), Bearing to way point(STG 314), boat speed(SPD 28kt), Distance of way point(DIST 72.9nm), time to go(TTG 02:13), cross track error (XTE 0.72nm) and arrival alarm.(See Fig.3.2)

4.3. Bearing To Way Point

To show the bearing from the boat to the way point as shown below.(See Fig. 3.3)

FIGURE 3.2

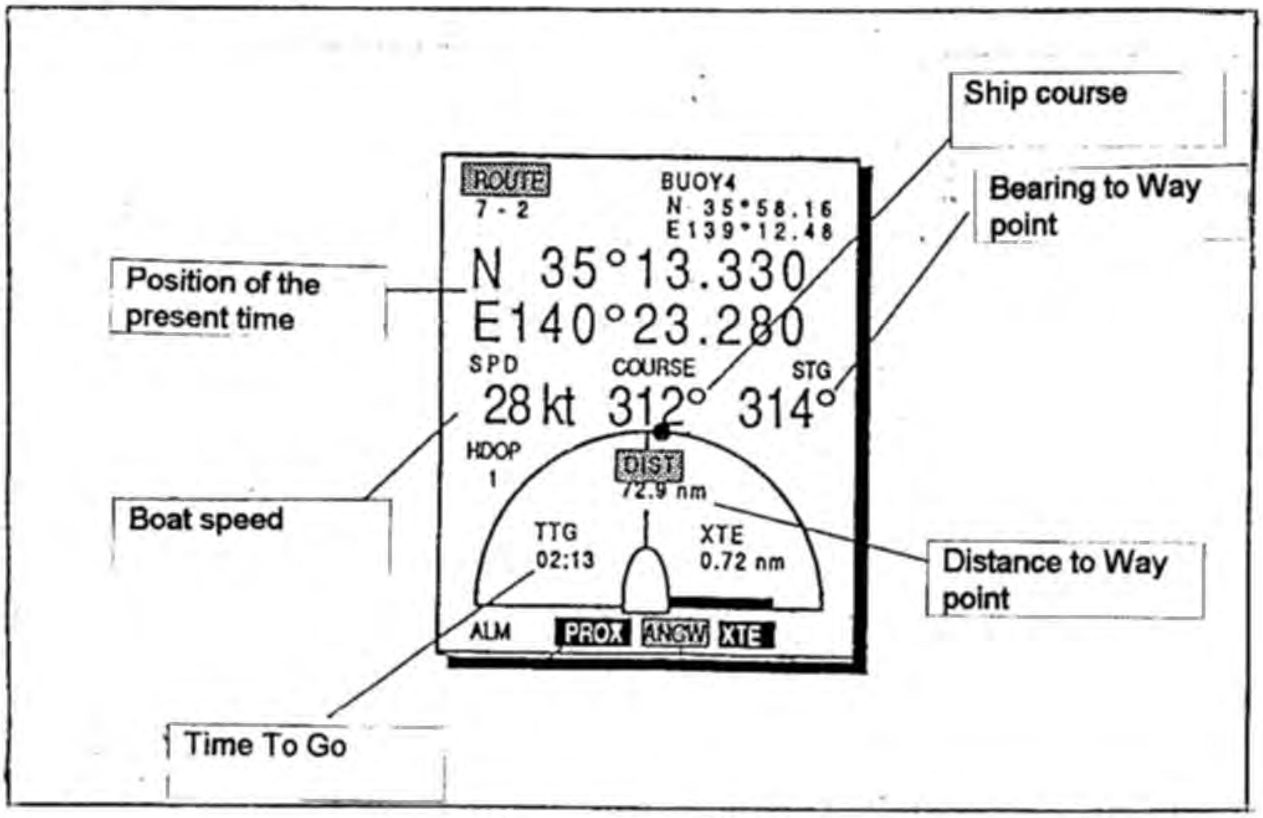
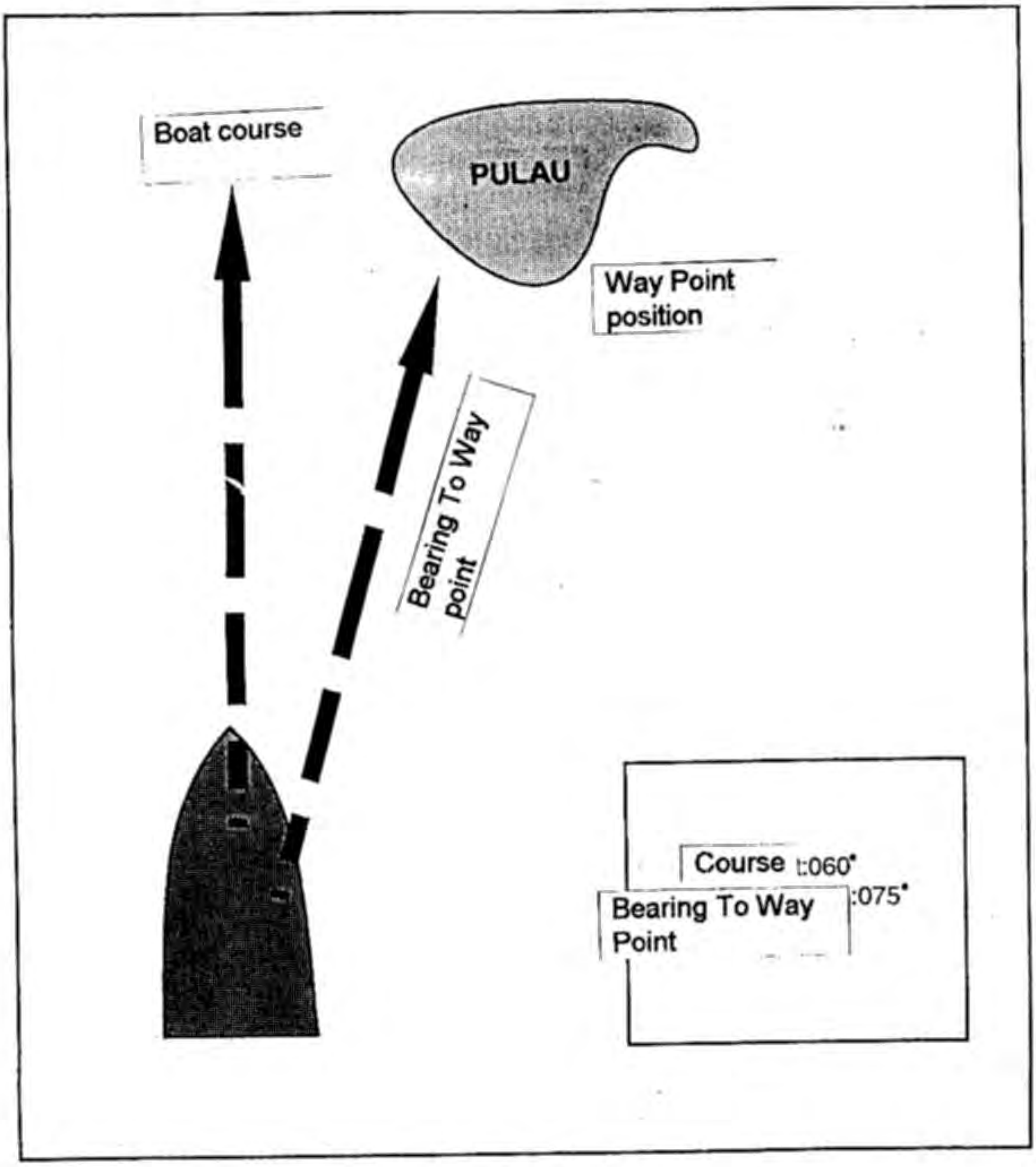
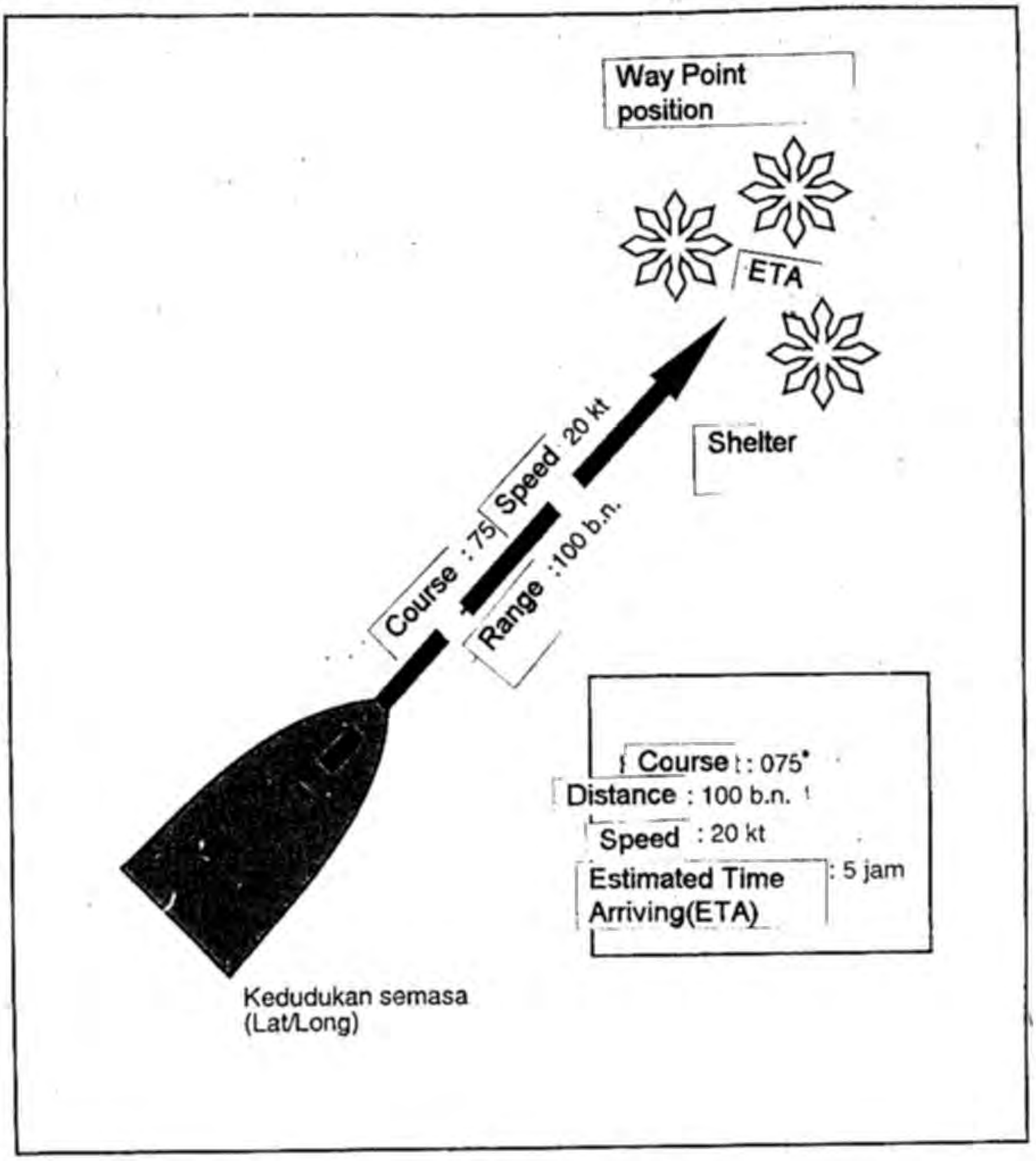

Ship course
Bearing to Way point
ROUTE
7 - 2
BUOY4
N 35°58.16
E139°12.48
Position of the present time
N 35°13.330
E140°23.280
SPD
COURSE
STG
28 kt
312°
314°
HDOP
1
DIST
72.9 nm
Boat speed
TTG
02:13
XTE
0.72 nm
Distance to Way point
ALM
PROX
ANGW
XTE
Time To Go

FIGURE 3.3


Boat course
PULAU
Way Point position
Bearing To Way point
Course :060°
Bearing To Way Point :075°

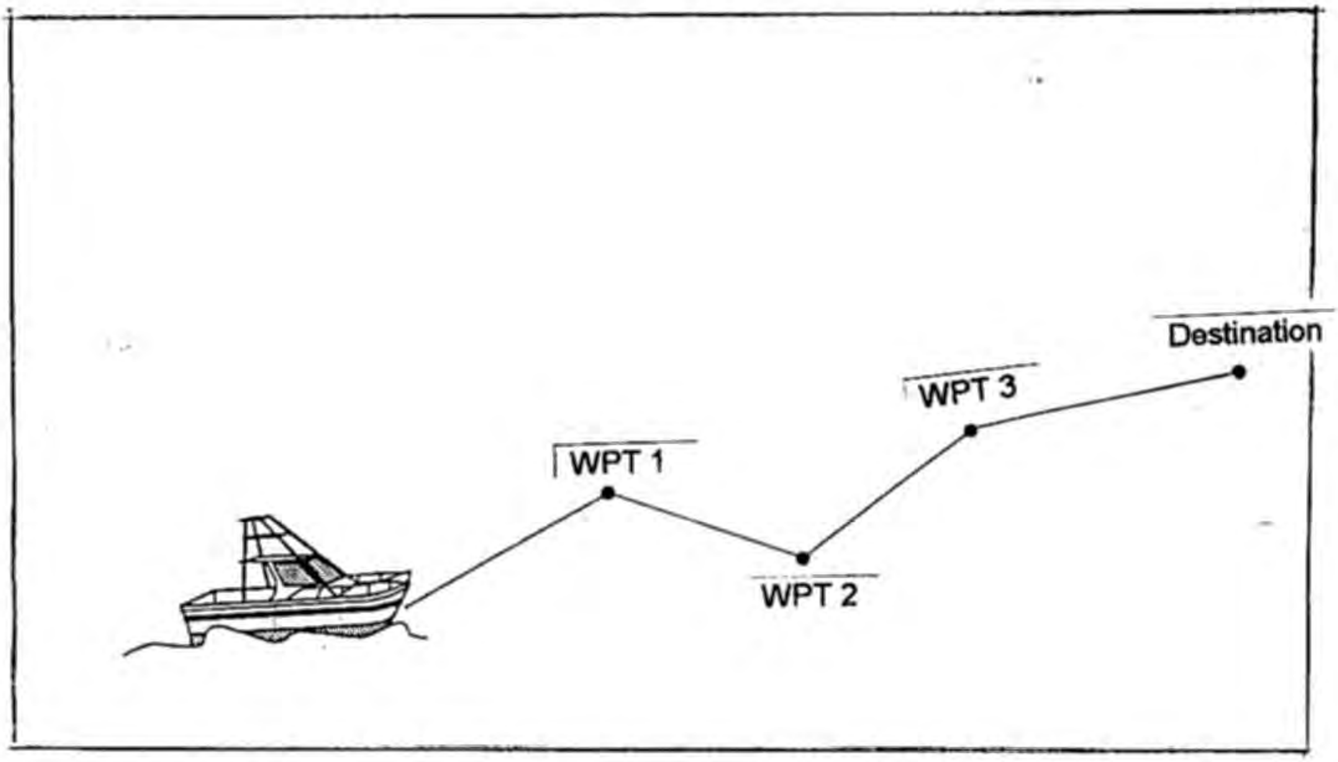
4.4. Time To Go (TTG)

Time to arrive from position of the present time to the way point (WPT) as shown below.(See Fig. 3.4)



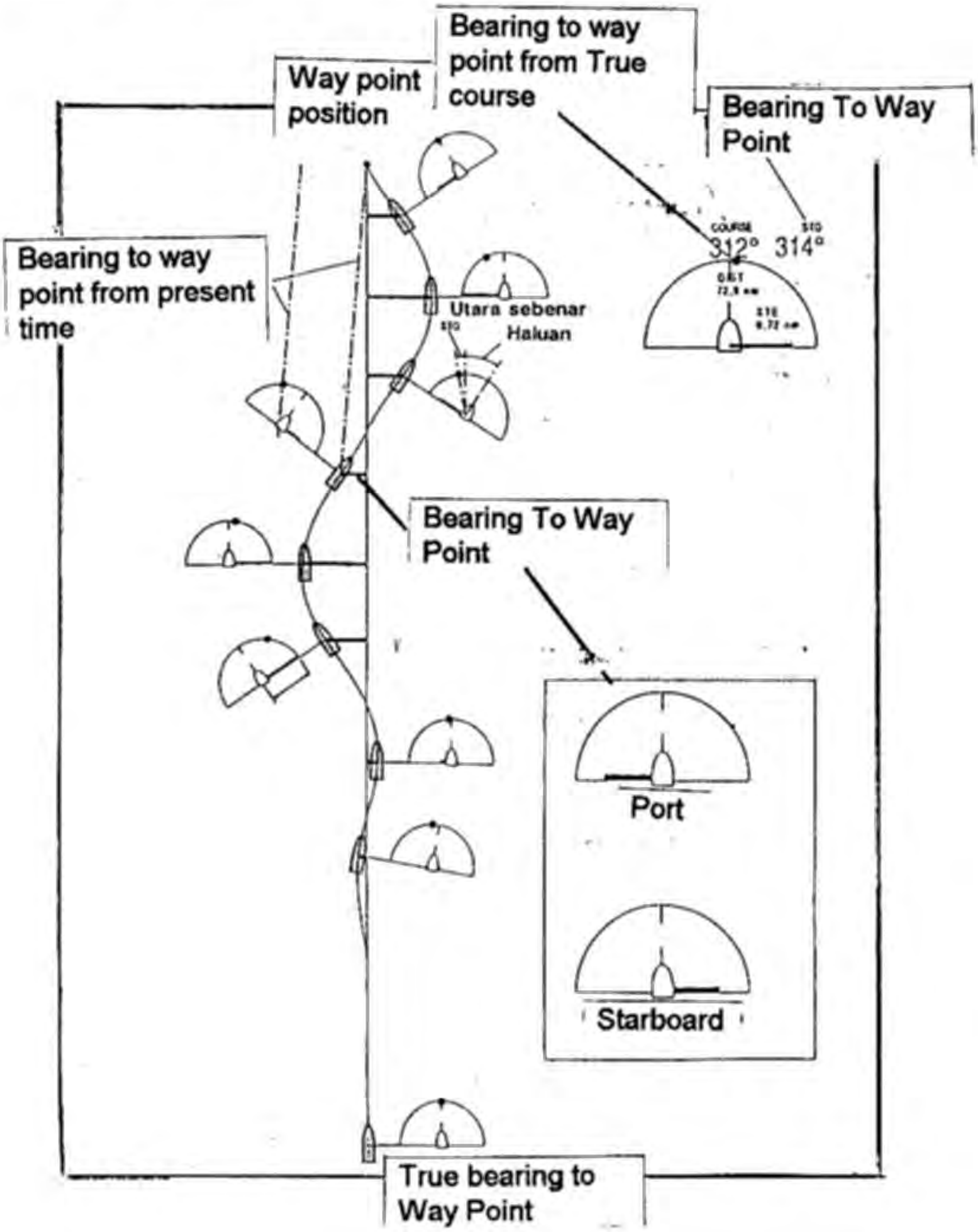
4.5. Way Point Position(WPT) and Route

The position of the way point determine first before start the navigation various position of way point can be combine together to make one route as shown below.(See Fig.3.5)



4.6. Cross Track Error (XTE)

How far the distance change and way off the boat out off the cross track from true route mantion as shown below. (See Fig. 3.6)

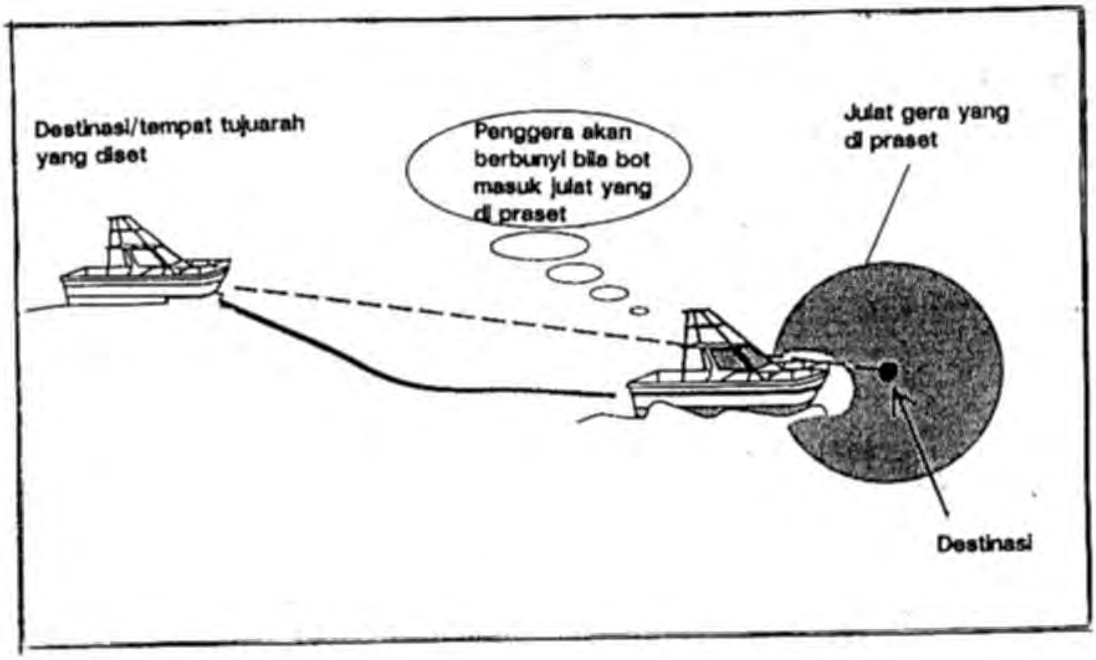


4.7. Alarm System

Alarm system use for knowing any different range that has determine.

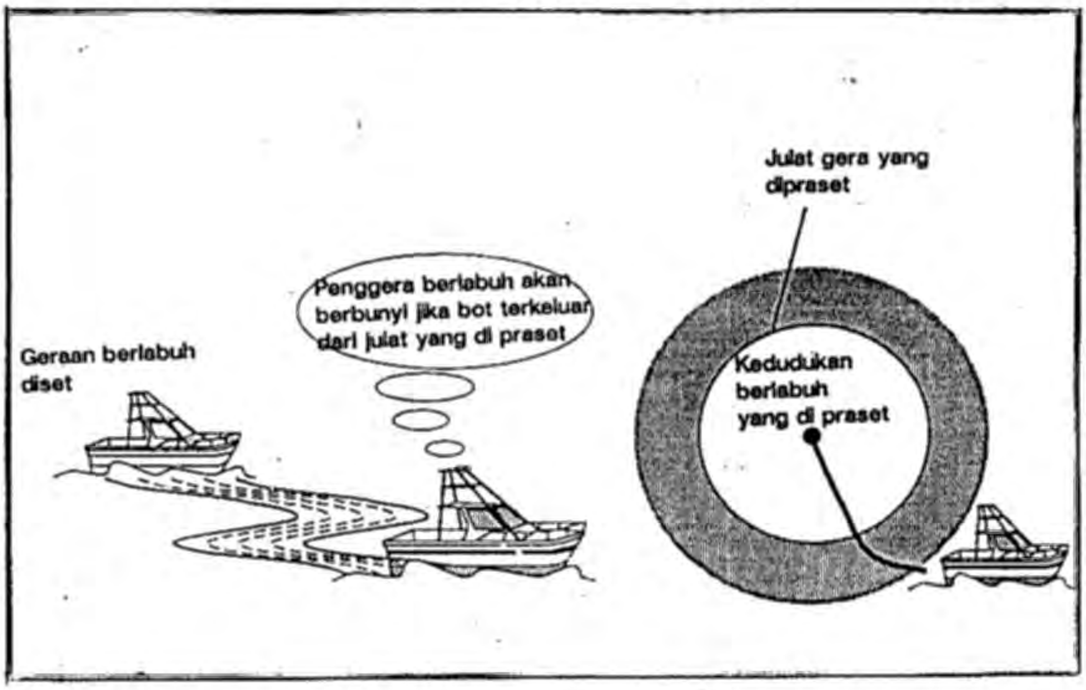
4.7.1. Arrival Alarm

When a boat arrive to the destination or to the way point at the border distance as determine, alarm system will be function as shown below.(See Fig. 3.7.1)



4.7.2. Anchor Watch Alarm (ANCW)

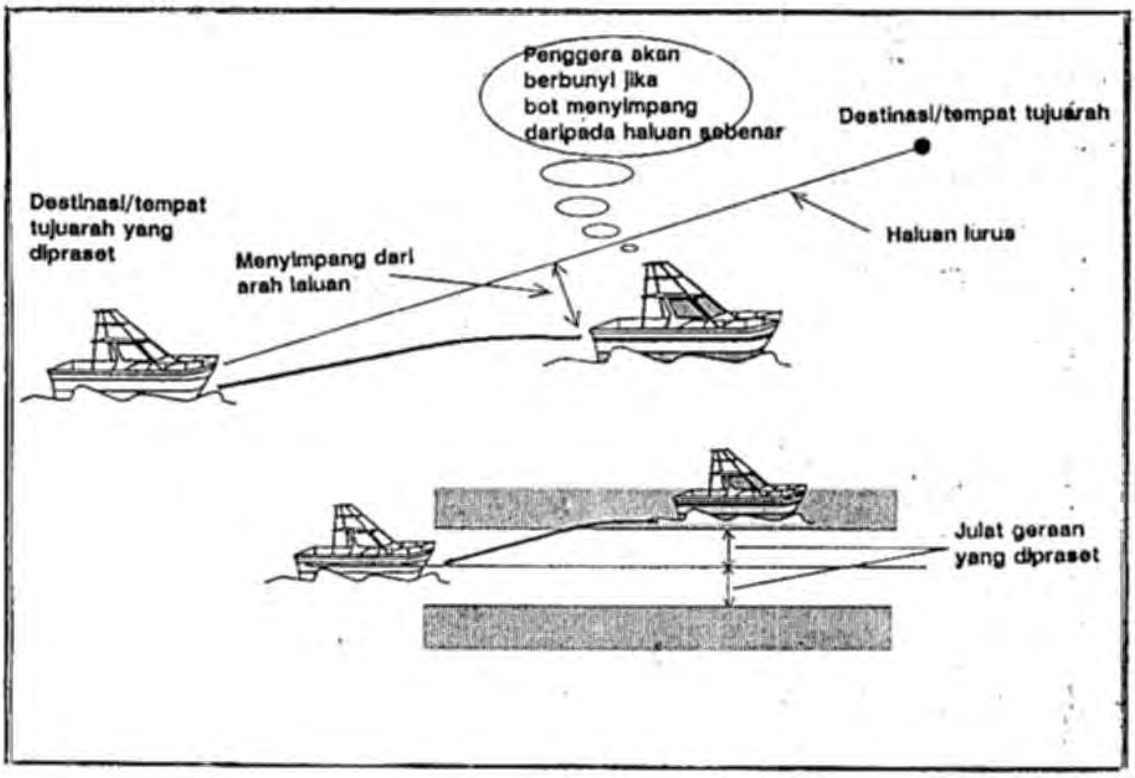
This Alarm system will be function when a boat out from the border at a distance as determine from anchor position as below. (See Fig. 3.7.2)



4.7.4. Cross Track Error Alarm (XTE)

How far the different route from way of the boat out from true track will be mantioned and when a boat out from distance limit as determine, alarm system ring.

FIGURE 3.7.1



5. Short Form

No.	English Language	Short Form
1.	Way Point	WPT
2.	Time To Go	TTG
3.	Estimated Time Arriving	ETA
4.	Steer To go	STG
5.	Latitude/Longitude	L/L(N/E)
6.	Speed	SPD
7.	Knot	Kt
8.	Distance	DIST
9.	Range	RNG
10	Horizontal Dilution Of Precision	HDOP
11	Course	CRS/C
12	Bearing	BRG/B
13	Route	RT
14	Cross Track Error	XTE
15	Navigation	NAV
16	Anchor Watch	ANCW
17	Enter	ENT
18	Proximate	PROX
19	Clear	CLR
20	Alarm	ALM

6. CONCLUSSION

By using GPS it can give a lot of profit many profit to the fishermen in effort to earning more and for the development of fisheries industry. GPS can give true position with fast and exact (+ 15) any where on the earth and can be use any time in all condition of weather. It is easy to install and use. It is use low power as a small size displace and need small area. Because of that, the GPS to become very important for fishermen in Malaysia.

By.
Mr Mohd Asri Bin Ismail
Fisheries Extension Centre
Terengganu.
Malaysia.

STUDY REPORT

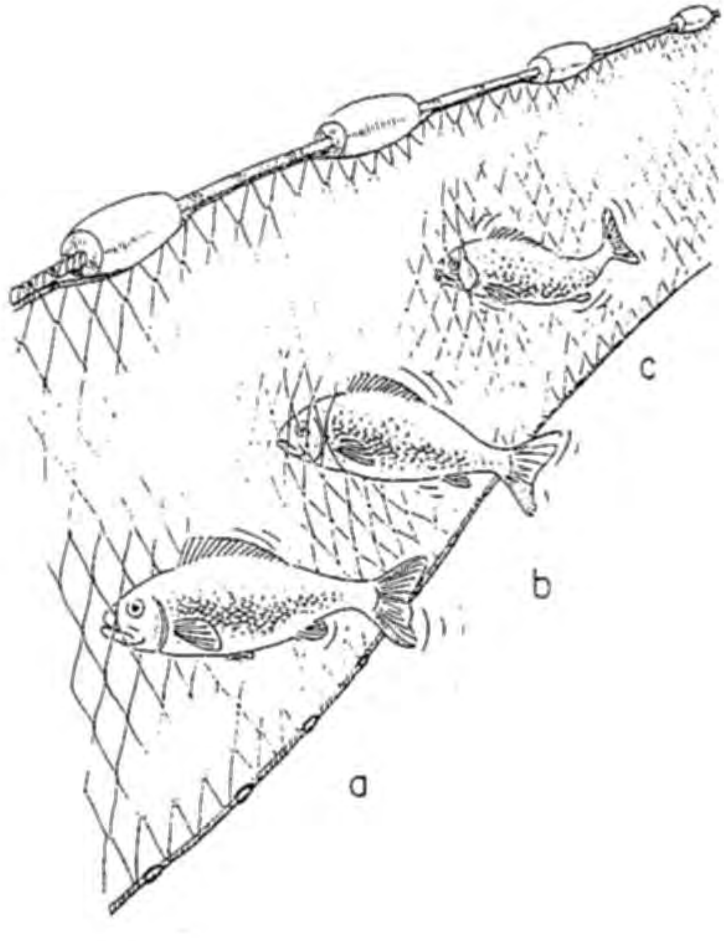
ON

GILL NET FISHERY

BY

MR. NOPPORN MANAJIT
SPECIAL TRAINEE
THE REGIONAL TRAINING COURSE IN FISHING
TECHNOLOGY AND RESOURCE CONSERVATION
(16th JUNE-15th DECEMBER)

TRAINING DEPARTMENT
SOUTHEAST ASIAN FISHERIES CENTER
SAMUTPRAKARN
THAILAND


c
b
a

Gill Net Fishery

Introduction

In developing fisheries, the first and foremost requirement is to introduce suitable fishing gear of greater efficiency, in oder to increase the effectiveness of fishing operations. However, in most cases, the introduction of foreign or modern fishing gear may not be appropriate owing to its high cost and its possible effects on the resources and environment. Modification of the existing traditional fishing gear to improve its catch ability is therefore recommended, in particular in the small-scale fisheries development of most developing countries around the world.

Today, we know that all food resources, including those in the sea, are not inexhaustible. The concept of conservation of resources has effected to fisheries. The first aim is no longer simply to catch a lot of fish but rather to maintain good catch without depleting the stocks.

With many fishing gears made of netting it is found that fish sometimes hang in the mesh. In trying to swim through a mesh of netting which is a little smaller than the largest circumference of their body, they get stuck or, in other word, "meshed". This can happened at the beginning of the dorsal fin of the fish, but mostly it will be behind the opercula and the gills or they are "gilled". The pressure of the mesh twine on the throat of the fish can cause the opercula to spread, and the net twine then hooks behind them so that the fish can go neither forward nor backward. By struggling to become free from the mesh the fish can further entangle itself. It may happen that small fishes can pass a mesh of a certain netting without difficulty., but bigger ones can be gilled, or gilled and entangled, and others, especially large ones, can be caught by entangling only, all in the same netting.

Characteristic of gill net fishery

The netting which is spread in the water to intercept the fish way and gill fish or get them entangled is generally called gill net. The gill net includes one which surrounds a fish school to get one gilled or ones which are spread on parallel in the water surrounded by a net.

The gill net is very simple gear so that it is being used all the world. It range from the small one handled by 1-2 fishermen to the large salmon drift net operated by a mother ship. Beside these, there are some nets for shrimps and craps, too.

Generally speaking, there are two fishing methods of the gill net, one of which is to gill such actively swimming spindle-shaped fishes as sardine, mackerel, salmon, trout and yellowtail etc.

The other is to get shrimps, crabs or flat fishes entangled with the net as they are difficult to gill. They are characterised by being inactive in swimming and not uniform in body size, so they are usually caught entangled with the bottom gill net.

Since the nets get fish enmeshed, there is a limit in size of fish to be caught by a certain mesh sized gill net. This is called selectivity of gill net.

Accordingly, mesh sized of gill nets must be determined assuming sizes of fish in fishing grounds. However, the mesh sizes of the bottom gill net or trammel net Which catches fish by getting them entangled does not much matter.

Flexibility and invisibility of netting cord to fish have a closed connection with the fishing efficiency, consequently, the selection of thread material is very important especially for a large scale of fish gill net fishery, such as salmon gill net fishery.

Gill nets are usually set across the direction of the migrating fish, so that they try to make their way through the meshes of the netting. For this reason, gill net can be operated in a variety of ways. Generally, Gill netting is a clear-water fishery, Used where there is not too strong a current. Gillnetting is not a fishery for deep waters. In too deep water, the hydrostatic pressure can compress the usual floats of cork or plastic to such an extent they lose their buoyancy and the gear can no longer function.

Their is a long list of the properties of a gill nets which may influence its efficiency and it may be that not all are known even now. Some of them depend on the gear construction, like mesh size and mesh shape, which influenced by the hanging of the netting, which also influences the slack of the netting. Of these properties, mesh size may be the most important. By the used of the correct mesh size and a high degree of uniformity in the size of all meshes, the gear become high selective so important for the management of the fish population. There may be no other gear which is as selective as gill nets in taking fish as a uniform size. Other properties influencing the efficiency of gill net depend on the material used for the netting of the gear. The most important are its low visibility, which depends not only the material used but also on its thickness, its knots (mostly double knots), its colour, and its contrast with the surroundings where the gear is set. Other properties influencing the efficiency of gill net are that the net should have the greatest possible softness and that it should have the lowest possible swelling from immersion in water. The net twines of the gill nets therefore have to be made as fine as possible, thus against reducing their visibility. To decreased the swell, netting should not be held tensely but should be as slack as possible. Slacking may be obtained in the construction of the gear by making the since lines of the gear much shorter than the depth of the netting. But this may increased the entangling effect of the gear more than the gilling effect. On the other hand, the water resistance of the netting will be decreased.

When comparing the visibility of the gill nets with its softness and its water resistance, visibility is the most important. The volume of a catch decreased with increasing visibility. It must be borne in mind that the visual faculty of fish differs not only according to the species but also according to their age and physiological condition. Therefore it is essential that the gill net should contrast as little as possible with its surroundings. A white cotton net, for example, would contrast far too much which what are usually darker surrounding, especially in clear water.

The efficiency of these nets has been increased sometimes by several hundred per cent when natural fibres have been replaced by less visible synthetic fibres (PA multifilaments), especially by transparent monofilaments (PA) or monotwines (twines made of monofilaments of PA and also PE). That fact has caused gill net fishery to expand considerably in recent years, and has decreased effort in some other fishing methods like beach seining, which need more manpower and money. gill nets made of monofilaments of surprising the transparency, scarcely visible without any disturbing sparkle in the knots. With the help of synthetic netting material of low visibility, it was proved possible to fish in clear water and during daytime.

The second important property of netting material used for gill nets is the softness of the twine. Visibility is more important, so that a hard net with a low visibility will catch more than a soft one with a high visibility, The softest will catch more. The importance of visibility decreases with the turbidity of the water. So it may happen that the same gill net with low visibility and high efficiency in clear water, may catch less than others in muddy water, because the others have a higher degree of softness. It has been mentioned before that the netting yarns of gill net should be as fine as possible, to decrease visibility and to increase softness. On the other hand, netting of very fine material in not Japan International Cooperation Agency only difficult to handle but it more prone to damage than thicker material. Moreover, very fine netting material may cut and damage some species (e.g. herring), known as "soft" fish.

Classification of the gill net

Surface gill net

One end or both ends of the surface gill net are fixed with anchors against the sea current to gill fish swimming near the water surface. Generally, the net is operated on a small scale in such slow current and shallow area as in back bay, small strait and coastal waters for sardine, mackerel, hours mackerel, salmon and trout etc.

Bottom gill net

Both end of the bottom gill net are fixed with anchors to be set on the sea bottom sea bottom for entangling bottom dwellers. The total sinking power of netting, ropes and sinkers of the net is larger than the buoyancy of float which are just floating in the water for spreading the netting vertical.

Being employed for taking bottom dwellers, some bottom gill net are all the time kept on a certain sea bottom where it is suitable for them to live. The net catch flounder, plaice, herring, horse mackerel, mackerel, yellowtail, sea bream, dogfish, shrimp, crab, mullet, carp and miscellaneous fishes.

Trammel net

The trammel net is a kind of bottom gill net (sometimes called bottom stake net) which consist of two large mesh outer net and one small mesh inner net. Fish which are rushing toward the trammel net pass through an outer net and are hung down by the inner and the other outer nets. The net fishes very efficiently and various sizes of fish could be caught by it if proper mesh size especially larger mesh outer nets are used.

Drift gill net

As the name implies, the net is not fixed with anchors but is drifted at the merry of the tidal current.

The drift net goes adrift on the water surface or in the mid-water of high seas in the most cases. The drift net is particularly used in a wide area on a large fishing scale among kinds of gill nets. The mid-water drift net is hung to the mid water by ropes fastened to tube floating on the water surface.

Drift nets catch sardine, saury pike, salmon, trout, Spanish mackerel, flying fish, tuna and skipjack etc.

Surround gill net

Upon finding schooling, the fishermen encircle the fish with the net to drive them in to the net for enmeshing them by beating the water surface, or spread gill net in a surround ~~area.~~ed area.

Generally the surrounding gill net is just deep enough to reach with its foot the sea bottom with a depth of about 30 meters.

Gill nets are usually used at night, but surround gill nets are done in the day time to encircle a fish school after finding one. The latter, accordingly, catches fish fishes which have a habit of gathering densely in a school, such as yellowtail, black sea bream and mullet so on.

Condition to be provided with gill nets

1.Kinds and characters of thread for gill nets

The overwhelming majority of gill nets are made of nylon thread, because of being superior in every point to any of synthetic fibres. Particularly the most important thing, the tensile strength of nylon thread is highest among the synthetic fibres and it is pliable and elongates 50% in breaking strength so that it is suitable to enmesh fish. Next to nylon thread, polyester thread is durable in tensile strength, about 70% to the former and elongates 30%, therefore it is said also good as flexibility for the gill net.

There were no large differences in catches of salmon and trout in the North Pacific by nylon monofilament gill nets and polypropylene gill nets. Nylon fibre, however, is far stronger than polypropylene in unit -compact and what is worse the latter is difficult to dye and raises nap on it, gradually lowering the gilling efficiency.

The gilling efficiency of polypropylene netting decrease by about 20% annually. It seem that colour of netting same with that of the background is good, in general blue-green matches and silver-grey is also suitable in the North Pacific.

Through the net is weakened by fishing operations, the principal factors are attributable to pulling power, impact and abrasion incurred at the time of the net hauling.

The limit of the tensile strength of a gill net usable for the fishing operations generally up to hydraulic resistance on the fishing gear, impact by waves, fatigue, wear and tear and safety limit of the netting against the maximum quantity of fish catch.

The fishing gear must be strong enough in accordance with the characteristic of its operation, especially it must be unti-impact breaking. This is the dimension closely the tensile strength of the netting and the extent of its elongation.

Pliability, bending flexibility, water-shedding, shrinkage and elongation by water absorption of the netting and ropes, volume of the netting when being stowed away and deformation of the net by the tide current are greatly important factors to increase the net-handling and fishing efficiencies.

Important things which participate in appropriate mesh size of a gill net are pliability, elongation of twine and recovery of Young's flexibility rate.

From the viewpoint of gilling efficiency, the twine which elongates too much is not good, on the other hand the both and which does not elongate much usually does not last long.

2.Color of gill net and gilling efficiency

(1) Eyesight: Except a few fishes, most of fishes have a pair of eyes on the tip of the head. As is the same with Mammalian, the fish eye is ball-shaped and composed of cornea, iris, pupil, lens and retina, but fishes do not closed their eyelids and the lens are glob-shaped. Accordingly, they sleep keeping their eyes opened. Fishes move their lenses forward and backward to see something, which is reflected on the retinas.

The distance in which something in the water is distinguished with eyes is called visual distance. It is said that there is little difference in visual distance between fish and man.

(2) Colour sense: Fish have much sense of seeing brightness and darkness rather than colour

(3) Colour of gill net: It goes without saying that it is desirable that fish are to be gilled not being stimulated on their eyesight sense. It is difficult for fish to notice a transparent net or one coloured about same with the background colour in the water.

Before synthetic fibre net come in to use for fishing, most of net were tarred(black) or catch-treated (brown) to prevent them from being corroded.

However, as synthetic fibre is dyed for any colour, gill nets are dyed blue, light grey, white and blue-green which are similar to the background in colour in the water. It gill nets operated at night in fishing grounds where phosphorescence of schooling fish is reflected or the moonlight is very bright, the fishing efficiency will drop down.

Experiment of sardine gill nets conducted daytime in water 90-110 meters deep, 15-20 meters in transparency and 38-60 meters in length of net hanging rope showed that the best colour of net in gilling efficiency was light-grey followed by black, red blue and green, on the contrary yellow, and white nets were no good. This was because the colours of nets changed into light and darkness in such deep water, in consequence the colours of the nets which became dark were effective for gilling fish, but those which were seen bright were ineffective. But there were no significant differences among various colours of nets when the nets were operated at night.

Advantages and disadvantages of gill net

Gill net is of special interest for artisanal fisheries because it is a low cost fishery. Not so much has to be invested in nets and their maintenance. Moreover, no specialized vessels are needed, and in tropical areas these nets can be operated without any vessel, by swimming and diving fishermen. As rowing boats or simple motor boats with a low power are adequate for gillnet, only a small number crew is needed when using a relatively small number of nets. Therefore, this method of fishing is widely practised all over the world and can be considered a typical small-scale fishery method which can be very effective, especially when monofilament nets are used. These advantages decrease when larger numbers of nets are operated. These can make this fishery labour-intensive in gear making and mending, setting and hauling, and especially by the work of removing the gilled and entangled fish from the netting. Therefore, all fisheries that employ large numbers of gillnets are today expensive, but the use of gill nets does permit careful fishing.

The quality of fish caught is appreciated much more than that of fish taken with other gear, particularly those caught by dragged bottom gear . Better quality may be true for drift nets as caught fish are removed fairly promptly in contrast to set nets, which have to stay longer in the water and may suffer losses by predatory fish or crabs. Sometimes it is mentioned that due to the higher elasticity of some synthetic netting yarns, the gilled are pressed much more and die quicker than in gill nets made of natural fibres. This adversely the quality of the catch.

The advantages afforded by the introduction of synthetic fibres, in particular of transparent monofilaments, were stressed, particularly in relation to the efficiency of the gill nets. Such nets not only catch more but, being non-rotting, can also be used much longer. Experience, however, has revealed one disadvantage which even roused the attention of the

Table 1. Annual catch by gill nets, 1978-1982

Type of gill net	Year (mt)				
	1978	1979	1980	1981	1982
Spanish mackerel	6,418	10,130	12,080	20,056	25,035
Mackerel encircling	32,575	66,476	50,209	34,178	27,888
Pomfret	1,307	735	1,222	801	784
Shrimp	12,910	12,720	12,752	18,047	13,431
Others	38,464	54,190	44,864	47,782	40,590
Total	91,674	144,251	121,131	120,865	107,728

However, the Spanish mackerel gill net fishing grew rapidly, until 1982 the catch was four times larger than in 1978. Most of the increase in catch was due to the presence of longtail tuna and eastern little tuna.

The mackerel encircling gill net also sustained a relatively high annual production. The major species caught by this gear is Indo-Pacific mackerel, a very popular fish known as pla-too in Thailand. The catch of Indo-Pacific mackerel was particularly high in 1979, when the production of mackerel encircling gill net double in relation to any 'normal' year. In 1980, the catch was also high, this time thanks to an exceptional abundance of sardine.

Pomfret is a very high value fish, but the annual by pomfret gill net is comparatively low.

The annual production by shrimp gill nets appears steady, about 13,000 tons. Shrimp gill net fishing has played an important role in spite of low production, because the captured shrimps have a high value.

The proportion of catch by other gill nets is rather high. Among these gears the most noteworthy is swimming crab gill net, which is usually operated by small boats, but has a comparatively high production.

The main species caught by various gill nets in 1982 were as follow :

Spanish mackerel gill net	Catch/year (mt)
Longtail tuna	10,392
Eastern little tuna	9,308
Spanish mackerel	3,300
Others	2,035
Total	**25,035**

Mackerel encircling gill net	
Indo-Pacific mackerel	23,804
Jack, Cavally	1,124
Longtail tuna	1,123
Indian mackerel	942
Eastern little tuna	744
Others	151
Total	**27,888**
Pomfret gill net	
Black pomfret	518
Others	266
Total	**784**
Shrimp gill net	
Penaeid prawns	8,301
Non-penaeid prawns	1,579
Swimming crab	408
Others	3,143
Total	**13,431**
Other gill net	
Swimming crab	11,217
Indo-Pacific mackerel	4,667
Mullet	4,621
Indian mackerel	1,818
Sardine	1,562
Others	16,705
Total	**40,590**

Fishing gear and methods

Surface gill net

This gill net is operated on a small-scale, mostly in very shallow waters and inlets. The net is fixed with anchor or bamboo poles. The netting is made of either nylon monofilament or nylon multifilament. The main size ranges from 4.0 to 8.5 cm, and the high of net from 0.9 to 3.6 m. The hanging ratio is around 0.5. Some surface gill nets for mullet are spread suspended on the water surface and with bamboo stakes and have neither floats nor sinkers.

Drift gill net

There are various kinds of drift gill nets. Nylon multifilament is most often used as the netting material, but the yarn size varies from 210 d/4 to 210 d/18. Green colour nets are commonly used. Some drift gill nets, especially those for Spanish mackerel and pomfret, have a width of saran nylon netting attached along the bottom edge. This acts as a sinker because the specific gravity of saran nylon yarn is greater than that of nylon multifilament.

The drift gill net for Spanish mackerel is operated on a large scale. netting yarn varies from 210 d/9 to 210 d/18, the size of mesh is around 6 to 10 cm, and the high of net ranges from 4.5 to 12 m.

Bottom gill net

Nylon monofilament and nylon multifilament are the main materials for the netting of most bottom gill net. The specifications such as the mesh size, the length and height of net, and the hanging ratio, vary for different species of marine animals. In the case of bottom gill net for blue swimming crab which is most widely operated, the mesh size is about 10-12 cm, height of net is about 120 cm and the hanging ratio is around 0.5. The bottom gill net for whiting is comparatively smaller than other bottom gill nets; its mesh size is about 2.5-3.0 cm, height of the net is 65-120 cm, and the hanging ratio ranges from 0.52-0.68. In contrast, the bottom gill net for giant greenfish, scad and trevally, has large dimensions; the mesh size is 9.0-9.5 cm, and height is about 8 m, so that sometime when it is operated in shallow waters it intercepts anything swimming between the bottom and the surface of the sea. Bottom gill net are operated in shallow coastal waters where the depth ranges between 3 and 40 m.

Trammel net

Trammels net are commonly operated to catch shrimps. The netting for trammel nets is in most cases made of nylon multifilament ; the size for the inner net is 210 d/2 whereas for the outer net it is 210 d/4. There are some local variations in construction of gear ; the size of mesh for the inner net is usually 4 cm, but for the outer net it ranges from 14 to 26 cm The hanging ratio of the inner net does not so much,; it is about 0.46-0.48 on the float lines, and 0.55-0.57 on the sinker lines. There is, however, a considerable difference in hanging ratio of the outer net ; we came across nets with a high hanging ratio such as 0.79, and other with a low hanging ratio of only 0.37.

Fishing operation is carried out in either day or night time. the net is shot across the tide, and allowed the drift by the tide for one hour before hauling. The water depth of fishing ground is between 5 and 20 m. Trammel net for the cuttlefish is set along the coast for 12 hours in the day time.

Conclusion

Gill net are a fishing gear with a high degree of selectivity, regulated by the mesh size. They contrast with entangling nets, which which have a very low selectivity. It has also been mentioned that this selectivity is very important for the management of a fish population. Because, with the gill net, fishermen can decide on the size of mesh to be used so that only fish of a certain circumference are caught (smaller ones would be able to swim through the net), the used of the passive gear gives the advantaged that fish stocks can be exploited more selectively than by any other gear. In oder to spare young fish, or fish that are too small for the market.

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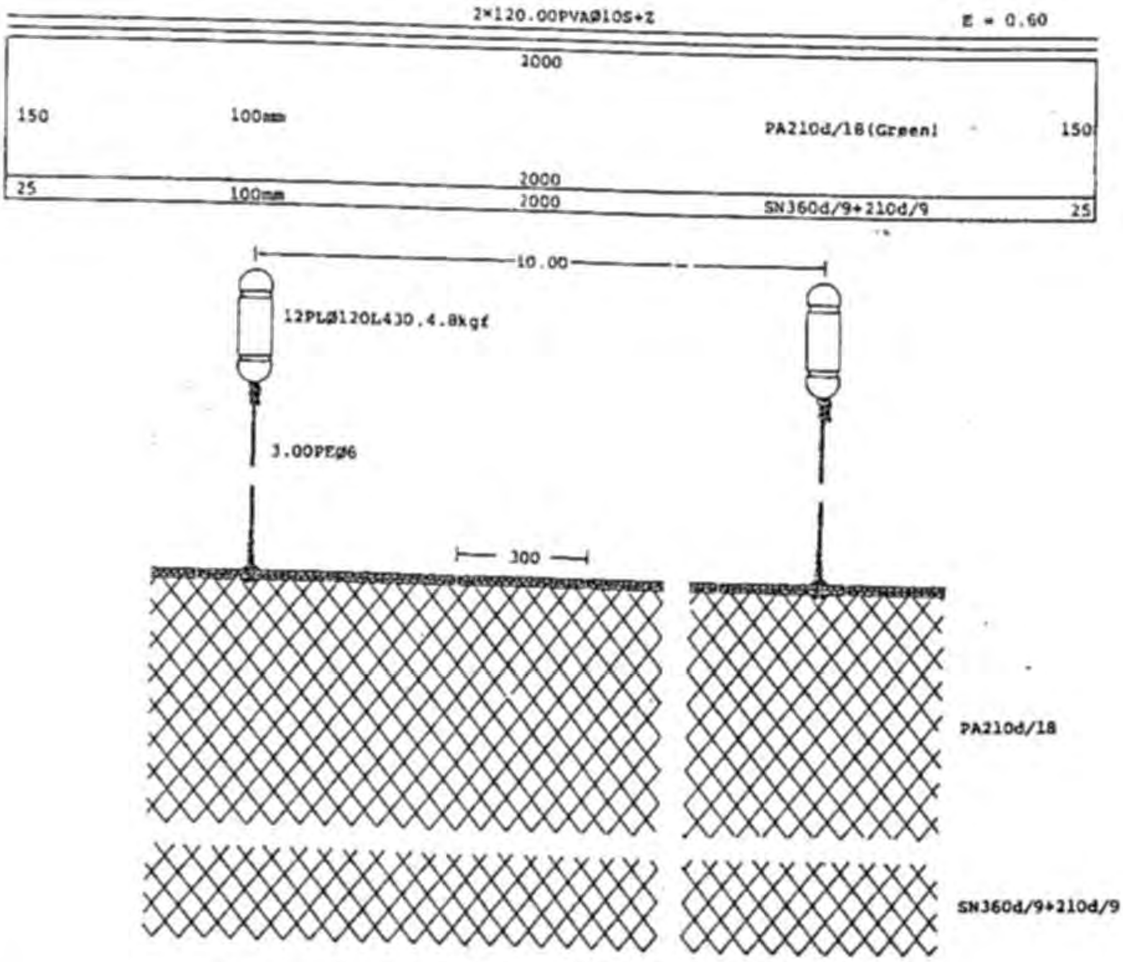
GILL NET
Driftnet
Spanish mackerel

VESSEL
Loa 17 m
hp 120

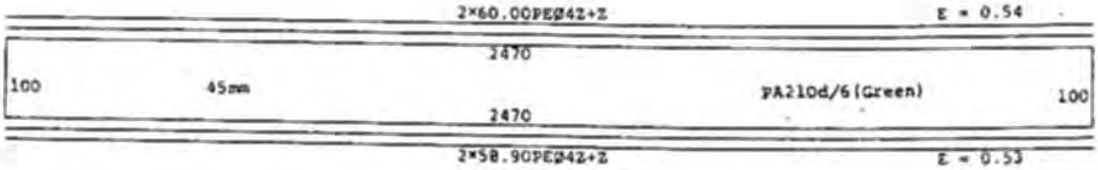
LOCATION
Pattani
Pattani

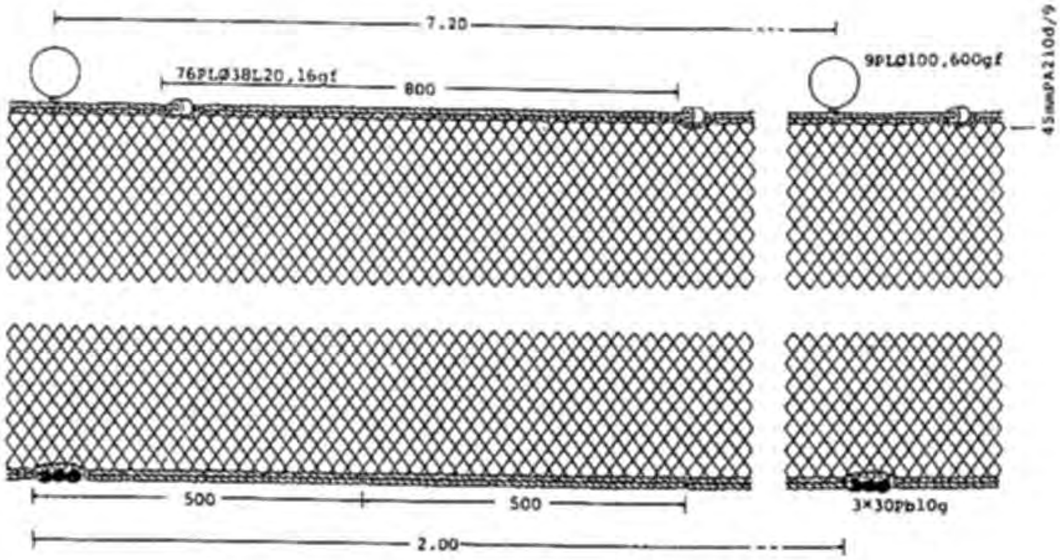


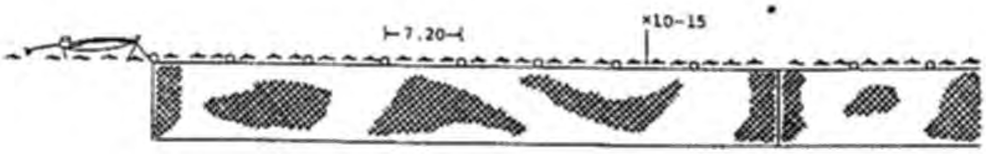
GILL NET
Driftnet
Indo-Pacific mackerel

VESSEL
Loa 10 m
hp 5 LT

LOCATION
Laem Sak
Krabi



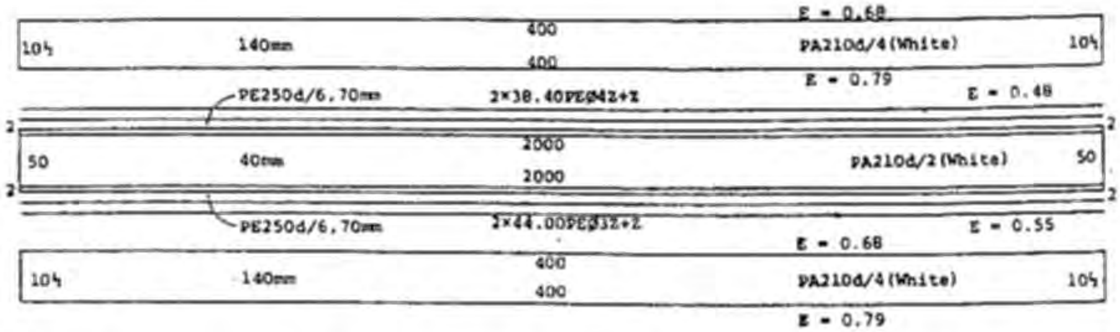


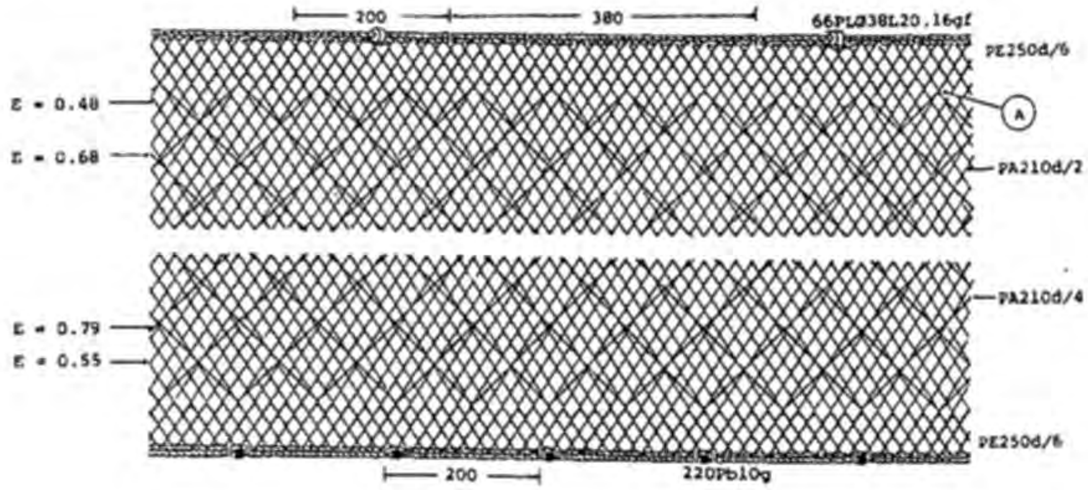


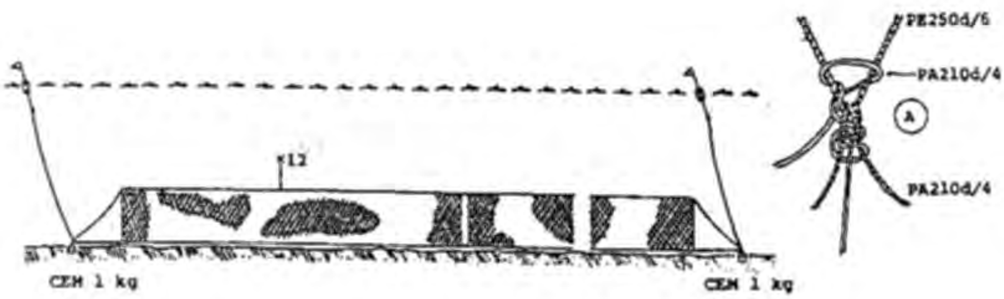
GILL NET
Trammel, Bottom set
Shrimp

VESSEL
Loa 10 m
hp 6 LT

LOCATION
Thasala
Nakhonsithammarat



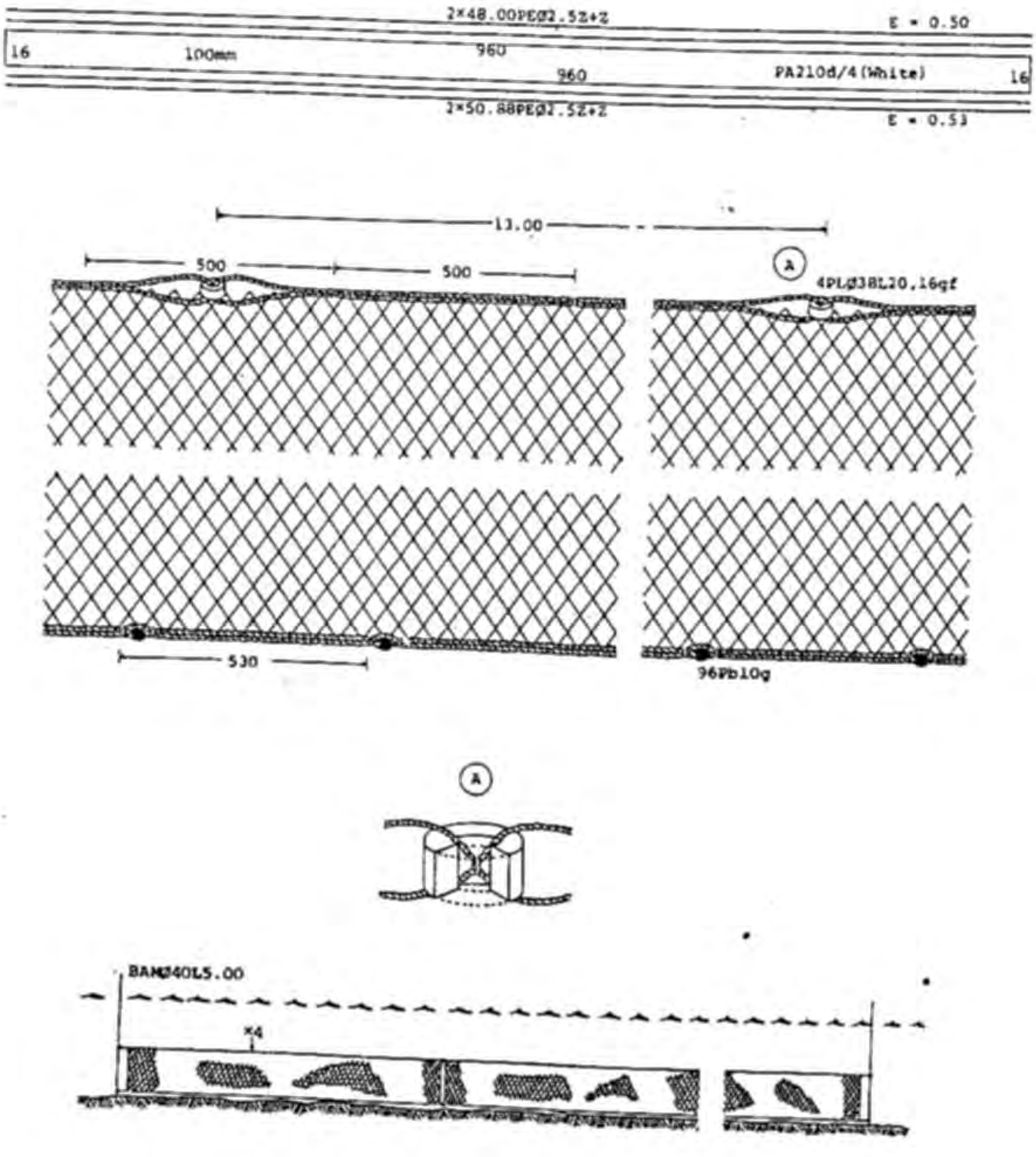




GILL NET
Bottom set
Blue swimming crab

VESSEL
Loa 8 m
hp 7 LT

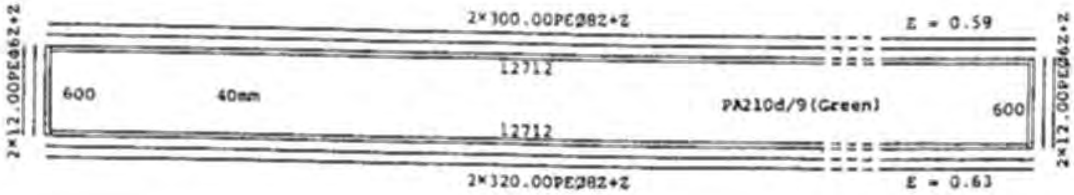
LOCATION
Thachang
Suratthani

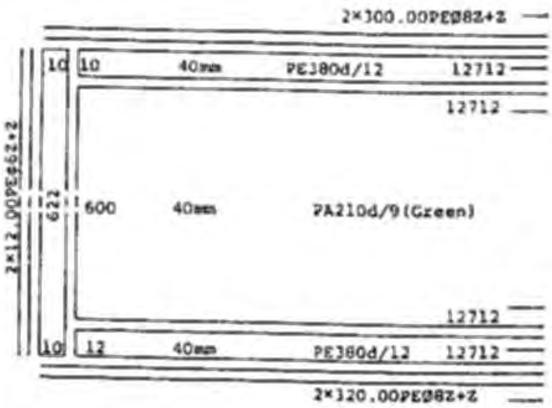


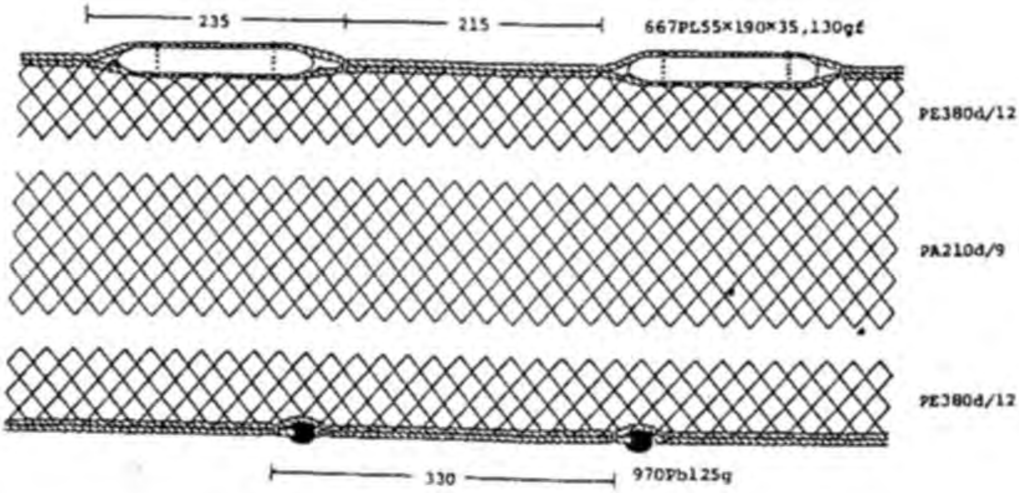
GILL NET
Bottom set, Encircling
Indo-Pacific mackerel

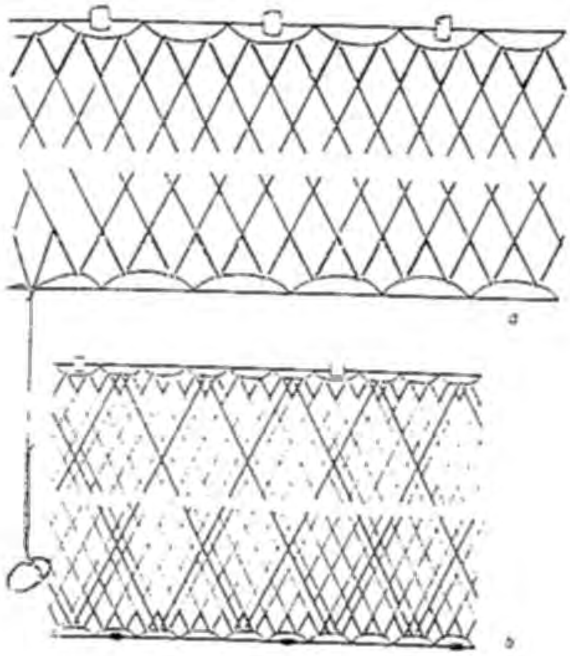
VESSEL
Loa 8 m
hp 24

LOCATION
Bangyaphlack
Samutsakhon

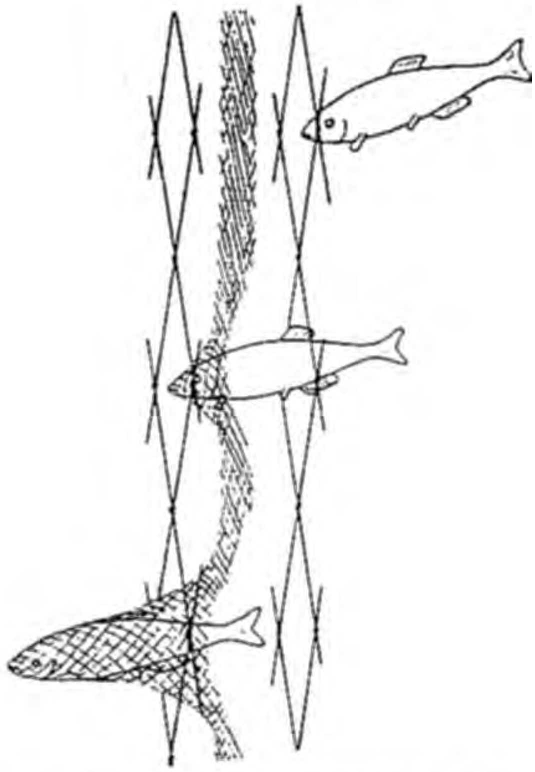




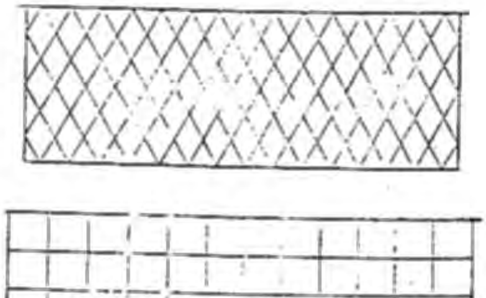




Turkish sturgeon nets: (*a*) single walled; (*b*) trammelnet.



How a trammelnet operates: the fish entangle themselves by forming a pocket of the small-meshed webbing between the two big-meshed walls.



Different forms of hanging the outer walls of a trammel net: (*a*) rhombic (*b*) quadrangular.

STUDY REPORT
ON

PURSE SEINE FISHING IN VIET NAM

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VIET NAM

Regional Training Course in Fishing Technology
16 / June -- 15 / December / 1997

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Samutprakan, Thai land

INTRODUCTION

Viet nam coast line is over 3,200 k.m long and the exclusive economic zone is about one million square kilometers

Marine product exploitation is important in the development of the marine economy . There are approximately 960 species of fish ,with stock about 2,219,997 tons including :1,274,000 tons Pelagic fishes and 945,997 tons demersal fish . Annual catch is about one million tons per year .

Most fishing boats in Vietnam are small boats with main engine power less than 100 hp . Some of them have higher power and modern equipment such as Radar , Sonar echo sounder GPS, Navigator , Radio transceiver , etc. ...

Many fishing gear are used, but normally : Trawl . Purse seine , Gillnet , Hook and line .

Over catching in the coastal zone where the depth is less than 40 meters has caused serious resource exhaustion . To improve this situation', Government of Vietnam has encouraged and conducted Fishermen to expand fishing ground to pelagic area , where the depth is over 40 m.

In this report We only mention one kind of purse , that is present used effectively in some area

FISHING GROUND AND SEASONS

1 SEA CONDITIONS

Coast line of Viet nam is divided to three parts

- ***Northern coastal area:***

It is limited from : 21°50 N to 17° N, about :140,000 sq. km

Along the coast line has many big river mouths, large amount of nutrient occur at the river mouth and estuaries, it is good for fish

The bottom is the same of depth, average depth is about 30m to 40m and the deepest is over 100m This area has two seasons :

-- The summer : it is from April to September with average temperature about :29 ° -30° c , the current direction is from North to South and going near by the coast line Storm and typhoon normally operates in this season

-- The winter : From October to march of next year . In the winter temperature is around 23 °- 24°c, and there is strong north wind so it is difficult for fishing .the current direction is from South to North and going further from the coast line

There are two fishing seasons :

North season : From October to march of next year

South season : From April to September . This is also main season for furse seine fishing

- ***Mid coastal area*** :

It lies at 17°N to 11° N ,about 63,800 sq.km . There are many mountain, which lies along the coast line . the sea bottom near this area is rather deep , in some places the depth exceeds over 1,000 m . The mid coast of Viet nam is usually effected by storm from the sea Temperature of area varies from 29° c to 33° c The salinity is very high and ranges from 30‰ to 36‰

This area has two seasons , but not usually :

-- Wet season: From June to December .In this season current direction is from north to south

-- Dry season : From January to may , the current direction is from south to north.

The special feature of the mid coast is rather deep . The grip line of the 100 m depth is about 10 NM from coast line . this area is assemblage of sea current s , which attracts many migrating fish schools to come

The purse seine can be operated better in this area from April to august

- ***Southern coastal area:***

It is from 11° N to 5° N . The deep sea is equal or around : 30 m -- 40 m ,sea bottom is sandy and muddy There are many big river mouths in the coast line , that provide a large feeding area for fish . The salinity of sea water is from 15 ‰ -- 20‰ , and average temperature about : 27 °c -- 29 ° c

There are two seasons in this area :

-- Wet season : From June to December
-- Dry season : From January to may
The current is complex , but normally the same as mid area . Fishing operation can be al the year .

2 FISH IS CAUGHT BY PURSE SEINE

Normally species of Fish is caught by purse seine fishing in Vietnam are : Sardine , Mackerel , Skipjack tuna , Frigate mackerel , bigeye scad , Cat fish , Russel's scad , Anchovy . etc. ...

Fish is caught by Purse seine depends on the size of Net, fishing ground and the Season .

3 FISHING BOAT AND EQUIPMENT

- ***Fishing boat*** :

Length	L = 24 - 26 m
Breadth	B = 5.2 - 6 m
Depth	D = 2.2 - 2.5 m
Draft	d = 1.5 - 1.7 m

Speed :

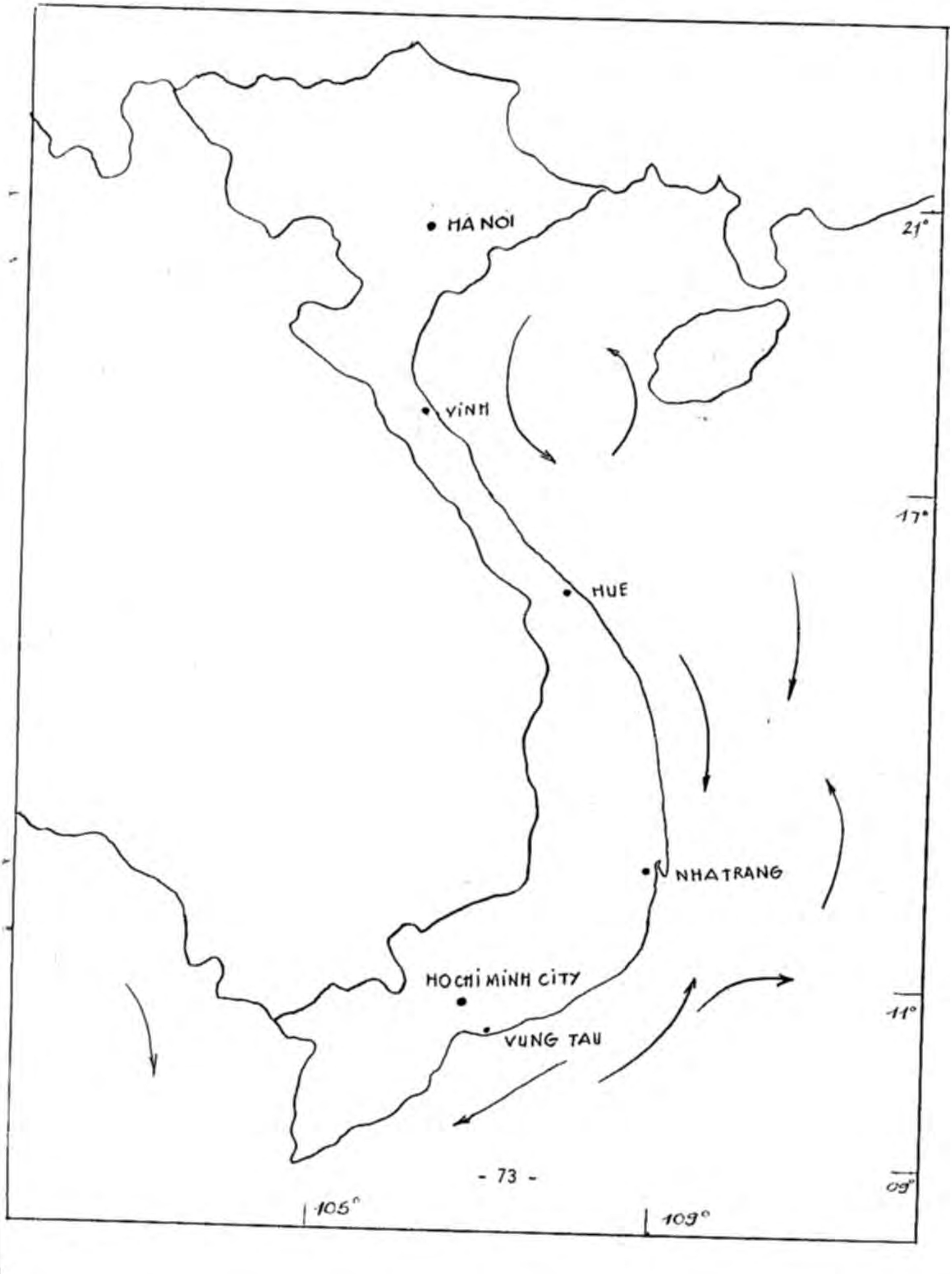
Free	9 -- 12 knot
Trawl fishing	3.2 -- 3.6 knot

Gross tonnage	45 -- 60 tons
Engine power	120 --150 hp
Generators	7.5 and 10 kW
Capstan winch	6 -- 10 tons
Small boat	15 hp

- ***equipment*** :

Sonar echo sounder
Radar
Radio Transceiver
Global positioning system navigation

Fig . 1 Fishing ground and current



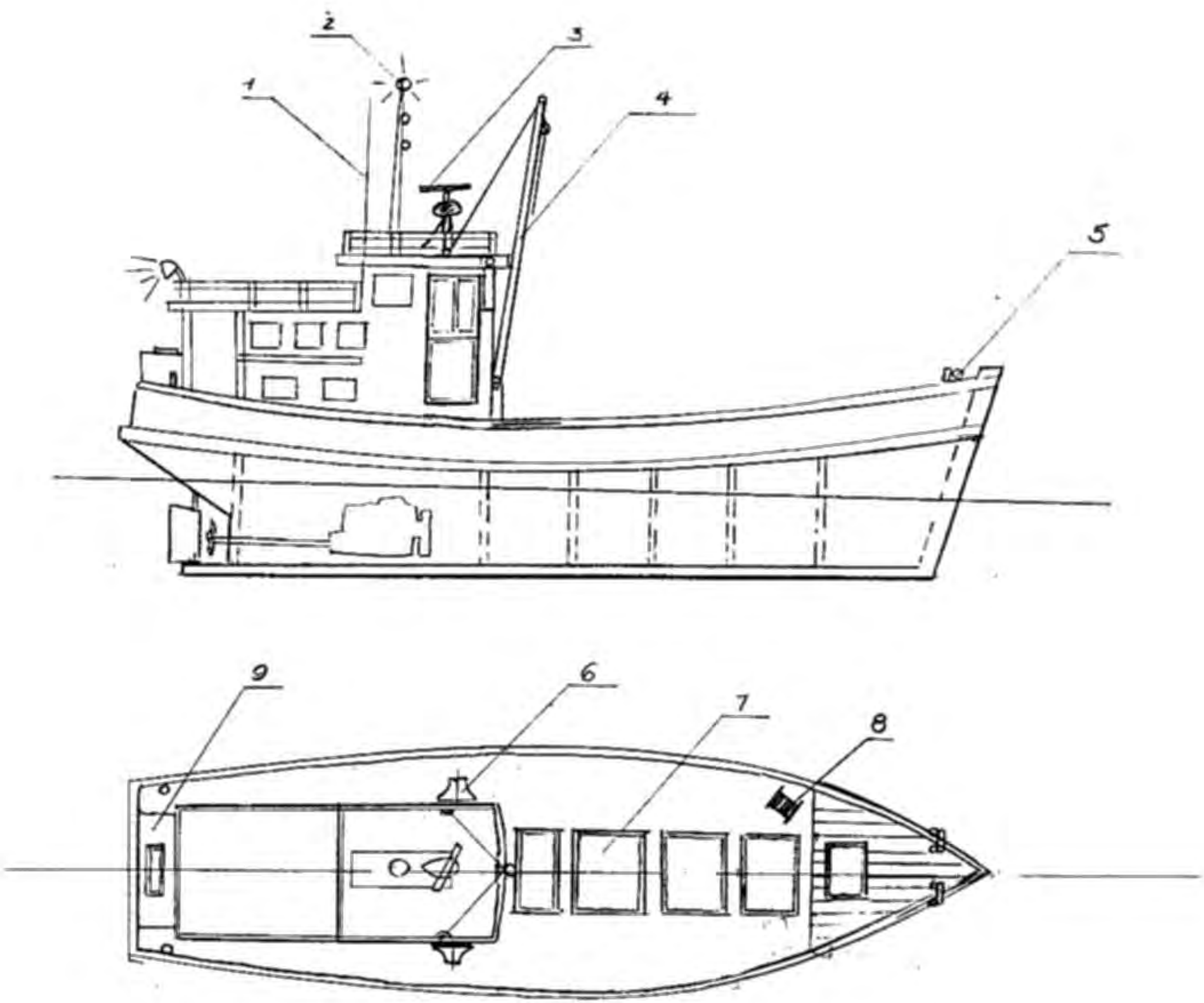


Fig 2 Purse seine fishing boat

1. Radio comunication
2. Fishing Light
3. Rada antenna
4. GIL SOM
5. Pulley
6. Capstan winch
7. Fish hold
8. Reel winch
9. Fresh water tank

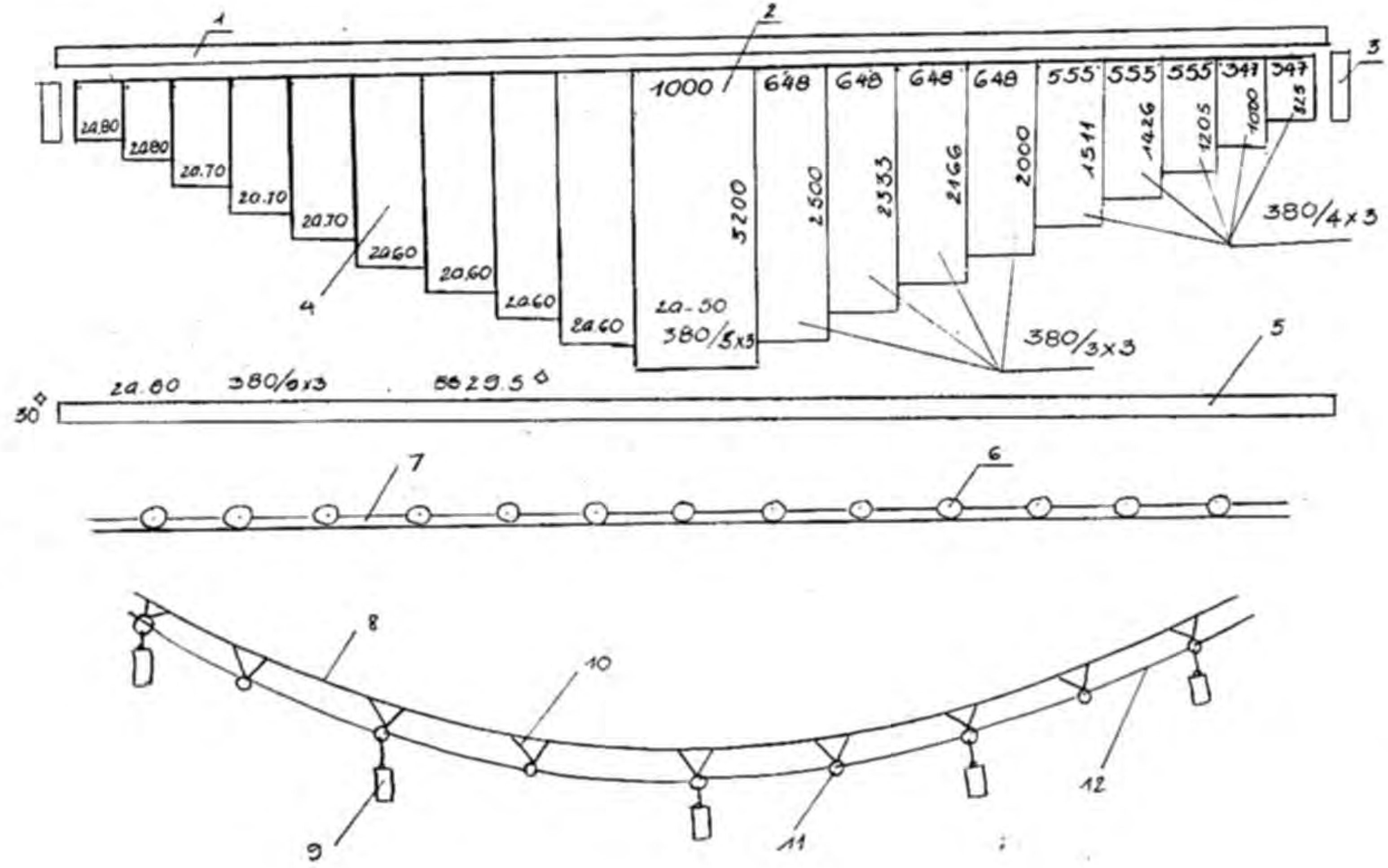


Fig. 3 Design of Purse seine net

1. upper selvage net
2. Bunt or cod end
3. side selvage net
4. Wing net
5. Lower selvage net
6. Float
7. Float line
8. Sinker Line
9. Sinker
10. Bridle
11. Purse Ring
12. Purse line

Total number of distances	Length of distance	Position
10	5.5 m	At the wing
17	6.5 m	At the belly
9	8.5 m	At the belly
9	10.5 m	At the bunt

- ***Bridle rope:***

Polyethylene rope , Φ 8 mm is used for bridle rope . The length of bridle rope is 2.5 m . Distance between two rope of a ring attached to the sinker line is 2.3 m (see figure 4) . Relation of bridle , ring and sinker line is shown in figure 5

- ***Purse line:***

Total number of purse line : 320 m , that is inserted through the rings. There 4 attachments of purse line :

-- Two pieces is both the ends : Nylon , 150 m

-- Two pieces is body with cable Φ 10 covered by nylon Φ 30 , 260 m

Relation of distances by swivels , that protect purse line not to twist during use

- ***extra rope:***

This rope connects with the float line at the end of the net. It is 100 meters long . When shooting the net to surround the fish school . some time the ends of the net can not meet , then this rope will be used Extra rope is polyethylene Φ25

- ***Side line:***

Construction of side line is the same sinker line . there is a rope polyethylene Φ 12 , that is used to pull the wing of the net

- ***Selvage:***

This part of the net acts like a frame to prevent the body net and the bunt being damaged during use . The selvage is divided in to three parts , large size and stronger webbing twine is shown in table 1

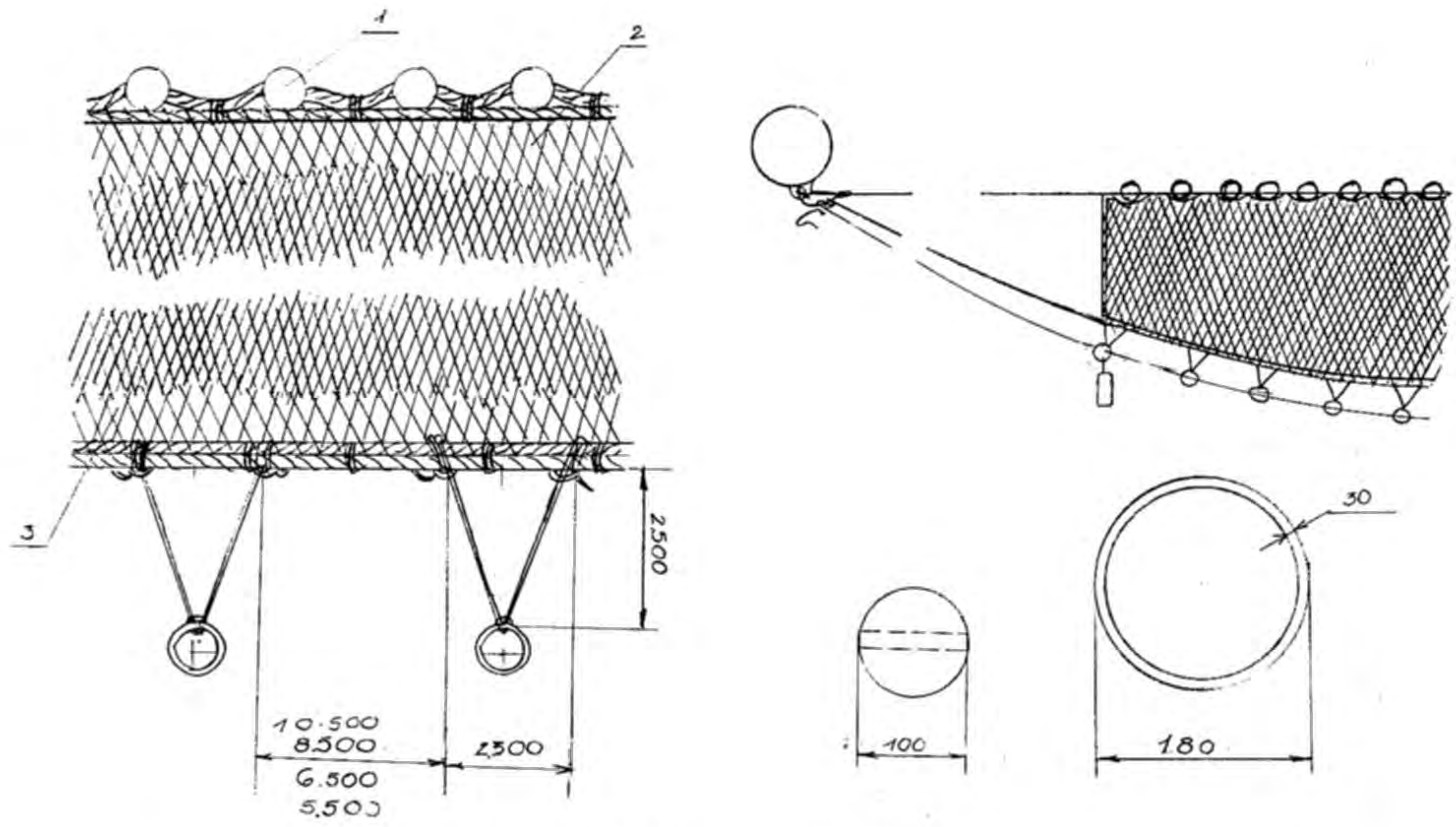


Fig. 4. Construction of purse seine

• ***table 1 construction of purse seine***

No	Name	Particular
1	bunt	PE 300d/ 15 5.0 cm M.s -- 1.000 M.l -- 3.200 M .d 1.p .es
2	Belly	PE 380d / 9 6.0 cm M.s -- 648 M.l -- 2.500 M.d 2.p.es -- 2.333 M.d 2. p.es -- 2.166 M.d 2. p.es -- 2 .000 Md 2. p.es
3	Wing next belly -- At the and	PE 380d / 12 7.0 cm Ms -- 555 Ml --1.571 Md 2. p.es PE 380d /15 8.0 cm Ms -- 347 Ml -- 1.000 Md 2. p.es
4	Upper selvage	PE 380d /27 8.0 cm Ms -- 8.830 Ml --30 Md 1. p.es
5	Lower selvage	PE 380 / 27 8.0 cm Ms -- 8.830 Ml -- 30 Md 1. p.es
6	Side selvage	PE 380d /27 8.0 cm Ms -- 875 Ml --5 Md 2. p.es
7	Float line	PE Φ 10 mm S and Z 636 Me.l 2. p. es
8	Sinker line	PE Φ 10 mm S and Z 676 Me.l 2. p. es
9	Purse line	Nylon Φ 30 mm 150 Me.l 2.p. es Cable Φ 10 mm covered nylon Φ 30 260Me.l 2.p. es
10	Side line	PE Φ 10 mm S and Z 30 Me.l 2. p. es
11	hand rope	PE Φ 12 mm 30 Me.l 1. p. es
12	Bridle	PE Φ 8 mm 2.5 Me.l
13	Extra rope	PE Φ 20 mm 100 Me.l
14	Small float	Extra float Φ 100 1.600. p. es
15	Big float	Plastic Φ 300 1. p. es
16	Purse ring	Fe Φ 8 covered by lead Φ 30 180 D. ter 90. p. es

5 FISHING OPERATION

- ***Fish school detection method:***

+ Traditional visual method :

Usually the fishermen like to search for fish school in the evening when sunset or early morning . Fish school detection is also searched during the day time , that depends on some experiences be low :

--Change of water color :

A fish school near the surface seen from far away , will make the water appear colored and the water around the fish school will show ripples distinguishing it from the surrounding water

-- Jumping fish :

Some time fish in the school are seen to be jumping

-- Flocks of birds :

A flock of sea birds often accompanies a fish school . Birds flying in a fixed direction are usually dependence of a school below . Flocks of bird flying be low ,

Fig. 5. sinker and Ring

fish school will be at surface of water . if flocks of bird flying highly , fish school will be deep etc.

+ Modern methods :

Generally to find fish school by using fish finder and sonar . The fish school must be migrating below the surface and can be found at any time of the day or night

- ***Fish luring method:***

Normally fishermen of Viet nam uses two method :

-- Luring by light boat

-- Luring by coconut - leaf shelter with light boat

- ***Fishing operation in the day time:***

Number of crew is 12 -- 16 persons . In the purse seine fishing , arrangement is important for effective operation . The net must be arranged tidy for easy shooting , that also help to avoid some accident

When the fishing boat is going on the fishing ground some experienced fishermen climb on the top of the vessel and detect fish school , in this time fish finder is also used . As soon as the fisherman finds a fish school , he will order the steerman to slow down and sail toward the school then stop while he considers the species , size of fish school , swimming speed , direction , current wind and bottom of the sea etc.

If the fisherman decides to operation , he will order stand by and shoot the net . Fish school often turns their direction or comes down quickly when they meet the net , so position of shooting must be chosen properly with present condition . Normally the position is chosen behind fish school , that will keep fish not to escapes by door of the net or under the sinker line . In the case of strong wind or current , the position will be chosen under the wind or current far from the fish school about 60 -- 90 meters . The vessel moves at full speed while releasing the net to surround the fish school in a circular or oval shape . The speed will be reduced when about three quarter of the net length has been released . Then the clutch turned off before arriving at the big float or light raft at the other end . The big float is hooked up and pulls the top of the wing to the boat . The purse seine will be maintained well in position . After that purse line from both sides of the net will be passed through two pulleys at the bow to the capstan winches . If the fish comes to the door , master fisherman orders some crewmen to jump down and chase the fish by beating the water until all purse rings are reached on the fore deck port . After that most of crew try to pull the net from right wing up on boat , three fishermen pull the other wing by the pulley and capstan winch on the left boat . The rings in left wing are taken off for easy to pull . when both side of the net have been pulled up to the bunt , all crew help pulling in on the start boat side . At the end ,all of fish will go down and concentrate at the bunt . The float line must be lifted over the bunt , up by the boom to prevent the fish escaping . After that fish is scooped from the bunt and kept in the fish hold . At the end the net will be

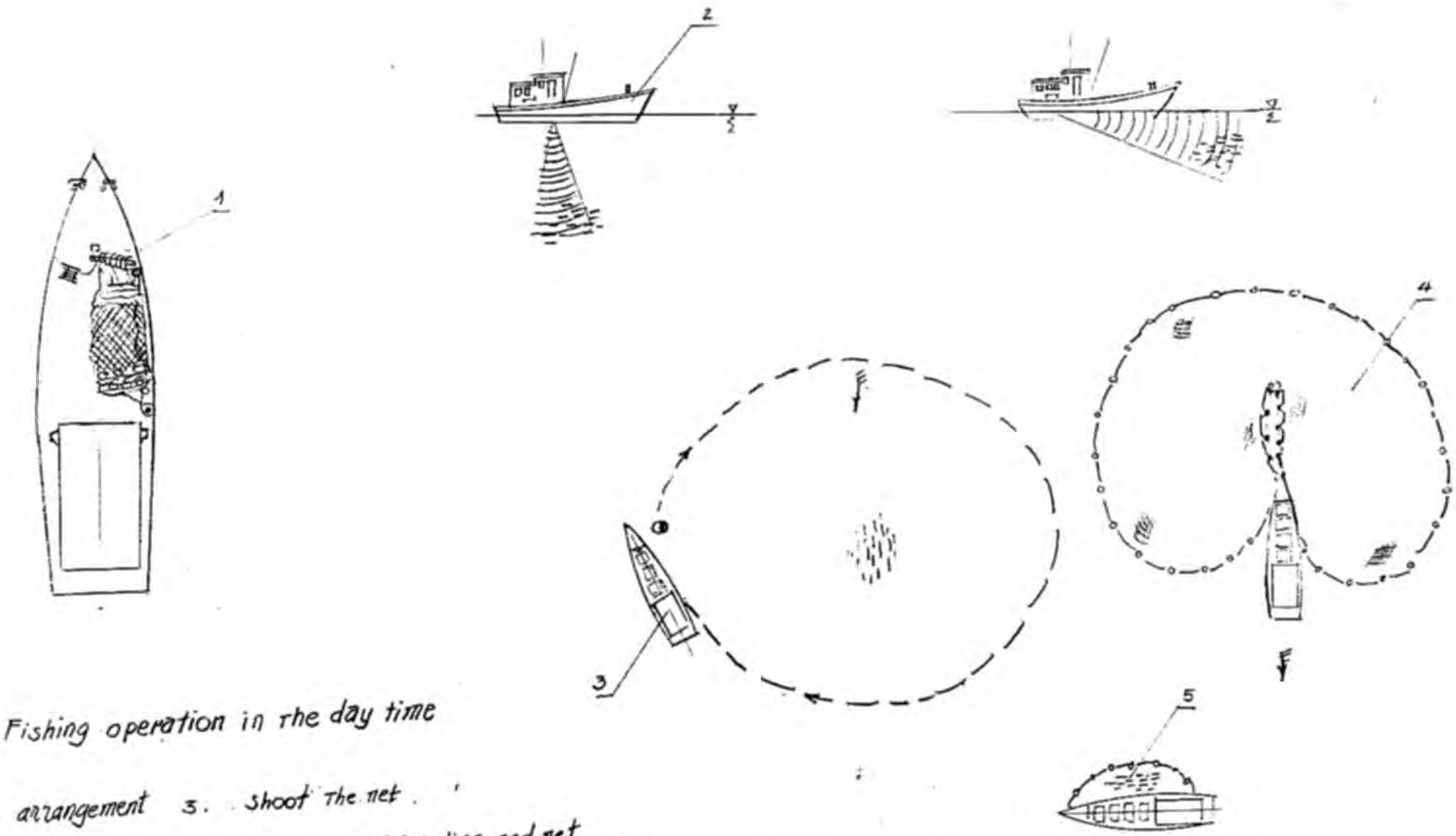


Fig.6 Fishing operation in the day time

1. arrangement 3. shoot the net.
2. detection 4. haul the sinker line and net
Fish school 5. Fish concentrated in the bunt are scooped.

arranged from the left side to the right side with the rings attached , for another operation

The time needed for a fishing operation depends on the number of crew members , the efficiency , the current and wind . Normally it takes 2 -- 4 hours if there many fish enmeshed , more time will be needed

- ***Purse seine fishing operation in the night time*** :

+ Fishing operation with luring light boat :

In this method Fishermen usually uses 8 sets of luring lamp with each set about 250 w ,that is attached to both side of fishing boat (see figure 7) There is a light boat with two bulbs 1.000 w . The purse seine and light boat are anchored where fish are expected to be in abundance with the luring of fish commencing late in the evening . All lamps are put on at once on both vessels After a while , the master fisherman will order the light boat to pull up anchor and sail slowly to wards the purse seine . The time waiting is depended on the fish attracted to each boat . The lamps on the purse seine boat are turned off one by one , in order to concentrate the fish around the light boat . After that the master fisherman will order the crew stand by for fishing operation . The crew start shooting from a suitable position in to the current or the wind in other to surround the light boat -. The light boat must be maintained at the center of the circle during shooting and hauling . When the pursing operation is completed , the light boat must be out side the circle of the net , and the light are turned off . The steps for hauling the net in are as already mention

+ Fishing operation with coconut -- leaf shelter and luring light boat

-- Coconut - leaf shelter construction :

A coconut leaf shelter or branch of the tree is used for attracting fish for purse seine fishing operation . The coconut leaf shelters are set in deep areas 20 -- 50 shelters are set during an operation . The coconut leaf shelter are composed of :

- 1--3 big bamboo poles , 10 -- 15 meters in length are tied together with wire . some time fishermen not need to use the bamboo , they mark coconut leaf shelter by position in navigation equipment
- Polyethylene ⌀12 mm rope is used . The length of the rope usually shorter than the deep of water by 3 - 5 meters
- Coconut leaf : strip the individual leaves from the stem and tie the coconut fronds to the rope . for one shelter 7 - 20 coconut leaves are used and the interval between them is about 1 - 3 meters . The number of coconut leaves used will depend on the depth of water
- Weight for coconut leaf shelter is usually used a stone or concrete of 200 -- 400 kg

-- Fishing operation :

After checking the fish at several shelter during the day , some times the shelter should be grouped to concentrate the fish ,the purse seine boat will anchor near by

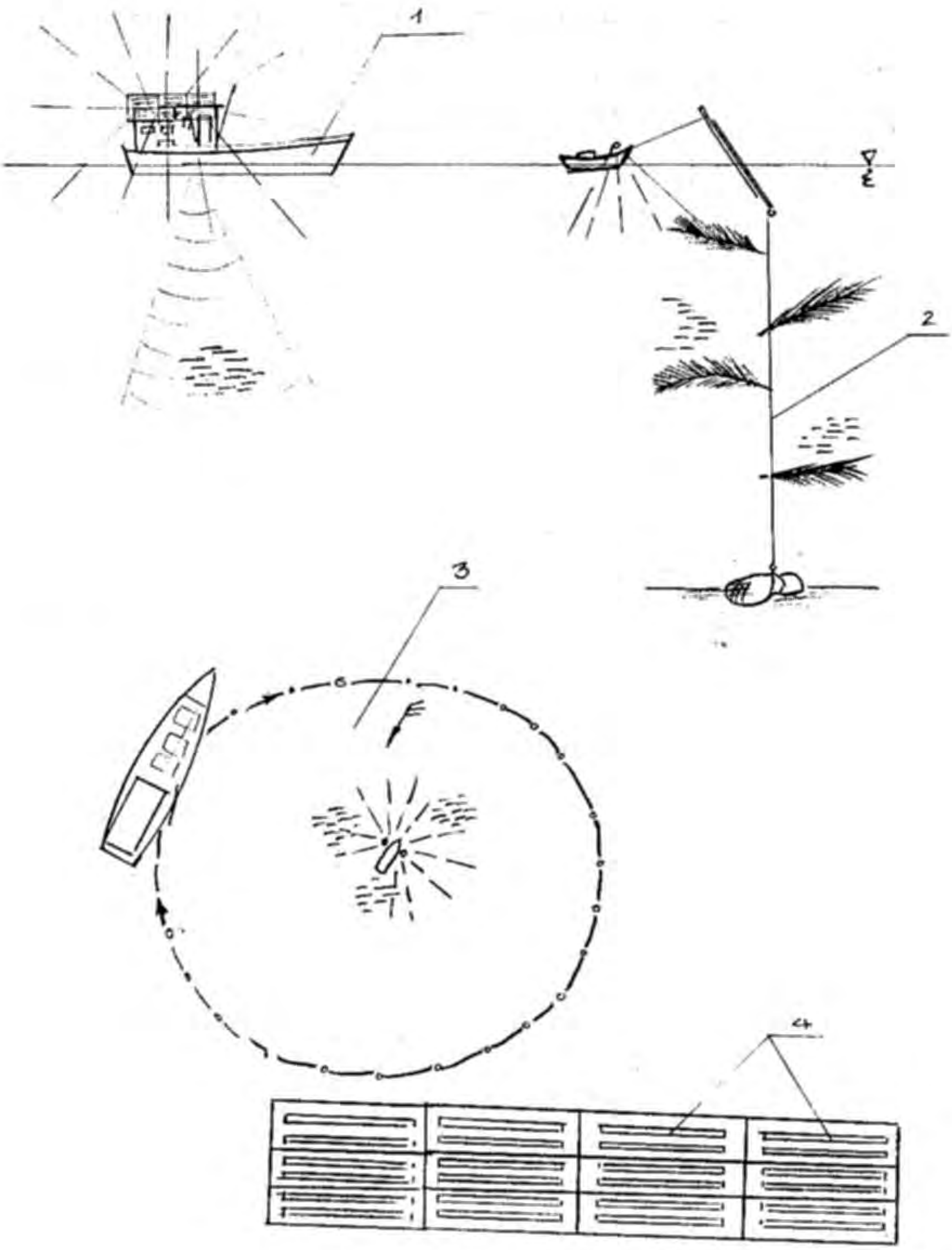


Fig. 7 Fishing operation with coconut-leaf shelter

1. Turn on the light
2. coconut-leaf shelter
3. Shooting the net
4. Neon tupe light

a shelter .The light boat will be tied or anchored to the bamboo and wait until after sunset . In the evening all boats turn on the luring lamps and checking fish school by sonar , echo sounder . when the master fisherman decides stand by shooting , the steps will be the same fishing operation with luring lamps

Thailand , 02 / November / 1997

SOME TECHNICAL ASPECT OF
DRIFT GILL NET IN INDONESIA

STUDY REPORT

By

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INTRODUCTION

Indonesia is an archipelagic country, comprising of 17,508 island and has over 81,000 Km of coastal line. The area of Indonesian territory is 5,000,000 Km^2 of which has over 3,100,000 Km^2 compresses the marine territorial zone and about 2,700,000 Km^2 of Exclusive Economic Zone. The Indonesian archipelago is located between two continents, namely Asia and Australia, and two oceans, namely Indian and Pacific oceans. This has made Indonesian sea waters as a trafic area for many pelagic fishes and inhabit by many various species of aquatic organisms. About map of the Indonesia archipelago is presented in appendix 1.

The estimated potential of marine fishery resources of Indonesia marine fishes is around 6,700.000 MT per year which includes a potential of resources in the Indonesia territorial waters of 4,400,000 MT per year an d Indonesia Exclusive Economic Zone waters of 2,300,000 MT per year. About 60 % of the total resources consist of small pelagic fishes such as scads (*Decapterus sp.*), Indian Mackerels (*Rastrelliger sp.*), Anchovies (*Stolephorus sp.*), Skipjack (*Katsuwonus sp.*), Little Tuna (*Euthynus sp.* and Auxis sp.), Sardine (*Sardinella sp.*) etc.

The marine fishes are produced by more than 1,889,500 fishermen, who use about 141,700 boats powered engine and 247,700 boats which are non powered engine. The Indonesian fishermen used 11 groups of fishing gear, with the total of more than 635,900 unit of fishing gear, among of them are 70,361 unit drift gill net or 11 % of total fishing gear. The details of marine fishing units, number of fishermen and marine fishing boat of Indonesia are presented in appendix 2 and 3.

Pelagic fishes in Indonesia sea waters have been exploited by small scale fishermen since very long time ago. Generally small scale fishermen catch pelagic fishes by drift gill net, purse seine, troll line etc.

DRIFT GILL NET FISHERIES

1. *General Situation* .

During 1975 -1980, most of the drift gill nets operated in Indonesia was by using small boats (1 - 3 GT) with 12 - 24 pieces, but since 1985/1986 most of drift gill nets are operated by boat 3 - 10 GT (in-board or out-boar engine) using 30 - 60 pieces. The target species are chub mackerel, horse Mackerel, little tuna, skipjack, spanish mackerel etc.

Little Tuna Drift Gill Net - : About drift gill net for little tuna or Skipjack (Little Tuna Drift Gill Net) have been developed in several part of Indonesia since 1988/1989. The gear consist of 40 - 120 pieces of 45 - 48 meters length rigged net and with mesh size 3.5 - 4.5 inches, depth of net is about 140 - 210 meshes. The design of drift gill nets used in Indonesia are shown in appendix 4,5 and 6.

Fishermen of west Java use drift gill net to combine with long line for catching shark . While drift gill net of central Java and western part of Sumatera equip their boat with drift gill net and troll line as additional gear that can be operated during travelling their boat from fishing base to fishing ground and from fishing ground to fishing base (landing place).

Drift gill netter with additional gear such as troll line, also have been developed in North and South Sulawesi, Florest, Timor , Lombok etc. The fishermen in these areas use 25 - 40 pieces in a boat with powered engine (3 - 6 GT) and crew of 3 - 4 persons per boat.

Generally the drift gill net material is made of polyamide multifillament (PA) 210/12 - 210/15, mesh depth 140 - 210 meshes with mesh size 3,5 - 4,5 inches and length rigged net is 45 - 48 metres with shortening (hang-in ratio) of 44 - 48 %. Also most of them use additional floats with 5 meters length ...

The drift gill nets are generally operated about 8 - 20 nm from the coast line with tokes about 2 - 4 hours to reach. Fishermen of western part of Sumatera, East Java, Lombok, Florest, North Sulawesi operate their drift gill nets as "one day fishing", while fishermen from Central Java, West Java, west Kalimantan and Southern Sulawesi operate drift gill nets during 5 - 15 days fishing trip.

Operations : Drift gill nets are operated twice during the night, namely first setting at 17.30 - 18.30 and first hauling at 22.00 -23.00, second setting at 00.00 - - 01.00 and second hauling at 04.00 - 05.00. In a month, totaly drift gill nets are operated for 22 days except on full moon nights.

Drift gill nets are operated 11 months in the year except january or February due to bed weather Target species of little tuna drift gill net is little tuna (*Auxis thazard* and *Euthynnus affinis*) and skipjack (*Katsuwonus pelamis*) but are also intended to catch Spanish mackerel (*Scomberomorus sp.*) and shark.

Fishing Season - : The peak seasons for catching little tuna and Skipjack in Indonesia is around Mach/April and August/September (2 month) while during on September - November and on April - June is the moderate season (6 month) and December - January and June is the lean season for catching little tuna and Skipjack (3 month).

At the peak season of little tuna and skipjack, drift gill neter are operated 30 days of the month, however for 22 days (dark moon phases) they use drift gill net and troll line, while 8 days (full moon phases) use troll line only in the morning and / or afternoon. During the bad weather period (1 month) no fishing is done but the time is used for repair, maintenance of nets,boats amd engine.

Production - : The production from drift gill net operating using 30 - 40 pieces during peak season (2 month) is around 110 - 200 Kg , while at the moderate season (6 month)around 70 - 100 Kg and during lean season (3 month) around 30 - 50 Kg of little tuan and skipjack is landed.

2. *Technical Aspect.*

A case study of drift gill nets operated in Bengkulu (weestern of Sumatera) is given below. Their drift gill net consists of 40 pieces with

length rigged net of 48 metres. The specifications of drift gill net that used by fishermen of Bengkulu is as follows, :

- Line of net's float	: PE ⌀ 7 mm ; 51 metres
- Line of net	: PE ⌀ 6 mm ; 51 metres.
- Net's float	: Y - 3 Vidax ; 45 X 2 pieces.
- Webbing	: - Pa 210 d / 15 ; 195 meshes. - Saran 210 d / 15 ; 15 meshes.
- Additional float	: bottle type (plastic), vol. 1 Lt. ; 1 piece per net piece.
- Line of additional float	: PE ⌀ 5 mm ; 5 metres.
- Additional sinker	: Fe ⌀ 100 mm X ⌀ 100 mm; 1 piece per net piece
- Length of rigged net	: 48 metres.

Detail of drift gill net design mentioned above is shown in appendix 7. Based on this design,the shortening, form of mesh, opening of mesh, width of net and high of net in the sea water can be calculated as follows,:

2. a. Shortening and Hanging Ratio.

l Shortening or hang-in ratio or hang-in coefficient of the net can be calculated by the following equations , :

$$S = \frac{Lo - L}{Lo} \times 100\ \%$$

- S : Shortening or Hang-in ratio (%)
- Lo : The stretched length of the net webbing (100 yard = 91.7 M)
- L : The length rigged net webbing or completed length of the net

- Lo : The stretched length of the net webbing (100 yard = 91.7 M)
- L : The length rigged net webbing or completed length of the net (48 M)

Based on equation above, there for

$$S = \frac{91.7 - 48.0}{91.7} \times 100\% = 48\%$$

While value of elongation (= E) or hanging ratio or hanging coefficient can be calculated as follows, :

$$E = \frac{L}{Lo} \times 100\% \qquad \text{or} \qquad E = 100\% - S$$

- E : Elongation or Hanging ratio (%)
- Lo : The stretched length of net webbing (= 91.7 M)
- L : Complete length of the net or length rigged net (48 M)

$$E = \frac{48.0}{91.7} \times 100\% = 52\%$$

$$E = 100\% - 48\% = 52\%$$

It value of elongation (E) = 52 % or more than 50 % there the fish will be gilled in the mesh of net, but if less than 50 % the the fish will be entangled in the meshes of net.

2. B. Form of a Mesh

The form of a mesh can be explained as follows, :

Shortening = 48 %

Elongation = 52 %

$$E = \frac{\ell}{\ell_o} \qquad \text{or} \qquad \ell = E \times \tfrac{1}{2}\, \ell$$

- ℓ = Half of mesh depth of rigged net
- ℓ_o = Half of stretched a mesh (= AB = ½ X 114,3 = 57,15 mm)

ℓ = 0,52 X 57,15 mm = 29,72 mm

In the angle ABE or angle β (see triangle AEB)

$$\cos \beta = \frac{BE}{AB} = \frac{\ell}{\ell_o}$$

$$\text{COs } \beta = \frac{29.72}{57.15} = 0.5200 \rightarrow \text{angle } \beta = 58^\circ\ 40'$$

Angle $\alpha = 90^\circ$ - angle β
$= 90^\circ - 58^\circ\ 40'$ angle $\alpha = 31^\circ\ 20'$

Angle DAB = 2 X angle α
$= 2 \times 31^\circ\ 20'$ → Angle DAB = $62^\circ\ 40'$

2.c. <u>The Depth of a Mesh and The Depth of a Net.</u>

To find out the depth of mesh of rigged net, the equation is as follows, :

$$\text{Sin } \beta = \frac{AE}{AB}$$

- AE : The depth of mesh opening
- AB : The half of the mesh or length of a bar (= l_o = 57.15)
- β : angle ABE = 58° 40'

$$\text{Sin } 58^\circ\ 40' = \frac{AE}{57.15} \rightarrow 0.8542 = \frac{AE}{57.15}$$

AE = 48.82 mm

The depth of mesh opening = 2 X AE
= 2 X 48.82 = 97.64

Or can also be calculated by the equations as follows,:

$$do = 2\,l\ \sqrt{(2S - S^2)}$$

- do : The depth of mesh opening
- l : The half of stretch mesh (a bar)
- S : Shortening (48 %)

$$do = 2 \times 57.15\ \sqrt{(2S - S^2)}$$
$$= 114.3\ \sqrt{0.7296} = 97.63 \text{ mm}$$

Based on above result the depth of the net can be calculated by multiplying the number of mesh by depth, namely

$d^* = do \times m$

- d^* : The depth of a net (" Theoretical net depth")
- do : The depth of mesh opening
- m : Number of mesh depth, depthwise (= 210 meshes)

$d^* = 97.63$ mm X 210 = 20,502.3 mm
thus, depth of a net (" Theoretical net depth ") is 20,50 metres.

2. d. Width of Net.

Value of net width can be calculated as follows, :

$$S = e \times n \times m \times a^2 \sqrt{(1 - E^2)}$$

- S : Width of net (m^2)
- E : Elongation or hanging ratio (= 0.52)
- n : Number of mesh in the lengthwise webbing (802 meshes)
- m : number of mesh in the depthwise webbing (210 meshes)
- a : length of stretch mesh (0.114 m)

$$S = 0.52 \times 802 \times 210 \times (0.114)^2 m \times \sqrt{(1 - 0.2704)}$$
$$= 0.52 \times 802 \times 210 \times 0.013 \times 0.854$$
$$= 972.29\ m^2$$

2. e. Length of Fish.

Fish length of fish to be cougth by drift gill net with specifications mentioned above can be calculated as follows, :

$$AC = \frac{L}{K} \quad \text{or} \quad L = K \times AC$$

- AC : Mesh opening (= 98 mm)
- L : Average of fish length
- K : Coefficient offish length (for fish that have measurement are medium length . value of K = 3,5)

$$L = 3,5 \times 98 \text{ mm} = 343 \text{ mm}$$

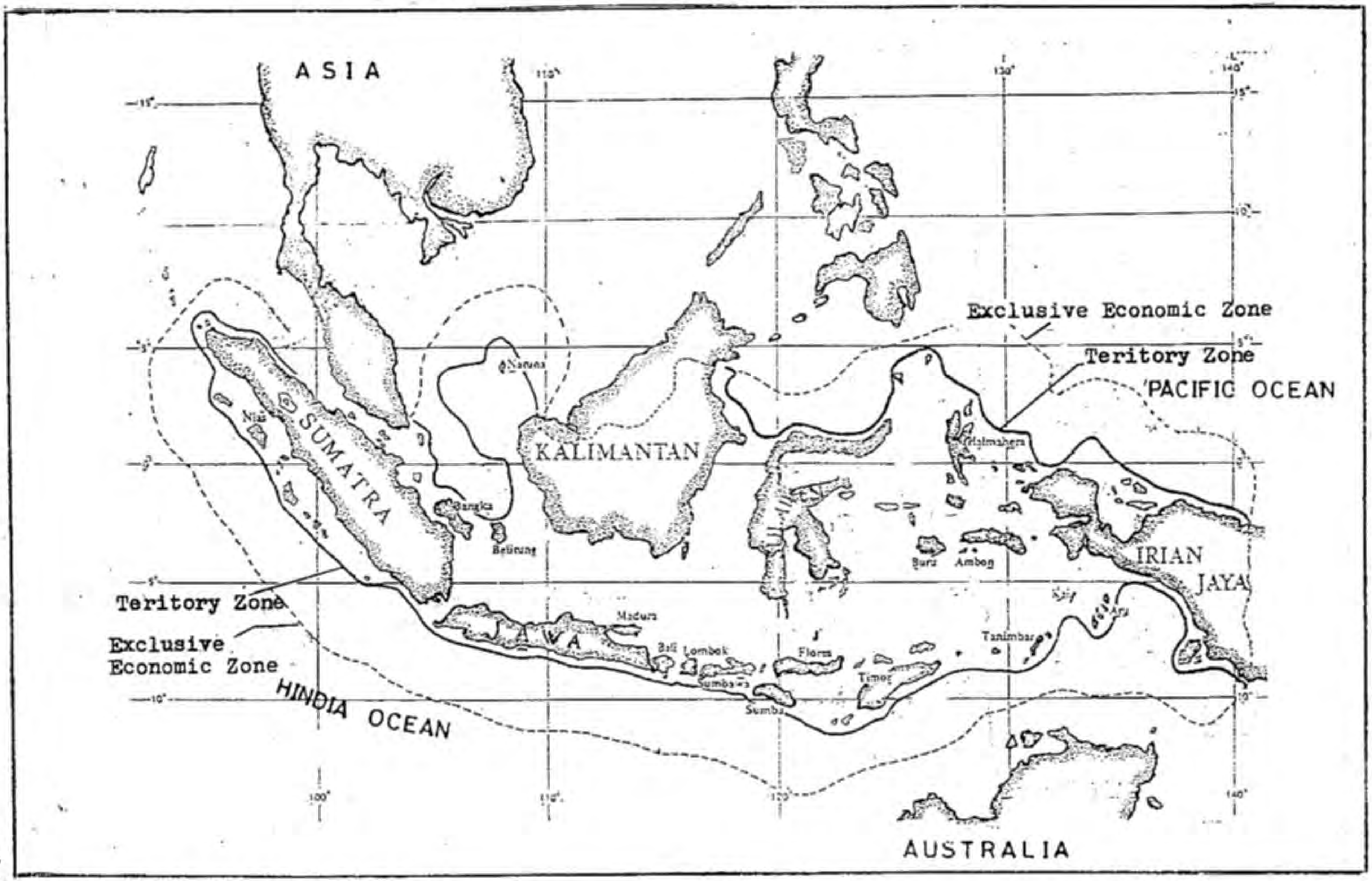
or in other words, average fish length that can be caugth by drift gill net is ± 35 cm.

CONCLUSION

a. In a technical aspect manner, drift gill net who be used by Bengkulu fishermen are good enough, in this case drift gill net mentioned above have shortening, net depth and its material that can make possible to catch little tuna, skipjack by gilled way and for big fish, like shark, spanih mackerel, sail fish or tuna can be caugth by entangled way

b. Using troll line as additional gear is very useful to increase step up the drif gill nets production, in partricular at the full moon phases on peak season and during sailing headed for fishing ground and come back to fishing base.

Appendix 1 : Position of Indonesia Archipelago



Source : Nontji, A. 1987.

Appendix 3.

Table 2 Number of Marine Fishermen by Category of Fishermen, 1984 - 1993

Fishermen Category	1985	1991	1992	1993
Total	1286448	1632630	1742210	1889524
Full Time	632189	817301	859004	937261
Part Time (Mayor)	481277	617544	618890	667129
Part Time (Minor)	172982	197785	264316	285134

Source : Directorate General of Fisheries

Table 3 Number of Marine Fishing Boats by Size of Boats, 1984 - 1993

Size of boats		1985	1991	1992	1993
Total		316446	354784	358906	389498
Non Powered Boats	- Sub Total	220823	231659	229377	247745
	- Dug out boat	115891	117361	115839	123760
	- Small	62265	70047	70554	73452
	- Medium	36663	35396	35143	41822
	- Large	6004	8855	7841	8711
	- Sub Total	95623	123125	129529	141753
Powered Boats	- Out Board Motor	61867	75416	77779	82217
	- In Board Motor	33756	47709	51750	59536
	< 5 GT	25937	35179	37913	43396
	5 - 10 GT	4863	7391	7935	9791
	10 - 20 GT	1797	2726	3156	2312
	20 - 30 GT	686	909	984	1558
	30 - 50 GT	330	738	1049	1170
	50 - 100 GT	15	185	208	351
	100 - 200 GT	83	272	184	213
	> 200 GT	45	309	320	245

Source : Directorate General of Fisheries, 1995

Appendix 2.

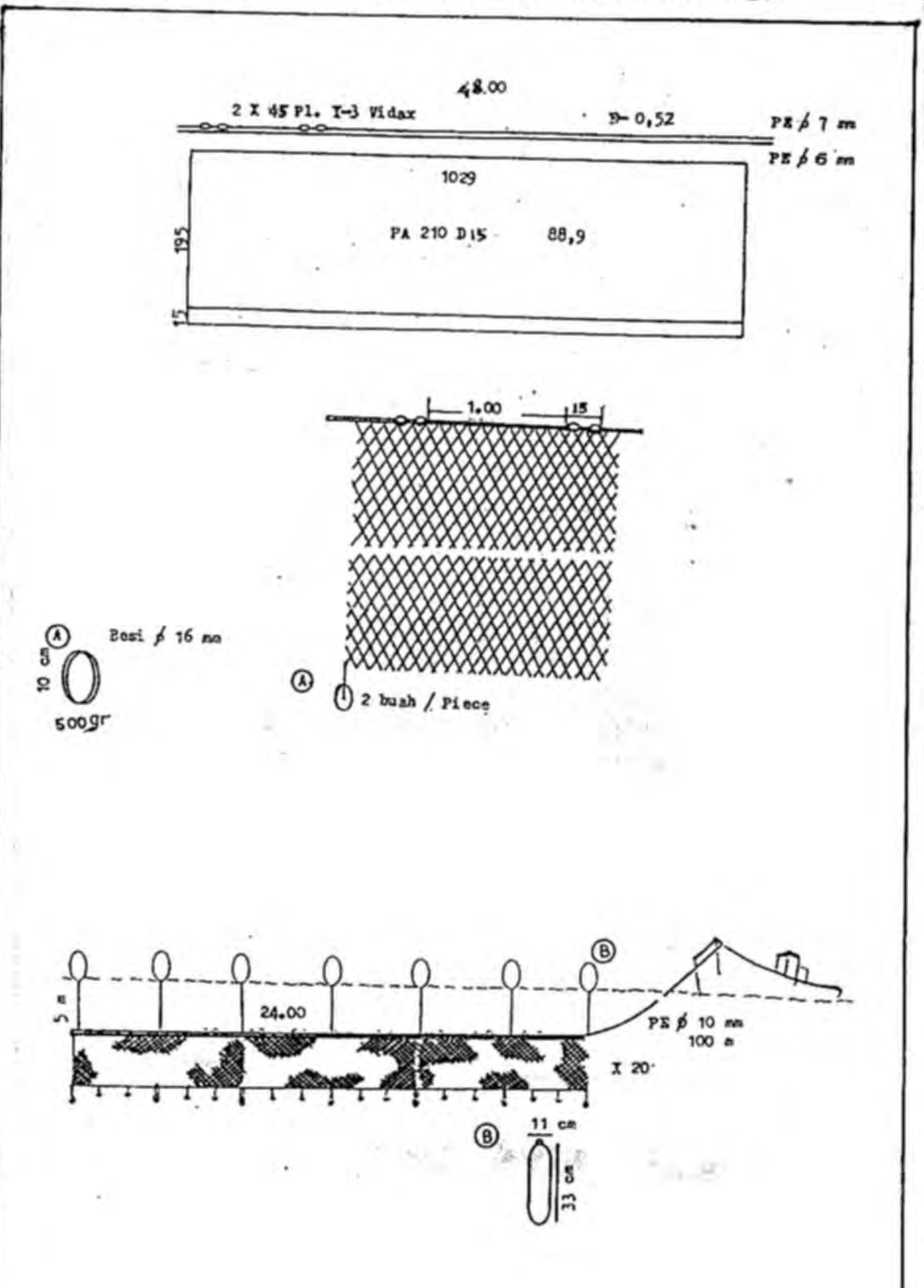
Table 1 Number of Marine Fishing Units by Type of Fishing gear 1984 - 1993

units : units

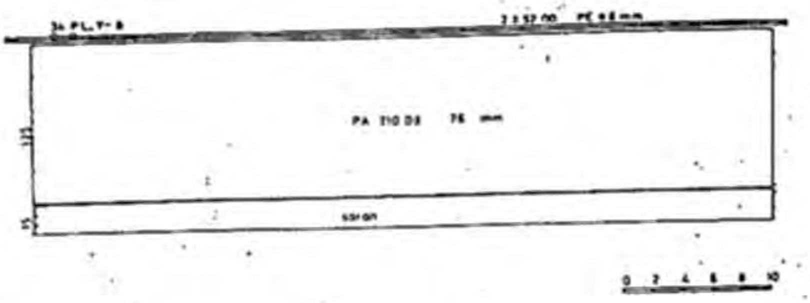
Type of Fishing Gears		1985	1991	1992	1993
Total		432272	534770	552809	635957
Seine nets	- BED equiped shrimp nets	331	390	439	359
	- Payang (incld. Lampara)	13878	18116	16362	23073
	- Danish seine	3080	3926	3652	4521
	- Beach seine	3948	10499	10278	10990
	- Purse seine	5113	6053	6929	8599
Gill nets	- Drift gill nets	63203	63367	64592	70361
	- Encricling gill nets	5732	8917	9557	10925
	- Shrimp gill nets	24536	21751	23176	25292
	- Set gill nets	31132	43473	46362	53628
	- Trammel nets	13881	22568	23927	23778
Lift nets	- Boat / Raft nets	7894	9185	10377	12829
	- Bagan (included Kelong)	12531	13364	12210	12619
	- Scoop nets	6781	8914	8670	7811
	- Other lift nets	8466	12400	10289	12643
Hook and Lines	- Tuna long line	395	3311	1321	2171
	- Drift long line other than tuna long line	4492	5348	5653	5755
	- Set long line	8510	10892	12788	13502
	- Skipjack pole and linej	1159	2137	1321	1200
	- Other pole and line	104921	130052	145143	170042
	- Troll line	42147	45345	45532	58355
Traps	- Guiding barriers	9097	11203	7270	7375
	- Stow nets	3590	5210	5529	5551
	- Portable traps	5556	7843	8987	8778
	- Other traps	9875	17106	19405	26053
Others	- Shell fish collection	6420	10949	12515	10488
	- Sea weed collection	2285	6172	6149	7066
	- Muro Ami (included Mallalugis)	420	4707	732	298
	- Cast nets, Harpon, etc.	27899	31572	33644	41895

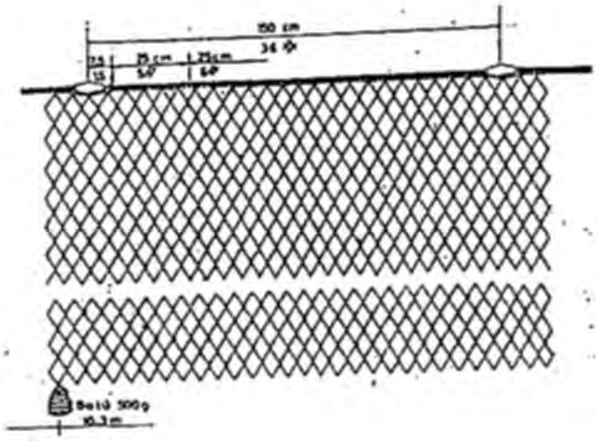
Source : Directorate General of Fisheries, 1995

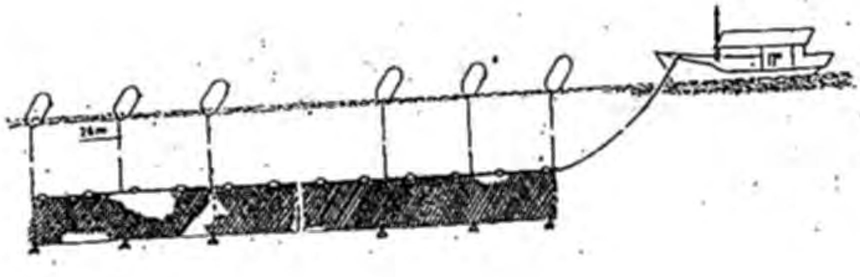
Appendix 7 : Design of Drift Gill Net from Bengkulu Province
(Result of Modification by BPPI Semarang)



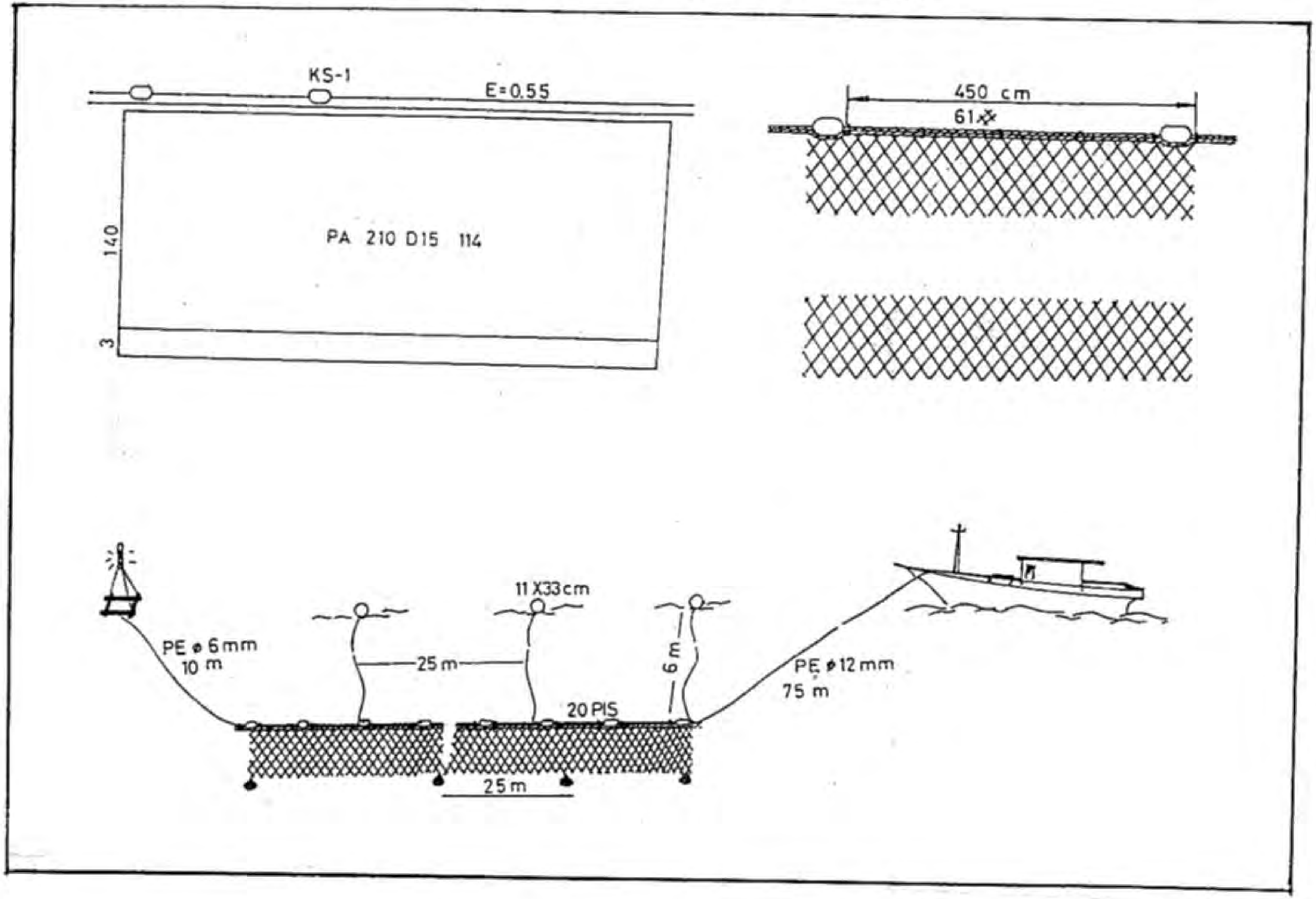
Appendix 6 : Design of Drift Gill Net From West Kalimantan



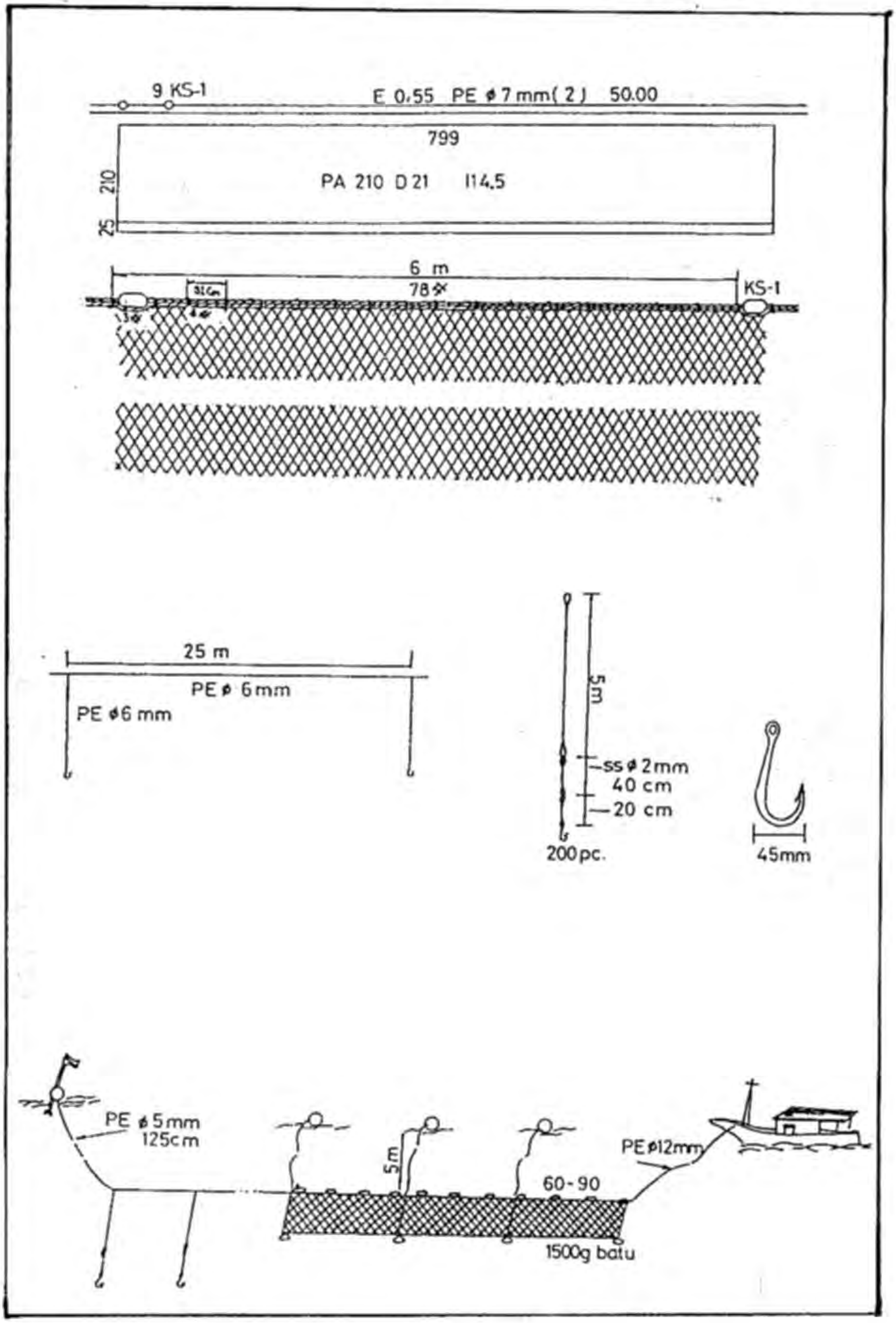




Appendix 5 : Design of Drift Gill Net from East Timor Province (Result of Modification by BPPI Semarang)



Appendix 4 : Design of Drift Gill Net from West Java Province



STUDY REPORT

ON

SOME FISHING GEARS FOR DEMERSAL FISH IN INDONESIA

BY

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SEMARANG, INDONESIA

FOR

THE REGIONAL TRAINING COURSE IN FISHING TECHNOLOGY

AND RESOURCE CONSERVATION

(16 JUNE - 15 DECEMBER 1997)

TRAINING DEPARTMENT

SOUTH EAST ASIAN FISHERIES CENTER (SEAFDEC)

SAMUTPRAKAN, THAILAND

SOME FISHING GEARS FOR DEMERSAL FISH IN INDONESIA

I. INTRODUCTION

Indonesia is an archipelagic country, consisting 17,000 islands and coastal length of approximately 81,000 km. The total fishing area is approximately 5.8 millions sq. km, which includes 3.1 millions sq. km of the territorial waters and 2.7 millions sq. km in the Exclusive Economic Zone (EEZ).

The potencial of marine fishery resources in Indonesia is estimated at 4,280,624,70 metric ton per year (1994) comprising pelagic and demersal fishes, shrimps and others.

The depth varies considerably along the coastal waters and each region has different sea-bed conditions such as flat but with slight slope, rocky, muddy, sandy or muddysandy. The coastal waters contain numerous species of fishes and shellfish. These are exploited using different fishing gears and fishing technique as suited to the particular topographic conditions.

Fishing gears which are suitable with respect to the charateristic of fishing grounds in Indonesia are as follows :

a. Surface and middle waters : suitable fishing gears are : Purse seine, Danish seine, Encircling net, Pole and line, Drift gill net, Tuna long line and Lift net.

b. The bottom area : the fishing gears suitable for the bottom are : Fixed gill net, Bottom long line, Hand line, Trammel net, Danish seine,Trap and Shrimp trawl equipped with BED.

c. The corral reef and tide area : The fishing gears suitable for this area are Muroami, Trap, Barriers and Pots.

The objective of this paper is to give information about some fishing gears used for catching demersal fish in Indonesia, waters by the small scale fishermen.

II. SOME FISHING GEARS FOR DEMERSAL FISH

1. BOTTOM LONG LINE

Bottom long line is clasified as traditional gear, made of hooks with baits suspended from the main line. It is very popular throughout the coastal of Nort Java and Western part of Indonesia, mostly used by small scale fishermen and operated in coastal areas which have depth of 20 - 40 meters.

a. Material and Design

Bottom long line consists of main line, Branch line, Wire leader, Swivel, Float, Sinker, Anchor, Hooks, Float line. The distance between two hooks is 5 meters The specification of the fishing gear are given in table 1, and design of Bottom long line in figure 1.

b. Operation

The operation of the bottom long line is carried out mostly by 2 set by fishermen and about 15 - 20 kg of fish baits are use for one fishing operation. These boat has a crewed of 4 - 5 fishermen and generally they go to the sea for 4 - 7 days per trip and the fishing operation is usually during night time.

Most of the boats used for bottom long line operation is made of hard wood . The size is mostly of 9 - 12 meters in length, 1.25 - 2.25 meters in width and 0.75 - 1.25 meters in depth with gross tonnage 3 - 6 GRT and engine of 16 - 22 HP.

Table 1. SPECIFICATION FOR ONE SET BOTTOM LONG LINE

Designation	Type of Material	Standard	Measurement
Main line	Polyethylene	6 mm Ø	800 meters
Brach line	Polyethylene	2 mm Ø	1.25 m x 150 pcs
	Nylon Monofil	No. 800	1.25 m x 150 pcs
Float line	Polyethylene	6 mm Ø	200 m x 3 pcs
Sinker line	Polyethylene	4 mm Ø	3 m x 3 pcs
Wire leader		1 mm Ø	0.25 m x 150 pcs
Swivel	Elips Type (Pb)		150 pcs
Float	Trawl Type	15 cm Ø 20 cm Ø	13 pcs 6 pcs
Sinker	Iron (Fe)	16 mm Ø	45 cm x 10 pcs
Anchor	Iron or stone	7,5 kg	3 pcs
	Mustag / Mustag hooks	No. 03 No. 2	150 pcs

Sometimes, the fishermen go to the sea with 2 types of fishing gears, the Bottom long line and Cantrang (Danish seine) . Cantrang is intended to catch bait fish in the day time to be used for the operation of Bottom long line during the night time.

c. Target fish

The main target fish are the large demersal fish such as Snapper, Grouper, and in muddy areas Rays, Pike Conger, Giant fish, Cat fish .

2. CANTRANG (Danish seine)

Cantrang (Danish seine) is classified as traditional gear, it consists of three main part : wings, body and cod-end. The function of wings to drive the fish into the cod-end through body. Now days, Cantrang is mostly used by fishermen, especially in the coast of North Java, because more effective in catching demersal fish, than Bottom gill net.

a. Material and Design

This fishing gear consists of wings, body and codend, rope, float, sinker,warp rope . Specification of Danish seine are given in table 2 and design of Cantrang (Danish seine) in figure 2.

b. Operation

The Cantrang is usually operated in the shallow waters of depth between 7 - 25 meters with seabed muddy, sandy and muddy sand. Usually the fishing ground is not so far from the shore about 1 - 2 nautical miles . The operation of this gear is done by 4 to 5 fishermen, they go to the fishing ground early in the morning at about 4,30 am and return in the afternoon (one trip per day). The Cantrang is operated for about 10 to 15 time per day, the duration of fishing operation from setting until hauling takes about 30 - 45 minutes.The size boat of used by fishermen is 9 - 12 meters in length, 1.50 - 2.25 meters in width, 0.90 - 1.25 meters in depth, engine used in board powered 16 - 22 HP. , boats are completed with captance (Details in figure 3.

c. Target fish

The main type of fish caught by the the Danish seine are the small demersal fish such as Pony fishes, Cat fishes, Lizard fishes, Grunters, Treadfin breams and Shrimps.

3. TRAMMEL NET

Trammel net is the other fishing gear which is very popular and commonly used by small scale fishermen. It consists of three wall nets, that is inner net with small mesh size and two outer nets with large mesh size and selvage. Selvage is a part of the net acts like a frame to prevent the net during use. The upper rim of the upper selvage is joined to the float line, while the lower rim is joined to the net . Likewise , in the lower selvage, the lower rim is joined to the sinkerline and the upper rim is to the net.

a. Material and design

The material used for Trammel net are as follows : net, float, sinker, rope, salvage The specifications of Trammel net are given in table 3 and design of Trammel net in figure 4.

b. Operation

There are two methods for setting Trammel net for the fishing operation, one is to sweep the areas by pulling in straight line and another is setting and encircling until a half or full circle is formed (figure 5).

Trammel nets are usually operated in the shallow waters where the depth is about 7 - 25 meters. The operation of this gear is done by 2 to 3 fishermen. While going to the sea , they carry 20 - 30 pieces of net. Fishermen usually leave the harbour to the fishing ground at about 5 ,00 am and reach the fishing ground after 1 - 2 hours.

Table 3. : SPECIFICATION FOR ONE SET TRAMMEL NET

Designation	Type of Material	Standard	Measurement
Selvage	Polyethylene	No. 380 D/3 1.75 inchi	1450 x 5 meshes
Inner the net	Nylon Monofil.	No. 210 D/3 1.75 inchi	1450 x 51 meshes
Outer the net	Nylon Monofil.	No. 210 D/9 10.5 inchi	19 x 7 meshes
Float line	Polyethylene	6.0 mm ∅	27 meters
Sinker line	Polyethylene	2.0 mm ∅	27 meters
Float	Plastic type	PL 35 L 33	50 pcs.
Sinker	Lead (Pb)	20 gram	125 pcs.
Warp line	Polyethylene	10 mm ∅	60 meters

The size of the boat is 7 - 9 meters in length, 0.90 - 1.25 meters in width, 0.70 - 0.90 meters in depth and use out board powered engine of HP.

c. Target fish

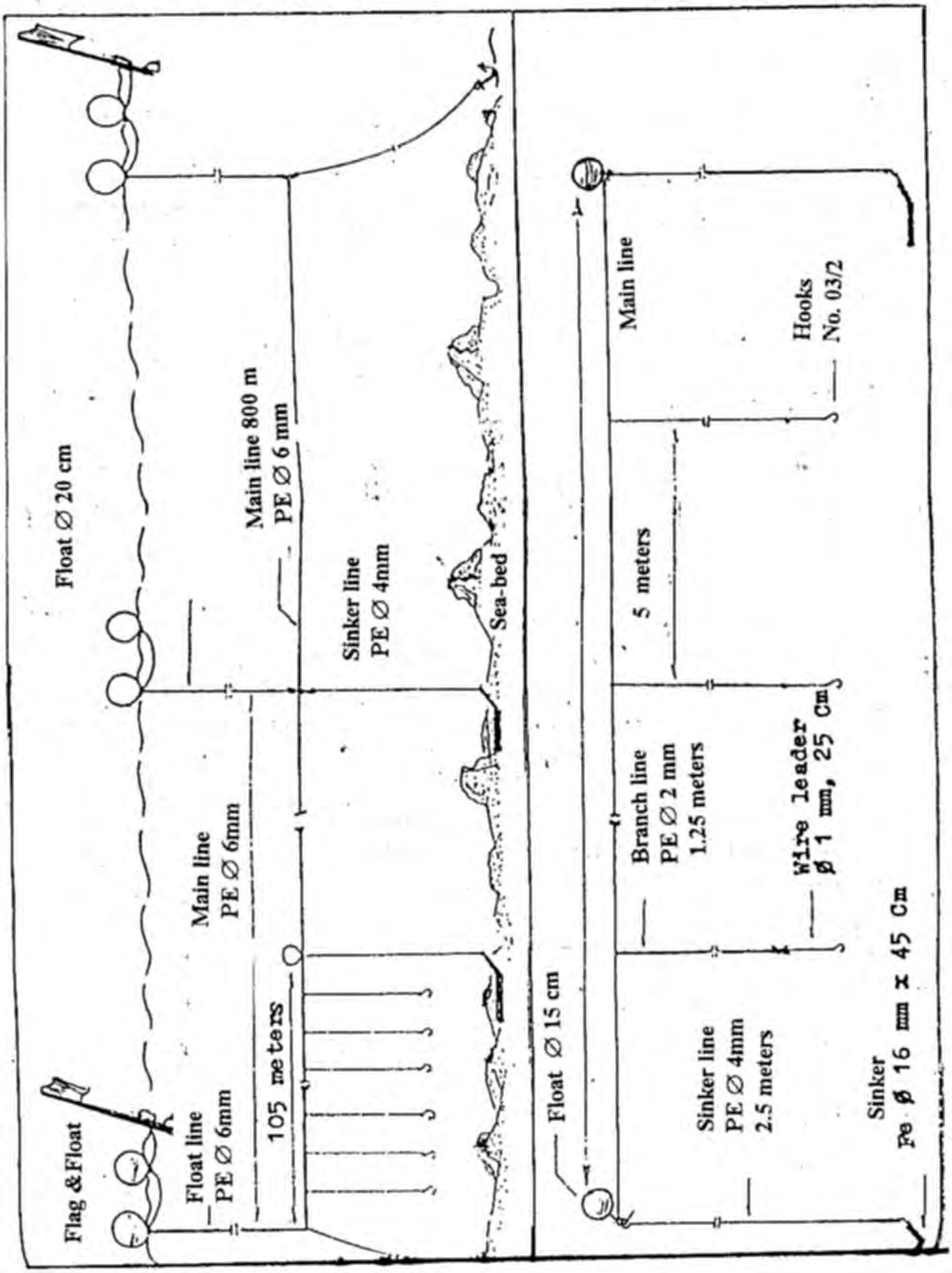
The target species of this gear is white shrimps during the shrimp season around October - Maret. Nevertheless, it can be operated for catching demersal fish such as : Sea cat fishes, Black pomfret, Grunters, Croakers and Treadfin breams.

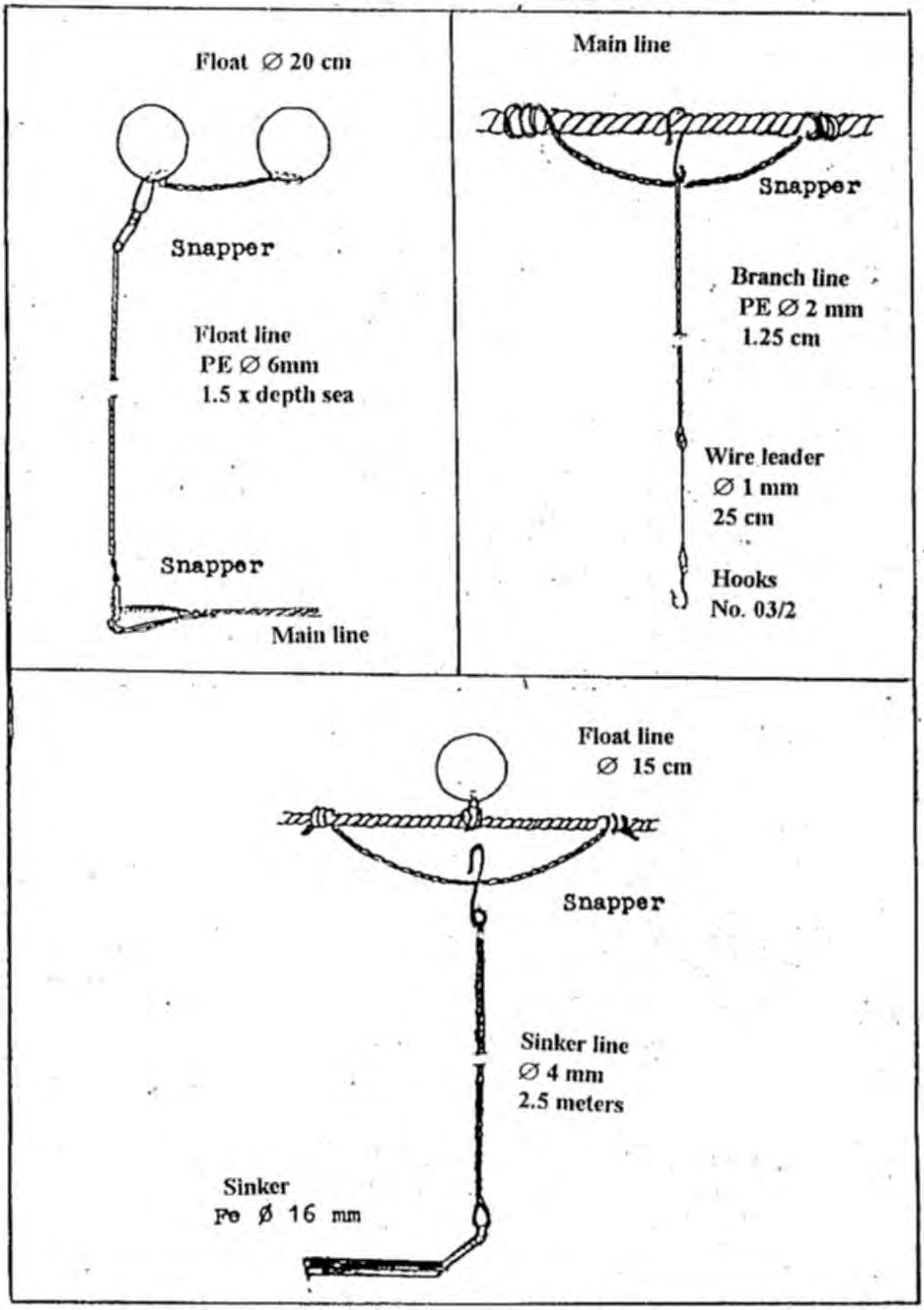
III. CONCLUSION

Indonesia has a great variety of fishing gear and methods which depends on fishing villages condition, fishing grounds and kind of species, either demersal or pelagic .

The fishermen, generally use the simple and small fishing gear. The boats are made of wood, categorised as small boats and use inboard or outboard engine powered boats. Mostly the operation is done by 2 to 5 fishermen and fishing is carried out 1 to 5 days per trip. Nevertheless, it's contribution to the production, either to the regional or national production are very high.

The gears for demersal fish, especially Bottom long line, Cantrang and Trammel net are very popular in coastal waters of the Western region because they are very effective and suited to the fishing grounds.


Flag & Float
Float line
PE Ø 6mm
105 meters
Main line
PE Ø 6mm
Float Ø 20 cm
Main line 800 m
PE Ø 6 mm
Sinker line
PE Ø 4mm
Sea-bed
Float Ø 15 cm
Main line
5 meters
Branch line
PE Ø 2 mm
1.25 meters
Sinker line
PE Ø 4mm
2.5 meters
Hooks
No. 03/2
Wire leader
Ø 1 mm, 25 Cm
Sinker
Fe Ø 16 mm x 45 Cm


Float ∅ 20 cm
Snapper
Float line
PE ∅ 6mm
1.5 x depth sea
Snapper
Main line
Main line
Snapper
Branch line
PE ∅ 2 mm
1.25 cm
Wire leader
∅ 1 mm
25 cm
Hooks
No. 03/2
Float line
∅ 15 cm
Snapper
Sinker line
∅ 4 mm
2.5 meters
Sinker
Fe ∅ 16 mm

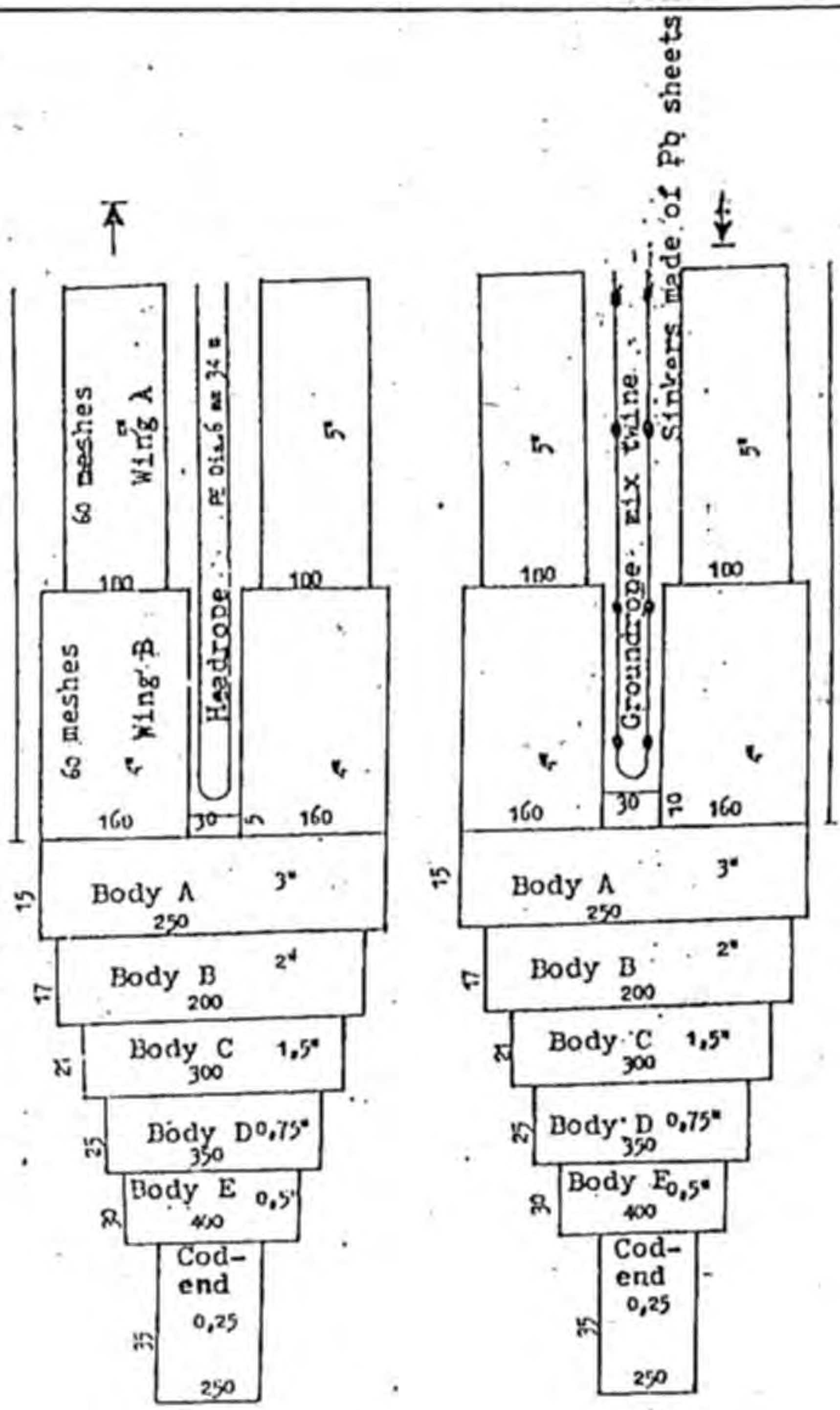
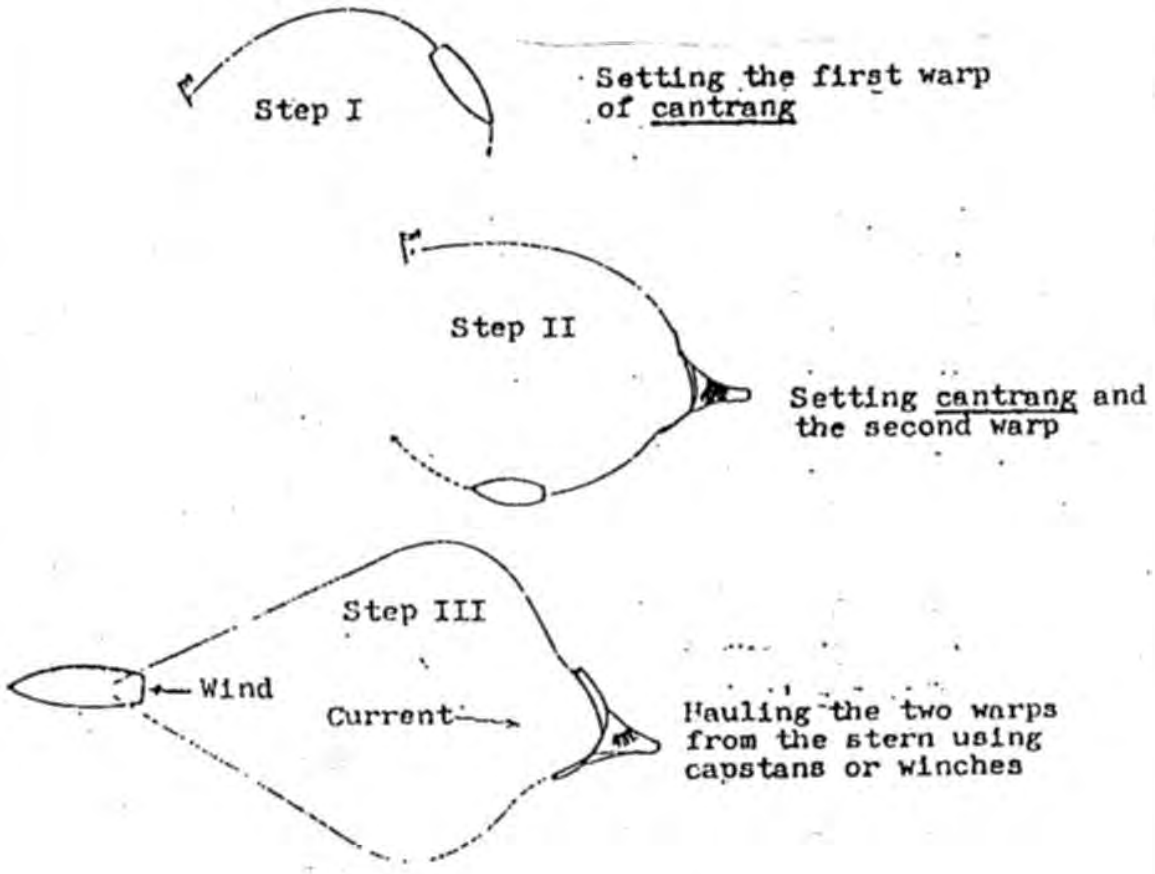


Figure 2. : DESIGN OF CANTRANG (Danish Seine)



: FISHING OPERATION OF CANTRANG

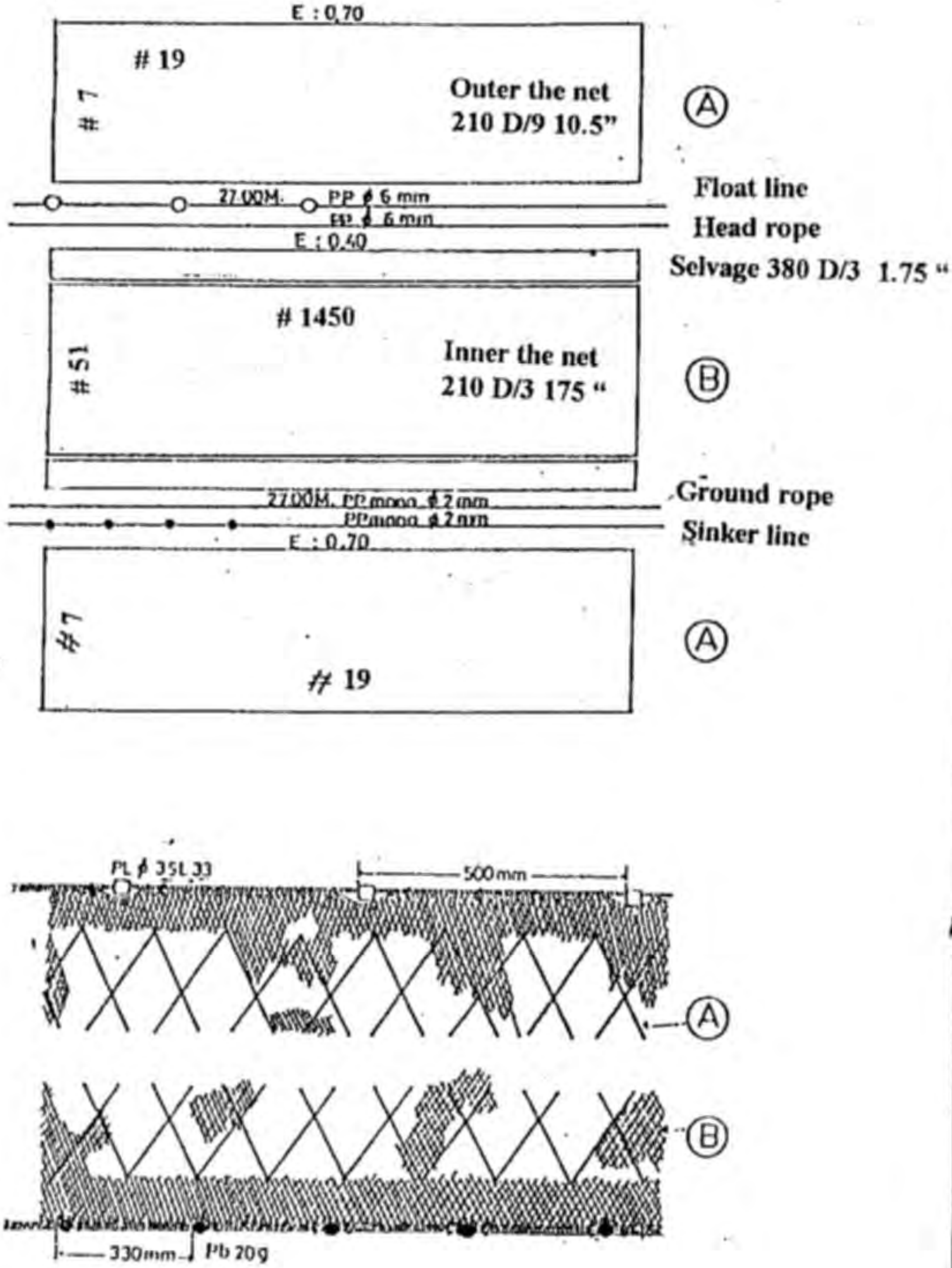


Figure 4 : DESIGN OF TRAMMEL NET

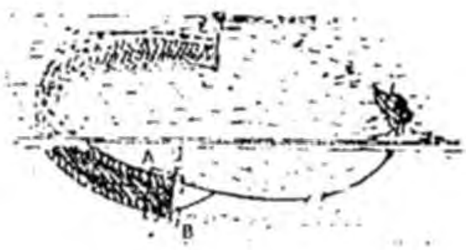


Figure 6.: FISHING OPERATION OF TRAMMEL NET

STUDY REPORT

ON

TRAWL FISHING IN THAILAND

BY

SOMPONG BOOTMAUANG

THAILAND

REGIONAL TRAINING COURSE IN
FISHING TECHNOLOGY AND RESOURCES CONSERVATION
1997

TRAINING DEPARTMENT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
BANGKOK, THAILAND

TRAWL FISHING IN THAILAND

INTRODUCTION

Trawl is one of the most recently introduced fishing gears in Thailand. It is now the most wide-spread and the most important gear in terms of production.

The first experiments with pair trawl and otter trawl fishing, conducted in the early 1950s by some private fishing companies, were unsuccessful. In 1960, however, the Department of Fisheries intervened and with the technical assistance from the Federal Republic of Germany launched a program designed to promote trawl fishing, particularly otter trawl which was gaining reputation of being highly effective. After that, the number of otter trawl fishing boats has increasad rapidly, with a corresponding sharp rise in production.

FISHING GEAR AND METHODS

The trawl fishing in Thailand can be grouped into four major categories;

- Beam trawl
- Otter trawl
- Otter trawl with boom
- Pair trawl

1. *Beam trawl*

The beam trawl was the forerunner of all trawl gear designs known today. Its main feature is a beam whose purpose is to spread the netting. The principal catch of beam trawl are shrimps, therefore the mesh size is relatively small. The mesh size of beam trawl also depends on the catch.

Fishing grounds of beam trawl are in shalow waters with muddy bottom. This kind of fishing is very common in Nakhon Si Thammarat and Surattanee province in the south of Thailand.

2. *Otter trawl*

The most popular form of trawl fishing in Thailand is by otter trawl, in which otter boards are used for horizontal spreading of the net mouth. Most otter trawl nets consist of two panels; this is called a "two-seam net". The mouth is oval-shaped when viewed from front. Two wings stretch out to increase the swept area and to guidse fish in the net,s path down to the cod-end. There are two types of otter trawl: one for shrimps and the other for fish.

The otter trawl for shrimp is usualy operated from small fishing boat about 8-16 m in length. The netting is 30-60 mm mesh-size. The size of net depends on the power of the fishing boat; the head-rope varies from 11-23 meters and the ground-rope from 13-24 meters. The difference between them is 1-2 meters. Both are made of polyethylene or polypropylene. The ground rope is weighted with a chain,or with lead sinkers. Otter-boards are rectangular and flat, made of wood and iron, 50-100 cm wide and 100-200 cm long, with a bridle chain and a back strap.

The warps are 14-28 mm in diameter, also made of polyethylene or polypropylene. A capstan winch is used for hauling warps and lifting the catch in the cod-end onto the foredeck of the fishing boat. The net is pulled by hand at stem. Four to eight fishermen take part in a fishing operation.

The fish otter trawls are the largest single fishery in Thailand. Most vessels used in this case are comparatively big, from 15-30 m in length. The fishing expeditions take one or two weeks, some times even longer. The teo-seam type of net is used 12-18 mesh-size for the wings, square, upper panel and belly, and 20-30 mm mesh-size for the cod-end. This net difference from the shrimp otter trawl net in that it has a triangular piece of netting at the top wings of boat panels. The head rope is 28-40 m and the ground rope 30-46 m long. The difference in their lengths is 2-6 meters. Both ropes are made of eire and combination rope. Wooden and rubber rollers, sometimes covered with spherical plastic capsul are attached on the ground rope for weighting nd nothing. Otter-boards are rectangular and flat, 1-2 m wide, 1.2-2.4 m long made of wood and iron. They have a fixed bracket and a bridle chain or fixed iron holders, and sometimes 1-5 plastic floats are attached at the front top part of the boards, so as to prevent the sinking of the boards into the muddy sea bed. The cod-end is hauled in the same way. Ten to twenty men are needed for a fishing operation. The main catch are bottom fishes and trash-fish.

Setting: When the gear is to be prepared, he boat streams along the desired course, into wind if desirable. The codend is thrown out and the working ropes retied intheir correct positions on head line and wings and the net streamed out astern, the sweep lines run out. The otter boards are connected to the warps and unhooked from the gallow, all is ready for setting.

Hauling: When hauling, the otter boards are hove up to the gallows and left hanging on the warps, being clamped if necessary to prevent slamming. The sweep lines were wound by winch to the ground rope. Then the ground ropes, wings and bellies of the trawl also are hauled up to the stern and the codend is pulled to the fore deck for emptying.

3. *Otter trawl with boom*

This fishing gear is similar to the bottom ottter trawl, except that a pair of booms are added to the fishing boat. The purpose of the booms is to increase the horizontal spreading of otter boards. Twin booms are arranged , hinging outward from the middle of fishing boat to provide outboard towing point for the towing warps. Most of the catches consist of shrimps.

4. *Pair trawl*

Pair trawling means that the net is towed by two boats. It both boats are small, less than 18 m long and with main engines of up to 150 h.p., it is a small pair trawl. A medium pair trawl combines towing of a boat of over 18 m in length and with a main engine of more than 150 h.p., with a small fishing boat. If both vessels are large, it is known as a large pair trawl. This fishing method was introduced in Thailand in the 1960s by Japanese fishermen.

In pair trawling, the net mouth is kept open by outward towing of the two boats, which always try to keep the same distance between them during operation. Otter boards are not necessary, the arrangement of gear is simplified, the warp is connected directly to the sweep lines whose other end is joined to a triangular iron frame at the end of Gridles from each wing of net.

Setting: The cod-end is thrown into the sea, or pulled out by one boat, while the net boat keeps "dead-slow ahead", lowers the net, and tows it until it is stretched. The other boat approaches and the mesenger line is thrown to it so as to transfer one wing of the net. The sweep lines are then connected to the triangular iron frame on each boat, and both boats sail-ahead together, paying out the sweep lines and warps evenly to required lengths, and the fishing commences.

Hauling: Both vessels stop and turn toward the net position, warps are hauled and passed through gallows at the bow until triangular iron frame reach the gallows. The boats then converge until they are a short but safe distance apart and sweep lines are disconnected, messenger line is thrown to the net boat in order to return the wing net. Then net is hauled on board by manpower or by capstan winch passing through a pulley on the boom crane until the cod-end is hung and emptied.

A pair trawl is usually operated in the day-time. Fishing grounds are in the Gulf of Thailand and the Andaman Sea at the depth of water up to 40 meters. Most catches consist of trash fish, squid, cuttlefish and threadfin bream. The major landing portsare Samut Sakhon, Samut Songkhram, Songkhla, Ranong and Phuket.

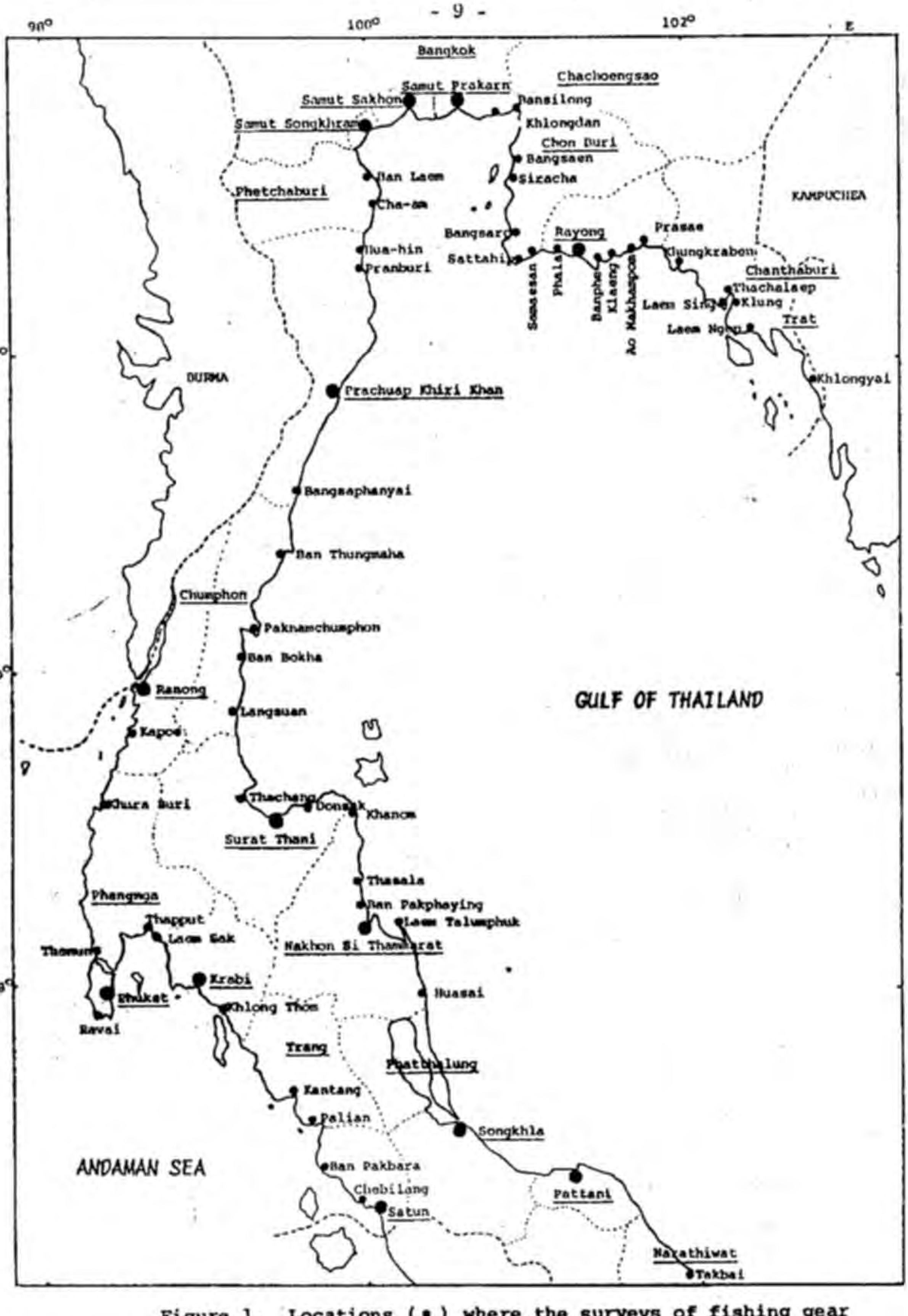
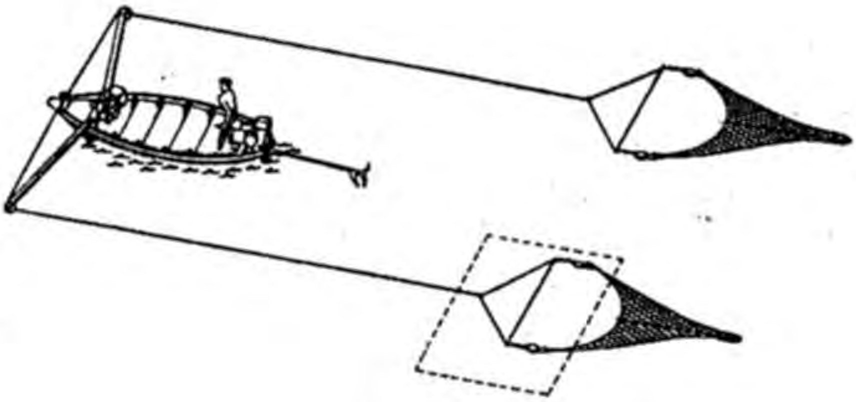
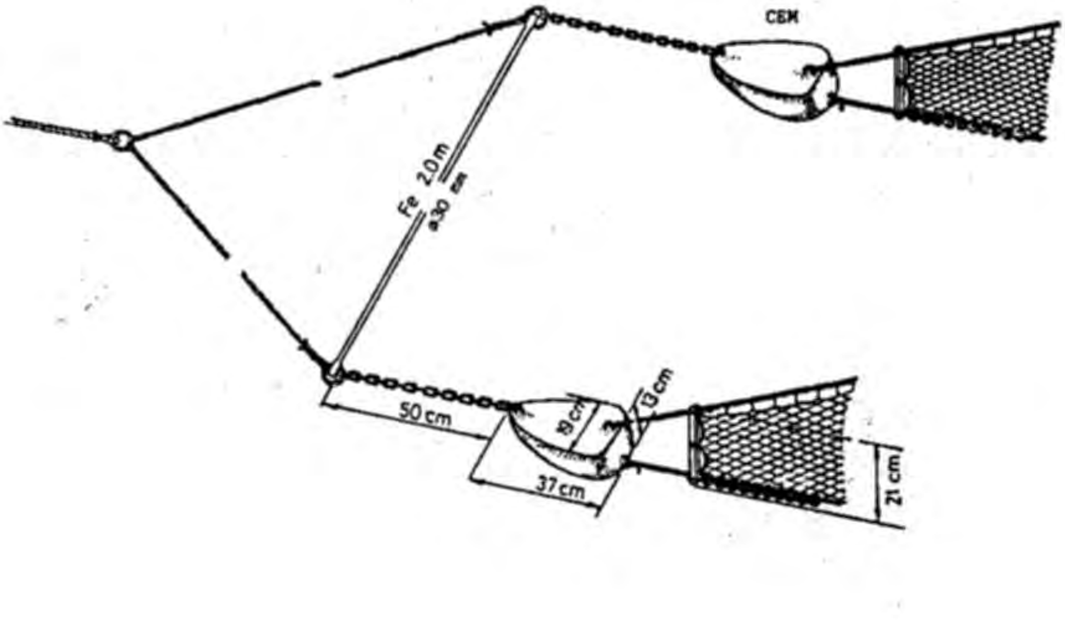


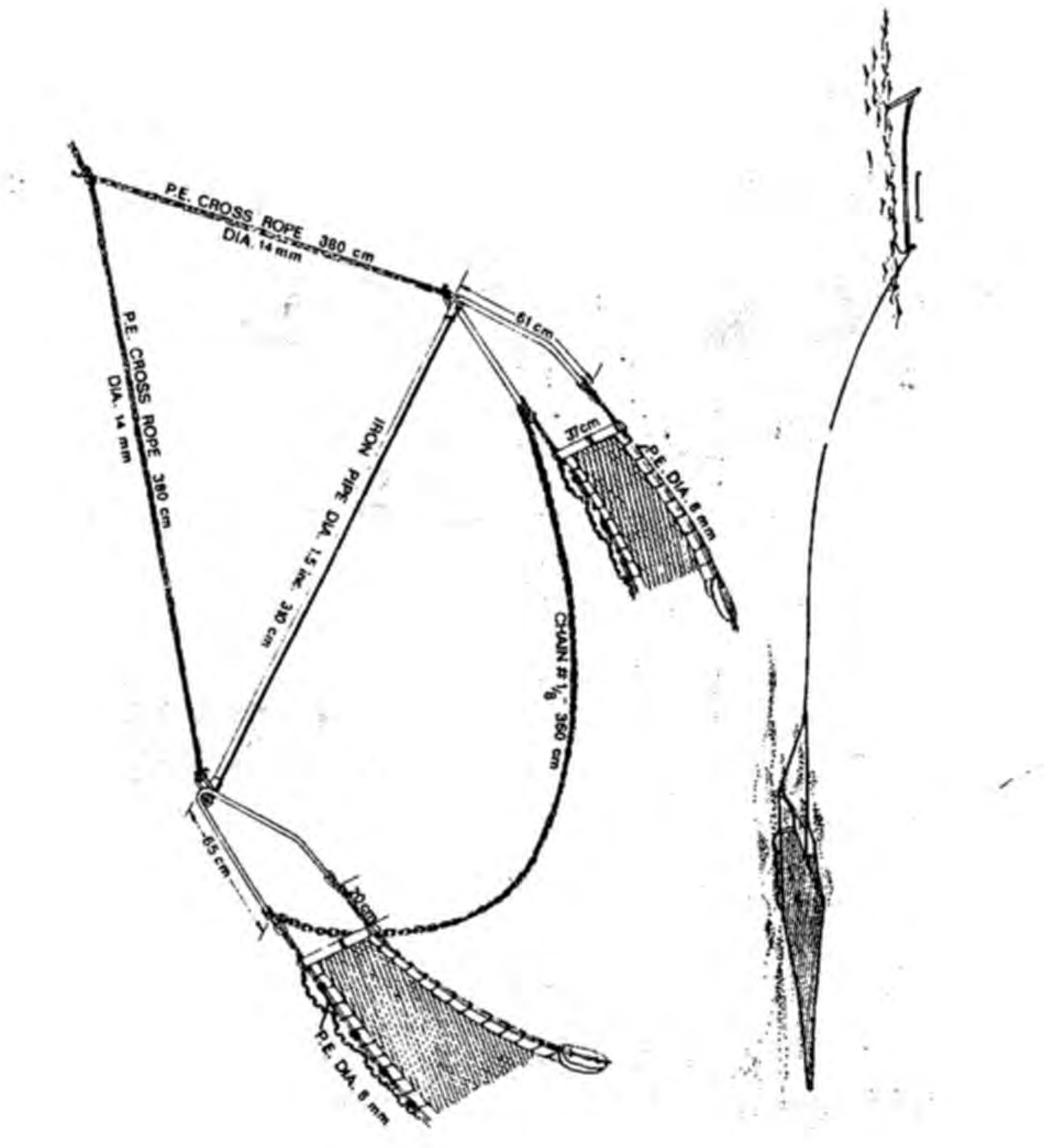
Figure 1. Locations (•) where the surveys of fishing gear and methods were carried out. The names of provinces are underlined.

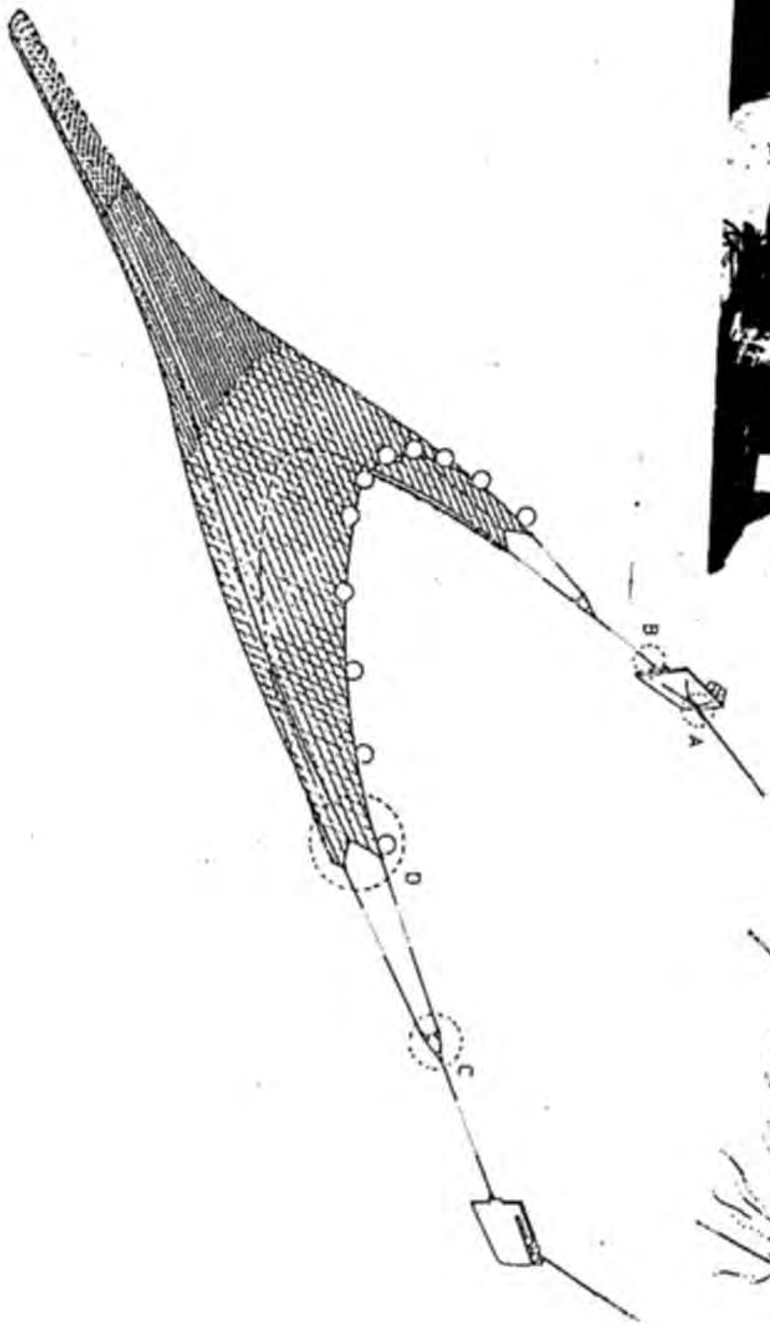
• Village or town

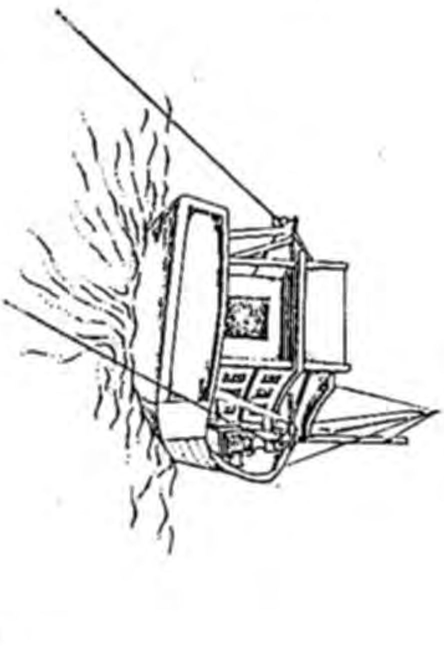
● Provincial capital

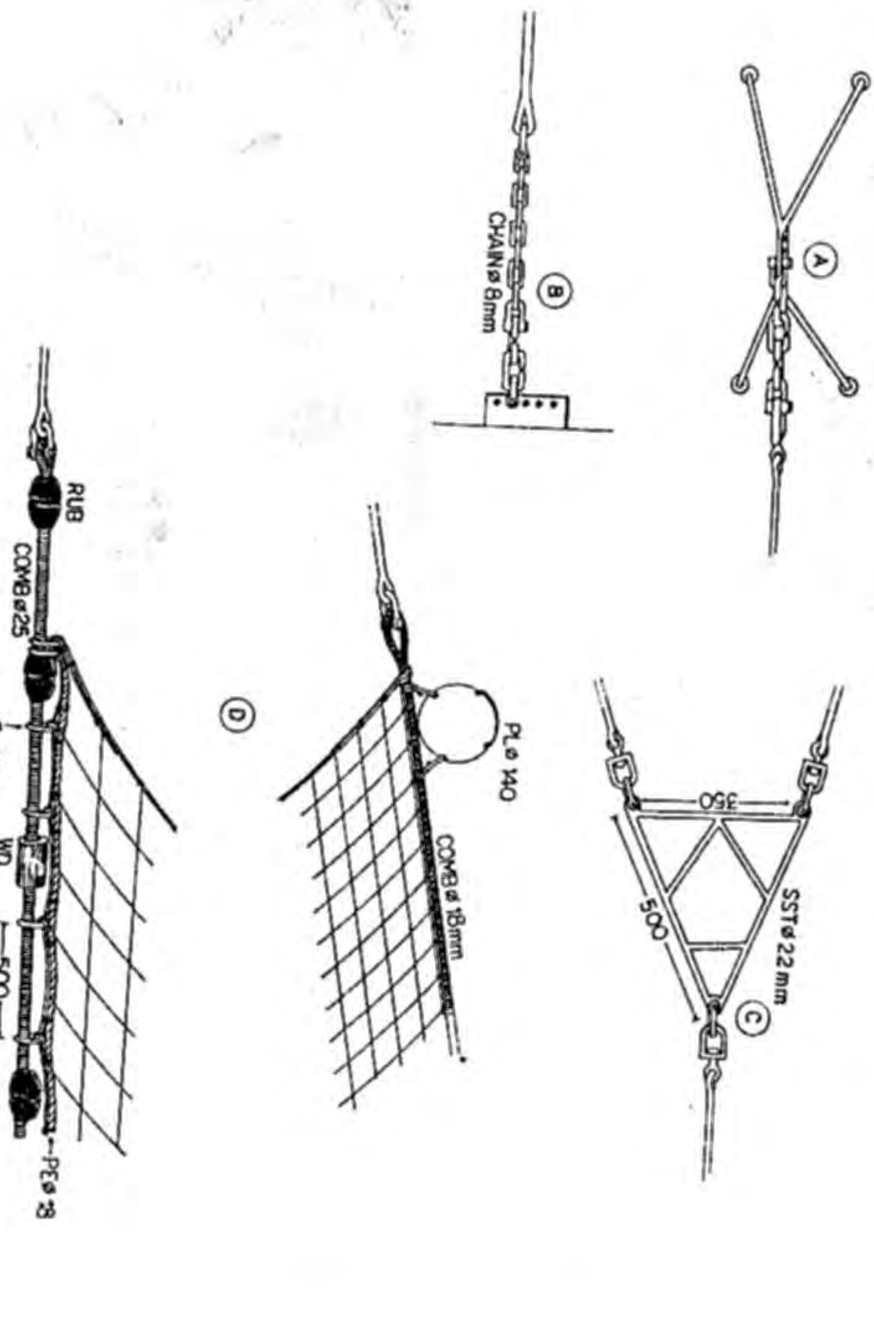


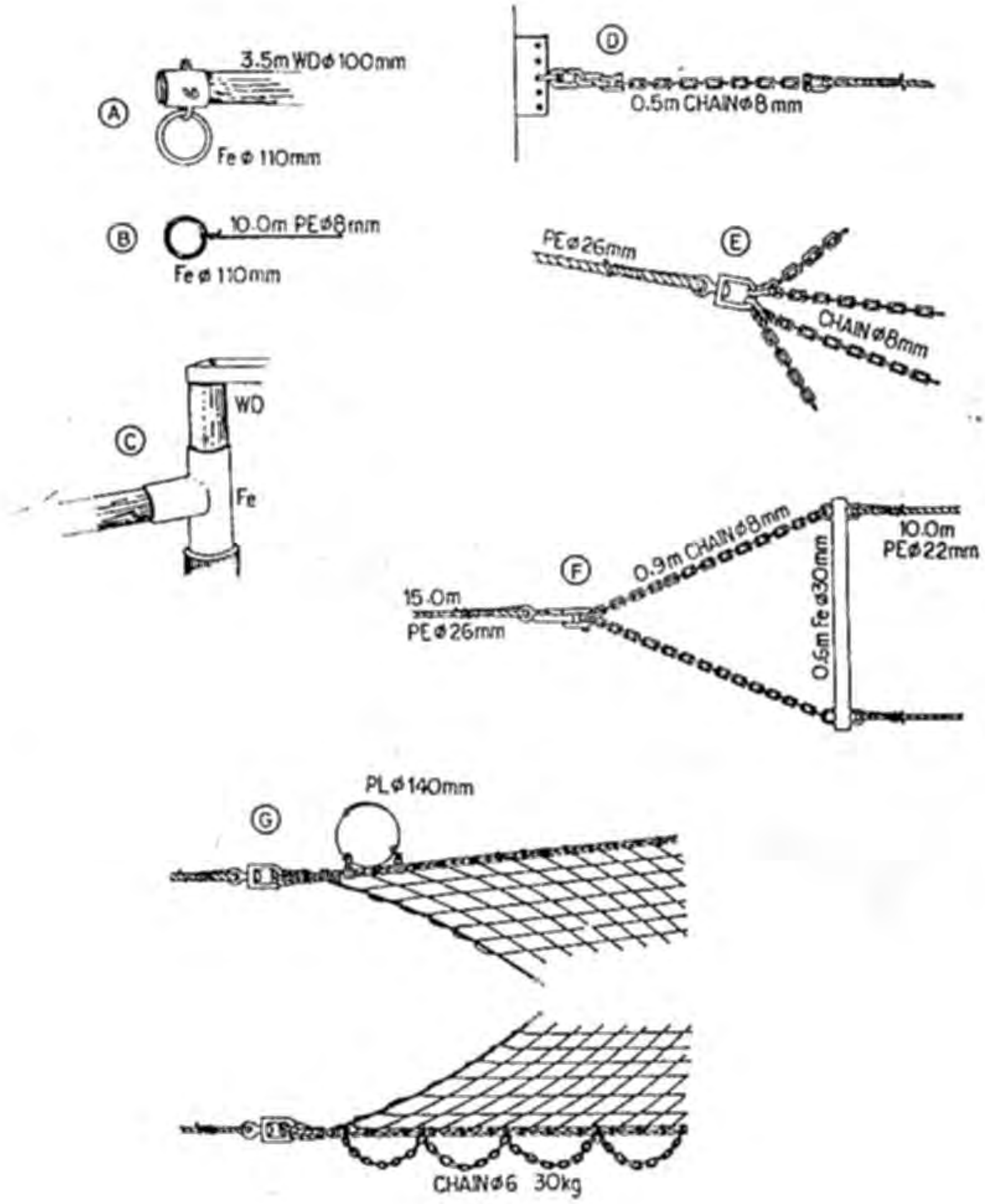

CBK
Fe 2.0 m
50 cm
37 cm
21 cm
13 cm

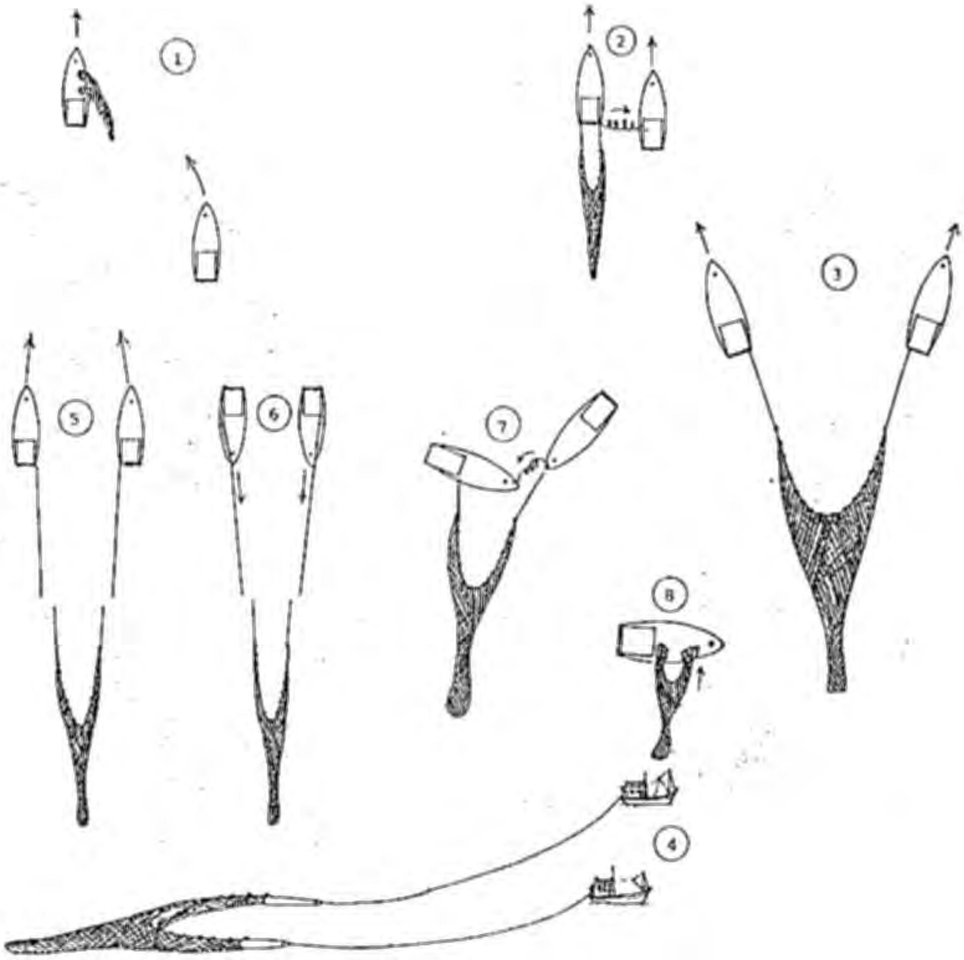

P.E. CROSS ROPE 380 cm
DIA. 14 mm
P.E. CROSS ROPE 380 cm
DIA. 14 mm
61 cm
37 cm
P.E. DIA. 8 mm
IRON PIPE DIA. 1.5 inc. 310 cm
CHAIN #1/8 360 cm
65 cm
20 cm
P.E. DIA. 8 mm


B
A
D
C




A
B
CHAIN ø 8mm
C
350
500
SST ø 22 mm
D
PL ø 140
COMB ø 18mm
RUB
COMB ø 25
Fe ø 60
WD
ø 70x120
500
PE ø 18


3.5m WDø 100mm
A
Fe ø 110mm
B
10.0m PEø8mm
Fe ø 110mm
C
WD
Fe
D
0.5m CHAINø8 mm
PEø26mm
E
CHAINø8mm
F
0.9m CHAINø8mm
15.0m
PEø26mm
0.6m Fe ø30mm
10.0m
PEø22mm
PLø140mm
G
CHAINø6 30kg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STUDY REPORT

ON

THE PATTERNS OF FISH SCHOOLS

By

Natinee Sukramongkol

(Special Trainee)

Regional Training Course in

Fishing Technology and Resource Conservation

(16th June - 15th December,1997)

Training Division

SEAFDEC Thailand

Introduction

A system of fishing information services was introduced by the Icelandic government in the early 1960s. The underlying principle is that of increased efficiency through specialization, i.e. the important task of fish location is mainly conducted by a few specialized ships and personal, and thus the fishing fleet is mostly relieved from this task and can spend more time on actual fishing. The work carried out by these specialized vessels led to a better understanding of the migration patterns of the capelin and herring stocks, and this vessel were able to carry out hydrological, phyto- and zooplankton investigation. At this time the sonars carried on this vessels were far superior to those carried on the commercial vessels.

Catches can be increased chiefly by more intensive fishing to hitherto not fully exploited pelagic fish in the World ocean - small tuna, jack mackerel, capelin, billfish, sardine, anchovy, mackerel, shark - plus invertebrates and squids.

In this connection an important task is the development of large-scale fishing of pelagic items and the construction of gear and methods for catching animals distributed in mid water and not informing dense and stable accumulations, such as were usual in the initial period of ocean fishing. This involves fundamentally new fishing methods based on the latest achievements of science and technology in the field of fish schooling behavior.

Fish spotter's position :

Schools of fish can often be seen from far away. They may be spotted indirectly by sighting flocks of marine birds flying up and down over a spot in the sea and diving into the water, or school of porpoises which are often followed by schools of tuna (especially in the Pacific Ocean). Normally, indirect spotting is effective from greater distances than direct spotting. Direct spotting of schools also requires more experience and first-class eyesight. First spotters (sometimes called "mastmen") assume as high a position as possible on board, most often in a crow's nest or on a chair mounted at the mast top, so that they can extend their horizon and increase the angle at which they can look down at the surrounding water. The closer their angle of vision to the vertical the greater the depth at which they are able to see fish, because of the optical characteristics of water.

Where fish schools come close to the coast they can be seen from high places, like hilltop, mountains or tall buildings and towers. In such areas, fishermen can be directed by shore-situated spotters. they may not even put to sea until fish have been located, thus saving fuel and time at sea.

The appearance of fish schools :

School of fish may appear to have different shapes. In general, they can be distinguished from the surrounding waters by their color, often a raddish or darker shade, by changing the appearance of water surface (ripples, oily patches), by their motion, and by breaking the surface. Inexperienced observers may sometimes be confused by shadows of clouds and patches on sea bottom, such as rock, reefs, or seaweeds (Ben-yami 1987).

Size of schools :

Fish school come in all size, which very with species, age, environmental condition, availability of prey, etc. Their relative appearance to the eye of the air scout or mastman will depend on their size and swimming depth, as well as the water transparency. In the tropics, especially in areas of very clear water, even an experienced observer may be misled, especially if he is accustomed to estimating the total amount of fish in a school by multiplying the number actually observed near or on the surface by a large figure. A tuna survey in the south Red Sea showed that, where the water is very transparent, this picture should be keep low, for sometimes the visible fish comprise the bulk of the school.

In sub-tropical water, fish school may be spotted at night by bioluminescence is more efficient than daytime scouting

Schooling patterns :

- Tuna and other large fishes

Fishermen distinguish many types of tuna schools and give them different names in different languages and parts of the world. The most important and most commonly encountered ones are (Scott & Flittner 1972) :

(1) Breezing school (breezers). Fish swimming very close to the surface of the water, usually in a single direction, creating ripples which resemble those created by a light breeze.

(2) Boiling school (boiler). Fish feeding intensively, and often in conjunction with marine birds, crowding upon the prey and creating an impression of the top of a boiling pot.

(3) Jumpers. Schools moving with some members breaking the surface and showing all or most of their bodies.

(4) Black spots. Subsurface schools appearing to the shipborne observer as black or dark spots.

Fish spotter's position :

Schools of fish can often be seen from far away. They may be spotted indirectly by sighting flocks of marine birds flying up and down over a spot in the sea and diving into the water, or school of porpoises which are often followed by schools of tuna (especially in the Pacific Ocean). Normally, indirect spotting is effective from greater distances than direct spotting. Direct spotting of schools also requires more experience and first-class eyesight. First spotters (sometimes called "mastmen") assume as high a position as possible on board, most often in a crow's nest or on a chair mounted at the mast top, so that they can extend their horizon and increase the angle at which they can look down at the surrounding water. The closer their angle of vision to the vertical the greater the depth at which they are able to see fish, because of the optical characteristics of water.

Where fish schools come close to the coast they can be seen from high places, like hilltop, mountains or tall buildings and towers. In such areas, fishermen can be directed by shore-situated spotters. they may not even put to sea until fish have been located, thus saving fuel and time at sea.

The appearance of fish schools :

School of fish may appear to have different shapes. In general, they can be distinguished from the surrounding waters by their color, often a raddish or darker shade, by changing the appearance of water surface (ripples, oily patches), by their motion, and by breaking the surface. Inexperienced observers may sometimes be confused by shadows of clouds and patches on sea bottom, such as rock, reefs, or seaweeds (Ben-yami 1987).

(5) Shiner. Fish swimming very close to the surface which shine from time to time, probably by reflecting light from their bodies as they twist and turn in pursuit of prey.

(6) Fireballs. Subsurface schools which can be spotted during night-time owing to the bioluminescence they generate in water, by disturbing bioluminescent organisms.

The directional motion of feeding tuna schools is slower and that feeding frenzy affects their awareness of the potential danger. Breezers and black spots on the other hand, swim faster, are apparently more prudent, and swim deeper, which bring them closer to one possible escape route, under the leadline of the seine.

Schools of yellowfin usually occur in close association with large schools (up to 1,500 animals) of three species of porpoise, (***Stenella attenuata*** - the spotted dolphin or 'spotter', ***Stenella longirostris*** - the 'spiner', and ***Delphinus delphis*** - the common dolphin). The reason for this association is unclear, through some food-base relationship is suspected, because both feed on similar food. The fish seem to follow the porpoise very closely, and hence they can be herded by herding the porpoise.

Tuna and other tuna-like species are among the fastest fish in the ocean, able to develop burst of speed exceeding 10 body lengths per second. This enables them, if frightened, to escape almost any purse seine before escape routes are closed, especially if they can see the gate to freedom, if they are not restrained from diving by a thermocline, and if they are not attracted to FAD, flotsam or porpoise.

- small pelagic

Different species and sizes of fish have different schooling characteristics. This makes it possible to identify different school types from the air and, if there is enough bioluminescence in the water, also at nigh.

for example, Off Chile and Peru, schools of anchoveta are usually located by the intense purple color they show in the water. The shades may vary considerably, depending upon light and water conditions or plankton occurrence. Birds are important indicators of fish presence and pelicans and gannets are the more reliable ones for indicating the presence of anchoveta. Larger fish, such as mackerel, horse mackerel and bonito usually show rust color, again the shade changing with environmental conditions and the swimming depth of the school. schools of mackerel can be distinguished by their whipping of the sea surface, which is one of the most intense of any fish species and is seen mainly during early morning hours. Later the intensity decreases and the fish normally disappear from the surface a few hours after sunrise. Horse mackerel do not whip as vigorously, and they are not necessarily accompanied by birds. Horse mackerel may be followed by small white birds and by fast-moving greyish gulls, the same that follow tuna and bonito. Bonito can be spotted by spotted by an unmistakable water-splashing action and reflection when breaking the surface.

Clupeoids are slower swimmers than scombrids and horse mackerel, but they are able to reach speeds exceeding six body lengths per a distance enabling them to escape a seine, if they see the way out. Hence the difficulty in purse seining for sardinella where water is highly transparent, and the reason for the frequent use of light and FAD attraction in the tropics.

Bottom attraction :

School of fish often prefer to remain in the vicinity of rocks, reefs and other shallow-water area, where the sea bed character prevents the use of purse seines. Fishermen may know from experience that if they wait patiently, the fish might eventually move to an area with clear bottom where they can be fished. In other case, fishermen lure them away using light attraction or chumming. These methods do not work in all case, especially if food is plentiful in the rocky area.

Typical schooling pattern attraction with light fishing :

The response and behavior of fish towards artificial light is not well enough understood yet to involve comprehensive and conclusive explanations for, and predictions of, school patterns for all type and species. The best guidance for practical purposes is probably the reaction to natural light condition, although this is not applicable in all case.

From observations and research may be deduced for fishing with light ;

- Under similar conditions, fish of the same or closely related species generally have similar schooling patterns, even geographically remote.

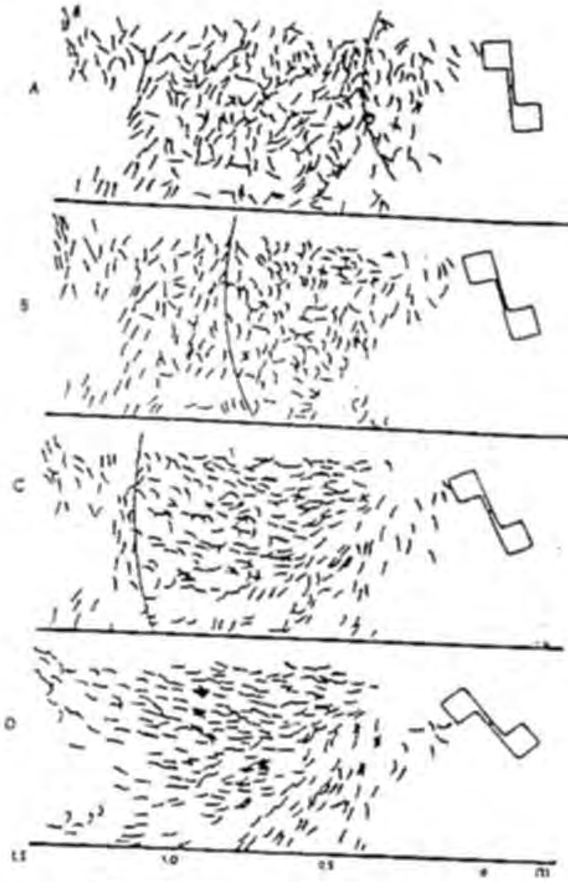
- Certain basic schooling patterns can be identified for classifying certain species and environmental condition, which helps in transferring light fishing techniques into new areas.

- Under similar condition, the schooling pattern of fish of the same or related species may very significantly according to, for instance, age, sex, physiological conditions, season.

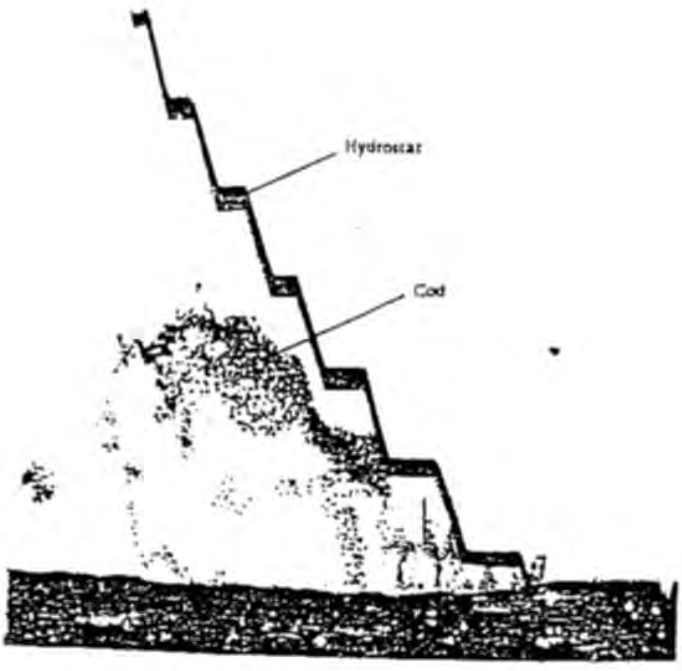
- The characteristics of the artificial light source, e.g. surface or underwater, color, beamed or diffuse, steady or flickering, constant or changing light intensity, can have a significant effect on response.

- Other specific external factors, such as water transparency, currents, surface waves, temperature barriers, moonlight, presence of food or predators, can strongly influence the efficiency of light attraction.

- the position of an underwater fishing lamp with regard to the normal distribution of the fish, as well as vertical movements of the lamp, may cause specific reactions.



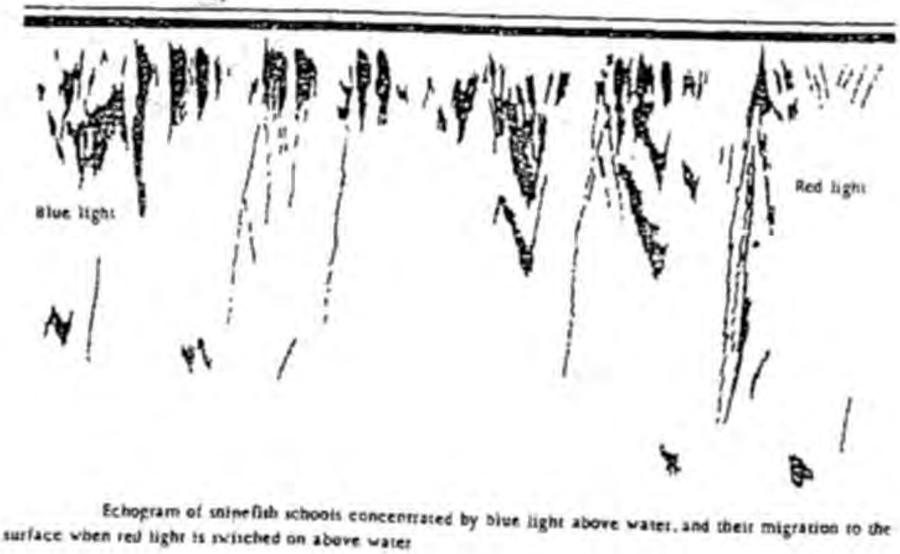
The "wave of stimulation" in a school of Atherino- morus stipes



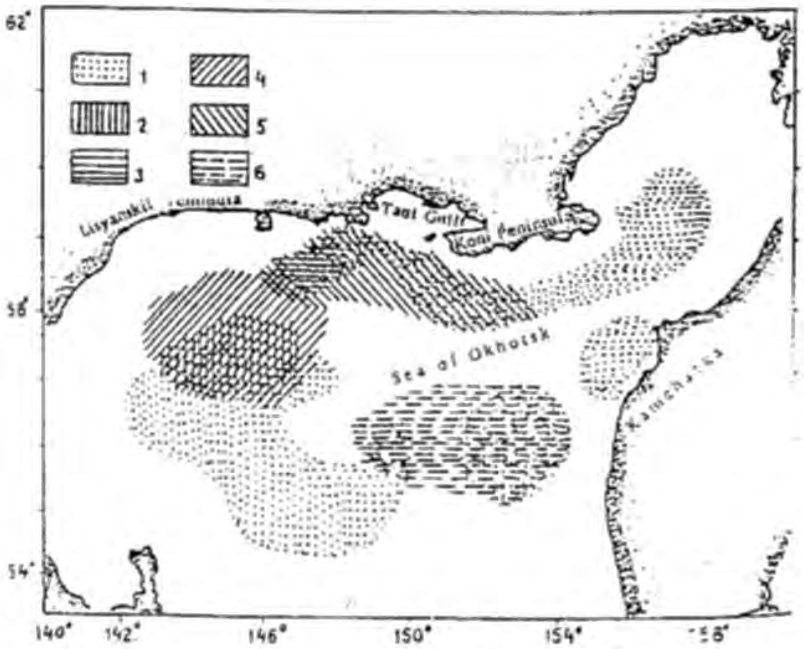
Echogram of a cod school and the hydrostat

Echogram of schools of Atlantic saury concentrated by blue light above water (left-hand side of illustration; power of lamps 50 kW), and the reaction to red light switched on above water (right-hand side of illustration; power of lamps 5 kW). Catch with stick-held dip net 1 ton per haul.

Echogram of snipefish schools at a depth of 50–70 m during reconnaissance at medium speed (7 knots) in the evening

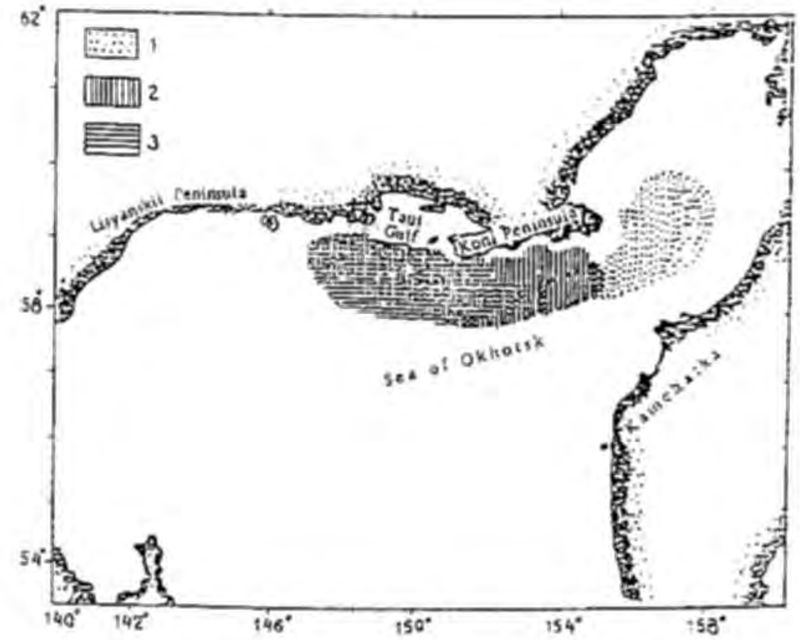


Echogram of snipefish schools concentrated by blue light above water, and their migration to the surface when red light is switched on above water



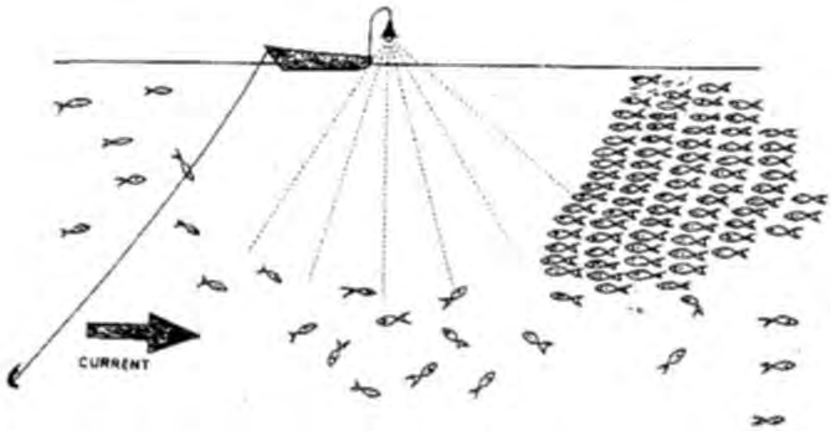
Distribution of fattening Okhotsk herring in June and July in relation to the type of year:

1 – zones of high biological productivity; 2 – June distribution in warm years; 3 – June distribution in average years; 4 – July distribution in warm years; 5 – July distribution in average years; 6 – July distribution in cold years.



Distribution of fattening Okhotsk herring in August and September:

1 – zones of high biological productivity; 2 – distribution in August; 3 – distribution in September.



"Sardinella type" fish reaction to stationary artificial light. Fish drift with the current into the illuminated zone where they can see and start feeding. They accumulate and concentrate down current of the light source and maintain position within the zone of preferential illumination.

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CONTENTS

CURRENT FISHERIES RESOURCES MANAGEMENT AND MECHANISM IN INDONESIA

I. INTRODUCTION

Policies and strategies for fishery resource is discribed in the Indonesia Five Years Development plan for fisheries. Accordingly, the focus of development is to increase the socio-economic welfare of the fisheries community.

The fisheries is categorised by scale of fishing, namely : small, medium and large. Small-scale fishing included the use of boats (non-powered or powered boats) with 5 gross ton or less (> 5 GT), medium scale are those who are engaged in fishing using boats with more than 5 GT to 30 GT, and, large scale fishing if boats ranges from more than 30 GT. In 1995, the small-scale sector composed of about 83.8% of total boat units. The medium and large scale sectors shared around 15.5% and 0.7%, respectively (Table 3) [I could be noted that boat units increased yearly for all sectors, however, in 1995 the number of large boat decreased (-7.6 %)].

In terms of employment, 50 % of fishermen are working full-time in fishing in 1995. About35 % are working for fishing as their major part-time job white 15% of fishermen are engaged in fishing as minor part-time source of income (Table 2).

Total fisheries production in 1995 was 4,263,587 tons. This is distributed according to sectoral type, namely : marine fishery with 3, 292,930 tons or 77.23 % of the total production; and, culture with 640,947 tons or 15.03 % share (Table 4). A continuing increase in production were achieved yearly.

Accordingly, the fisheries policy basicaly take main priorities for developing small scale fisheries, by implementing responsible fishing in terms of fisheries resources management. For this purposes , the Government of the Republic of

Indonesia has issued several laws and regulations and Ministerial decrees for fisheries concerning the development plan including resources management strategies.

In term of its mechanism of the policy the authority of fisheries resources management is principally under management of the Directorate General of Fisheries. However, a part of these have been delegated to the Provincial Fisheries services, especially for small scale fisheries management. In some special cases, it involves other related institutions.

2. SITUATION OF FISHERIES MANAGEMENT.

The implementation of fisheries resources management is to up lift livelihood conditions of artisanal fishermen in small scale fisheries. Other main goals include increase of fish production, sustainable yield, harmonize effort between small and large scale fisheries and to improve fishermen welfare. Accordingly, fisheries resources management could be discribed in various aspects, such as :

2.1. *Stock assesment aspect*

Stock assesment is first step of fisheries resource management. Relating to the fishery stock situation, the Directorate General of Fisheries has issued information concerning stock and potential yield assesment as result of various studies and research. The information has been issued in several stock information such as potential yield and distribution indication of fish in Indonesia and EEZ water. However, these activities are in limited condition due to insufficient data available and funding. As such, information is still in process.

2.2 *Fisheries resources explotation aspect*

The main goal of utilization of fish stock is to increase fisheries production which aim further impact to increase income of fishery community. The Goverment, in term of management plan, particulary to arrange the level of fish exploitation and the potential yield equally with several aspects relative to the stock assesment, fisheries resources status, distribution of fishing gear and fishermen. Accordingly, the Directorate General of Fisheries established management measures, such as determining fishing effort allocation by fishing gear, fishing vessel and fishing ground.

Relating to fisheries development for industrial fisheries, the fishing effort in off shore and EEZ waters are determined. For example : In South China Sea, the area is potential for increasing operations of Gill Net, Purse Seine and Fish Net; In Indian Ocean for Long Line; In Pacific Ocean for Long Line and Purse Seine; and, In Arafura Sea for Fish Net and Shrimp Net.

The other side of the aim of fisheries resources management besides increasing fisheries production, is to keep sustainable yield of resources which is more important. Policies related to banning of fishing gear which are hazardous for sustainability of fisheries resources are promulgated such as trawl, electric and dynamite fishing.

2.3 *Control and law enforcement aspect*

Currently the situation of the fisheries in Indonesia has been developed fastly. However, not all of the development has positive impact. There are also negative impacts, such as violation of fishing ground, the use of banned fishing gear, etc. Relating to control and law enforcement, monitoring, control and

Surveillance (MCS) system is being applied in fisheries. Several activities are being conducted by the Directorate General of Fisheries, such as :

- Monitoring of fisheries resources exploitation.

Commonly, monitoring activities to understand the level of fisheries exploitation is conducted through collection of fisheries data statistics. However, statistical approach of exploitatied species is not so accurate, since most of the data come from fish landing places. Therefore, data collecting system per individual fishing ground approach through use of fishing log book, is necesery :

- Implementation of fisheries regulation, control, which is conducting in landing place.

- Surveillance activities for fisheries relating to fisheries regulation implementation in the sea. These activities were conducted by joint operation with the Navy Patrol.

2.4 *Environmental conservation and protection aspect*

The status of fisheries resources is also influenced by environmental condition. Therefore, to maintain fisheries resources sustainability, beside the effort mentioned above, it is also followed by environmental protection effort, such as, endangerous species protection, restocking, pollution prevention, environmental rehabilitation, etc.

For biodiversity protection and conservation there are several measures for protecting Arochus(*Trochus niloticus*), Turtle(several species); Kima(*Pinctada* sp.) and other such as certain species of Arowana(*Schlerophagus* spp.), Dugong and keep measures of CITES

2.5 *Evaluation*

Fishing activities regulary need to be evaluated, particulary the based data came from MCS activities in the field. The evaluation of MCS activities have two main purposes there are :

- Fisheries resources status evaluation.

It will be used for stock assesment and fisheries regulation evaluation, especcially relating to its exploitation. Beside the Directorate General of Fisheries data, it is also use research data from other institution.

- Violation of fisheries regulation evaluation.

It will be used to evaluate the implementation of fisheries resources management regulation, its problem and how to solve it.

3. FISHERIES DEVELOPMENT POLICY

3.1. *Fisheries Development Policy in General*

Fisheries development policy of the goverment of Republic of Indonesia has objectives as follows :

a. To increase quality of fisheries human resources and fisherment income through optimal sustainable utilization of the fisheries resources;

b. To increase added value of fisheries commodity;

c. To increase stock and distribution of fisheries commodity in order to increase the nutritional requirement of the people;

d. To increase work opportunities;

e. To encourage industry development through the used of raw materials;

f. To increase of source foreign exchange, through export of fisheries production.

Principally, all of the fisheries policies are aimed to establish good conditions on agribusiness development, of which the fisheries product would be in a good demand in domestic or international market as well as to increase fisheries community welfare.

3.2. *Fisheries Resources Management.*

The objectives of fisheries resources management is to achieve optimum utilization and sustainability. Management strategies have been dealing with the policies, such as : regulatory measure on fishing gears and methods to be used in Indonesian waters by :

- Determining type of fishing gear;
- Determining technical condition (specification) of fishing vessels;
- Regularly conducting of stock assesment studies and effort allocation in certain fishing areas;
- Determining the type and size of fishing gear or fishing vessel in different fishing grounds; and,
- Environmental protection and rehabilitation.

In line with the management purpose above, the Goverment of the Republic of Indonesia has issued fisheries regulations, such as :

- The Law No.9/1983 and The Goverment Regulation No.15/1984 concerning fisheries regulation in the EEZ of Indonesia. It is to control containe the access for domestic and foreign fishing vessels considering the conservation of the resources and other regulations relating to the UNCLOS 1982.

- The Minister decree No.815/1990. This fishery regulation authorizes and delegaties from the Central Goverment (Directorate General of Fisheries) and the Provincial Fisheries Service, to issue fishing license For small scale fisheries, it is being issued by the Provincial Fisheries Services and large scale fishing license is issued by the Directorate General of Fisheries.

In order to implementation of the fishery regulation the Government of Indonesia applies the the Monitoring, Control and Survaillance (MCS) system to enforce the laws. Several regulation according to fisheries resources management measure were :

- In 1976, Indonesian Goverment established fishing zonation policy. This regulation measures taken, principally to protect small scale fisheries from preventing large scale fishermen in their fishing grounds by dividing the fishing ground into several zone and criteria upon which each fishing ground to be utilized by certain size of fishing vessel respectively (Ministry decree No.607176).

- Respecting to sustainable principles, of the above there were also a provisions to regulate mesh size of fishing gear, where by mesh size less than 2.5 cm are prohibited and purse seine with target species tuna and skipjack may not use mesh size less than 6 cm.

- Considering fisheries allocation policy. Directorate General of Fisheries always directing fisheries resources evaluation regularly. These evaluations give information on fisheries utilization, rate of exploitation, fisheries resources allocation (as basis for fishing license), potential yield as a whole etc.

- Regulation for fishing vessel with due respect to potential yield. Fish resources utilization which reflected by numbers fishing vessel operated that would be commensurate with the issue of issuing fishing license, there are Directorate General of Fisheries (on behalf of Minister for Agriculture) and part of them authorized for local (Provincial) Goverment which principally, large scale of fishing vessel (of.30GT), their license issued by central Government, less than 30 GT by local Government.

In line to this policy, because of the Nusantara (archipellagic) principles upon which these vessel commonly may operate in all of Indonesia water (not to be limited by local government administration), this condition potential to raise conflic among fishermen or among local authorization (right). Based on situation, central Government create and apply a coordination of Management. Their members are all of Local Fisheries Service, under guidance of central Government (Direktorate General of Fisheries), by taken participation institutional concerned i.e. : Navy, Fisheries Company Assosiation, Fishermen Organisation, etc.

- Tasking for shrimp trawl companies for using (to take benefit) their by catch product. This measurenment regulated by Ministry decree No.561/1973.

- Tasking for shrimp trawl to install By Catch Excluder Device (BED) under regulation of Director General of Fisheries Decree No. IK.010/s3.8075/1982. This decree as subsequently the President Decree No.85/1982 that regulate shrimp trawl operation in certain area of Eastern Part of Indonesian Water including Indonesian EEZ.

4. MANAGEMENT MECHANISM

Because of two institutions authorities concerned fisheries management there are central goverment (as leading on this matter) and Provincial Fisheries Service, accordingly for the implementation of management measures, it is needed coordination between the two institution mention as follows :

- Principally the large scale of fisheries under manage of central goverment and medium to small by local goverment these arrengement has been a provision taken in Minister decree No.815/1990. According to this,fishing licence for over 30 GT (90 HP) fishing vessel is issued by the Directorate General of Fisheries and fishing licence for under 30 GT (90 HP) fishing vessel is issued by Provincial Fisheries Service. Consequently, to avoid a conflict in fishing area which is operated the fishing vessels managing by two authorities it is therefore in a fishing ground charateristic which operated fishing vessels, which its licence are issued by the Directorate General of Fisheries and the Provincien Fisheries Services the Goverment take joint management policies amongs local goverment under coordination and central goverment.

In that regard with conducting of the polecy, the goverment has established communication forum system which its member are consist of the Provincien Fisheries Services involved under coordinated by the Directorate General of Fisheries. By the system it will could solve fisheries problem faced by local goverment. The forum will be a unit of activities for :

- Determining of fishing effort allocation for the Directorate General of Fisheries and Provincial Fisheries Service.
- Coordinating of fishing licence issued
- Monitoring the status of fisheries resources

- MCS system implementation
- Evaluation of the implementation of the duties.

In term of its duty mention above, the forums are supported by other institution involved, such as :

- Statistic activities unit, in preparing data. This institution establised in Directorate General of Fisheries and the Provincien Fisheries Service as well data sources also came from the result of fishery research data from The Marine Fisheries Research Institute this is quite important to evaluate the status of fisheries resources and level of exploitation. The implementation of MCS involve several institution such as, police, Navy, local goverment and fisherment organisation and fisherment it self. This system established become of various authorities relating to utilized the Indonesia sea water. Coordination in management is basic principles in Indonesia.

5. CONCLUSION AND SUGGESTION

5.1. Conclusion

The Directorate General of Fisheries has taken management strategies and applied several fisheries resources management measures, which is consist of several aspect, such as : stock assesment, fisheries resources exploitation, control and law enforcement of fishery regulation violation and evaluation.

In its implementation involve other institution, such as :

- The Marine Fisheries Research Institution for stock assesment and fisheries resources status evaluation;

- The Indonesian Navy for surveillance and law enforcement of fisheries regulation violation;

- The Provincial Fisheries Services for conducting fisheries resources management measures, due to part of it have been delegated to the Provincial Fisheries Services.

5.2. Suggestion

For effective fisheries management, it is important to collect accurate data, strengthen the implementation and enforcement system. Therefore, an intergrated and coordinated approach is between all the concerned institutions vig Marine Fisheries Research Institution, Indonesian Navy and Provincial Fisheries Services is extremely important and essential.

TABLE 1. NUMBER OF MARINE FISHING ESTABLISHMENTS BY SIZE OF MANAGEMENT, 1991 – 1995

SIZE OF MANAGEMENT	YEAR					AVERAGE (%)
	1991	1992	1993	1994	1995	
TOTAL	259,959	284,398	283,845	288,730	286,003	3.7
WITHOUT BOAT	44,185	59,657	53,139	57,033	57,556	8.1
NON POWERED BOAT	215,774	224,741	230,706	231,697	228,447	1.5
OUTBOARD MOTOR	71,185	74,164	89,738	82,282	88,974	6.2
INBOARD MOTOR	46,186	47,146	52,687	54,769	61,097	7.3

TABLE 2.

NUMBER OF MARINE FISHERMEN BY CATEGORY OF FISHERMEN
1991 – 1995

Unit : Person

FISHERMEN CATEGORY	YEAR					AVERAGE (%)
	1991	1992	1993	1994	1995	
TOTAL	1,632,630	1,742,210	1,889,524	1,850,244	1,957,678	4.7
FULL TIME	817,301	859,004	937,261	925,335	979,434	4.6
PART TIME (MAJOR)	617,544	618890	667129	648007	686174	2.76
PART TIME (MINOR)	197,785	264,316	285,134	276,902	292,070	11.05

TABLE 3. TREND OF MARINE FISHING BOAT BY SIZE OF BOATS, 1991 – 1995

Units

SIZE OF BOATS	YEAR					AVERAGE (%)
	1991	1992	1993	1994	1995	
NON POWERED BOAT	231,659	229,377	247,745	245,486	245,162	1.5
OUTBOARD MOTOR	75,416	77,779	82,217	87,749	94,024	5.7
< 5 GT – 30 GT	46,205	49,989	57,557	59,999	62,725	8
> 30 – > 200 GT	1,504	1,761	1,979	2,951	2,742	17.9
TOTAL	354,784	358,906	389,498	396,185	404,653	3.4

TABLE 4. TREND OF FISHERIES PRODUCTION BY SUBSECTOR, 1991 – 1995

Tons

SUB SECTOR	YEAR					AVERAGE (%)
	1991	1992	1993	1994	1995	
TOTAL	3,349,601	3,493,332	3,795,322	4,013,831	4,263,587	6.2
MARINE FISHERY	2,537,612	2,642,068	2,886,289	3,080,168	3,292,930	6.7
INLAND / OPEN WATER	294,477	300,896	308,649	336,141	329,710	2.9
CULTURE	517,512	550,368	600,384	597,522	640,947	5.5

TABLE 5. EXPORT AND IMPORT OF FISH PRODUCTION BY YEAR, 1993 – 199

ITEM	YEAR			AVERAGE (%)
	1993	1994	1995	1993 – 1995
EXPORT (TON)	529,213	545,371	563,065	3.15
IMPORT (TON)	177,200	276,829	163,240	7.6
EXPORT VALUE (US $)	1,503,748	1,678,720	1,763,989	8.36
IMPORT VALUE (US $)	109,197	136,713	115,917	4.99

STUDY REPORT

ON

FISH TRAPS IN MALAYSIA STATE OF JOHORE

BY

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FOR

THE REGIONAL TRAINING COURSE IN FISHING TECHNOLOGY AND RESOURCE CONSERVATION
(16 JUNE - 15 DECEMBER 1997)

TRANING DEPARTMENT
SOUTH EAST ASEAN FISHERIES DEVELOPMENT CENTRE
(SEAFDEC)
PHRASAMUTCHEDI, SAMUTPRAKAN
10290 THAILAND

FISH TRAPS IN MALAYSIA
STATE OF JOHORE

1. 0 Introduction

Fish traps is a traditional fishing gear and very popular in the Eastern Part of Johore (Tanjung Sedili, Kota Tinggi) and Western Part of Johore (Parit Jawa, Muar). It is usually operated by a certain groups of people that has the knowledge about the fish traps. This fishing gear is easily to carry and can be placed anywhere in the sea which is suitable. It can be stationed in the water for a certain length.

The objective of the study report is to show that fish traps in Malaysia still widely used by the fishermen because it can give better income to the fishermen. It also can catch good quality of fish and still fresh and this fishing gear will not destroyed the resource.

Fish traps is also easy to handle and not costly to make it and the material is easily found at the local market.

2.0 Shape of Fish Traps

Fish traps is a semicylinderical shape with a rectangular bottom frame. Front part of the traps placed one entrance called "valve" to enable fish entering into the traps and protect the fish from going out. At the bottom frame has another door to take out the fish that has been trapped . (see figure 1)

The size of fish traps used by the fishermen in Malaysia is about 2 meter (Length) x 1.3meter (wide for the front part) and about 1.2 meter (wide at the back portion) x 1.2 meter (height) .

2.1 Construction of Fish Traps

2.1.1 Material Use

The material used is a wood size 5 cm diameter (round wood) as a base for the traps. It is usually use a type of wood that can last long in the sea.

The other material to be use is rattan. It is use because it is strong and pliable to make a cylinderical shape and does not get rusty if compare with metal or iron. The cost is also cheap .

Wire netting which has hexagonal shape with the size of 60 cm x 58 cm also been used. As the frame of the fish traps has been completed it will be used to cover the fish traps need about 7 meters to cover the whole traps.

Others material to be used is a sinker made of bricks, to make the fish traps easily immersed in the water when it lowered down into the sea and iron bar to anchor the traps fixed to the ground and will not drift by the current of water and tied at the corner of the traps. The rope Polyethelene , tied at the traps as a wing and extend with other rope with the length depend on the depth of water (See figure 2)

3.0 Type of Boat

Most of the boat used in this operation is made of hard wood like chenggal because it can last long and easy to maintain. Each boat can be used at least more than 15 years. The fisherman usually erect one wheel house for them to shelter from the hot sun and rain because the operation in the sea take time at least one or two days before going back to the landing place.

At the front part of the wheel house (bow area) they make a fish hole for the storage of the fish, ice and etc. The size of fish hold depend on the size of the boat. At the starboard side the fisherman place a roller (used engine power) for pulling the main rope of the trap while hauling is in progress.

3.1 Boat Size

The size of the boat for operating the gear is about 10 - 25 gross tonnage, with the size between 15 to 20 meters length by 3 to 5 meter width by 1 to 3 meter depth. The horsepower of the engine is about 60 to 100HP. Nowadays the fishermen used bigger power of the engine because their fishing ground is far from the shore take about 7 to 8 hours to reach the place (see figure 3).

3/..

4.0 Operation Area

The fishermen at Tanjung Sedili usually operated their fishing traps near the island especially easy for them to hide from the wind or during rough sea wave. The island is also as their place to get the water supply and some food.

Nowadays the fishermen operating the gear by using new modern equipments like echosounder, GPS and others to make them easy to find a good fishing ground to place their traps and easy to find back the place where they lowered the traps. When there is a bad whether by using new equipments like GPS, the fishermen can easily go back to the shore because GPS can show the route in any condition of the sea.

4.1.1 Operation of fish traps

The fishermen usually leaved the fishing port to the fishing ground early in the morning at about 0400hrs and reached the fishing ground after 7 to 8 hours sailing.

Fishermen will operating their fish traps at the rocky seabed or at the coral reef either surround the island or far away from the shore. By using GPS and echosounder fishermen can easily found the fishing ground and at the same time marked the position of the fishing ground.When the fishermen has found a suitable place they lowered the fish traps one by one.

In a single operation 20 - 80 fishing traps are lowered in a stage the area with the depth between 15 - 20 meters and each traps are placing about 100 meters from each others and the position will be kept in the GPS to make them easy to search during hauling time. At about 2 to 3 hours the lowering of the fish traps can be finished.

4/..

The placing of fish traps also depends to the fishing ground. If the fishing ground is rocky area the fishermen will place the traps one by one and quite near from each other. If the fishing ground is not very rocky area it will tie together(10 piece for one area) . By this way it is easy for the fishermen to haul the traps.

At every groups traps the position will marks in the GPS and the fish traps will tie to the float line with the length shorter than the depth of water so it does not show on the surface to avoid the trap being known by other fishermen.

At the duration of 3 to 4 days the fishermen harvest their fish traps by rope equipped with grapnel and sinker at the end of the rope and drag at the location of the fish traps by the boat at the speed of 1 - 2 knots, the grapnel will engange to the ropes linking each unit and the fish trap is lift to the boat and the fish is take out and the fish trap lowered again or move to some other strategic place. Usually the fishermen traced back the position of the traps by GPS and the number of traps lowered down can be hauled up easily (see figure 4)

The operation is going on like as before and the fishermen can harvest again every 3 - 4 days after the first operation and will be continued. Within one month the fishermen can operate the fish traps about 5 trips (20 days). Usually for the next operation the fisherman will bring along a few number of traps to replace the demaged or lost of fish traps. One fish traps can be used about 3 months and it cost about Ringgit Malaysia: Hundred twenty only.

5/..

5.0 Season of Operation

Fish traps can be operated for the whole year axcept for the monsoon season.

6.0 Type of Fish

Usually fish traps can catch the type of fish like groupers, Grunters, Treadfin breams, sea bass, snappers and others (See figure 5)

7.0 Conclusion

Nowadays the fishermen operating the fish traps do not face any difficulty because of the new modern equipments. The new generation fishermen who want to involve in this type of fishing gear can learn from the experienced fisherman about the knowledge and the skill operating of the fish traps.

For the operation of the fish traps it can be leave in the sea for certain period that means the fishermen can do another work to earn more income while waiting for the next operation of fish traps. The men power used also very few, about 3 person.

Now, most of the fishermen operating the fish traps has changed their mind to equipped their boat with new modern equipments such as echosounder, GPS, line haulers and others. By doing this the fishermen can easily detect the fish traps at a short time, less labour requirement and reduce the operation cost.

6/..

Shape of Fish Traps

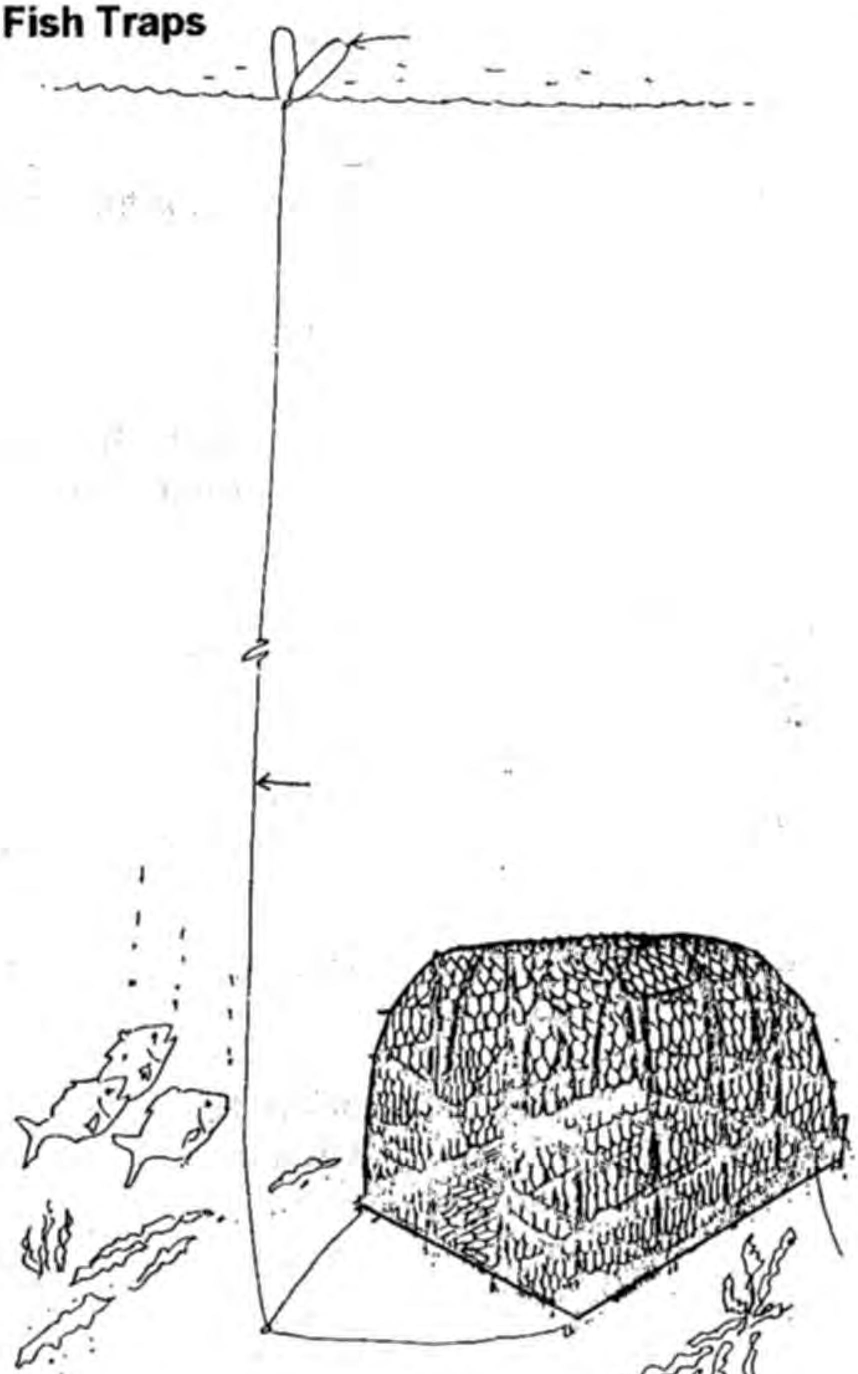


FIGURE 1

Construction of Fish Traps

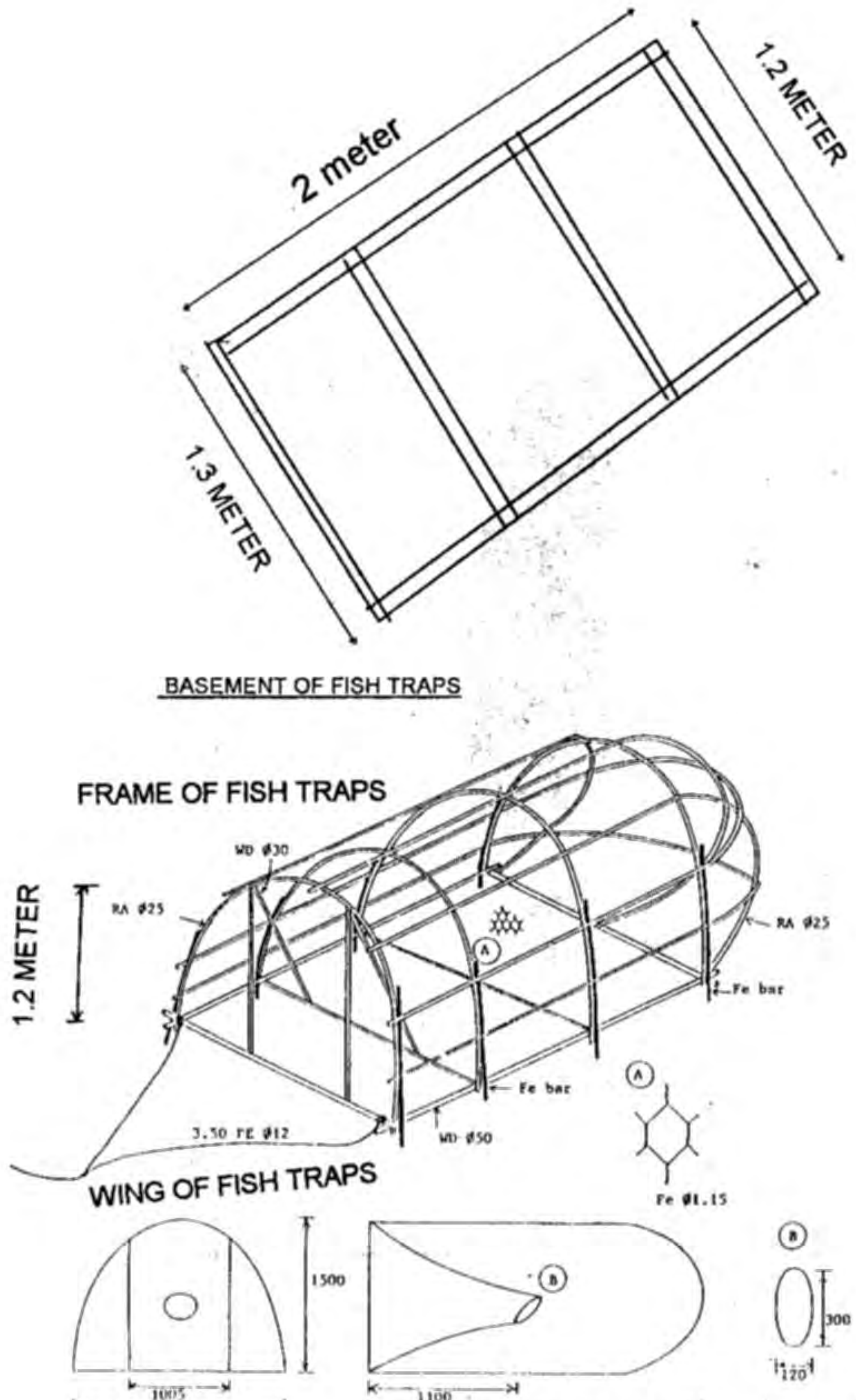


FIGURE 2

Type of Boat

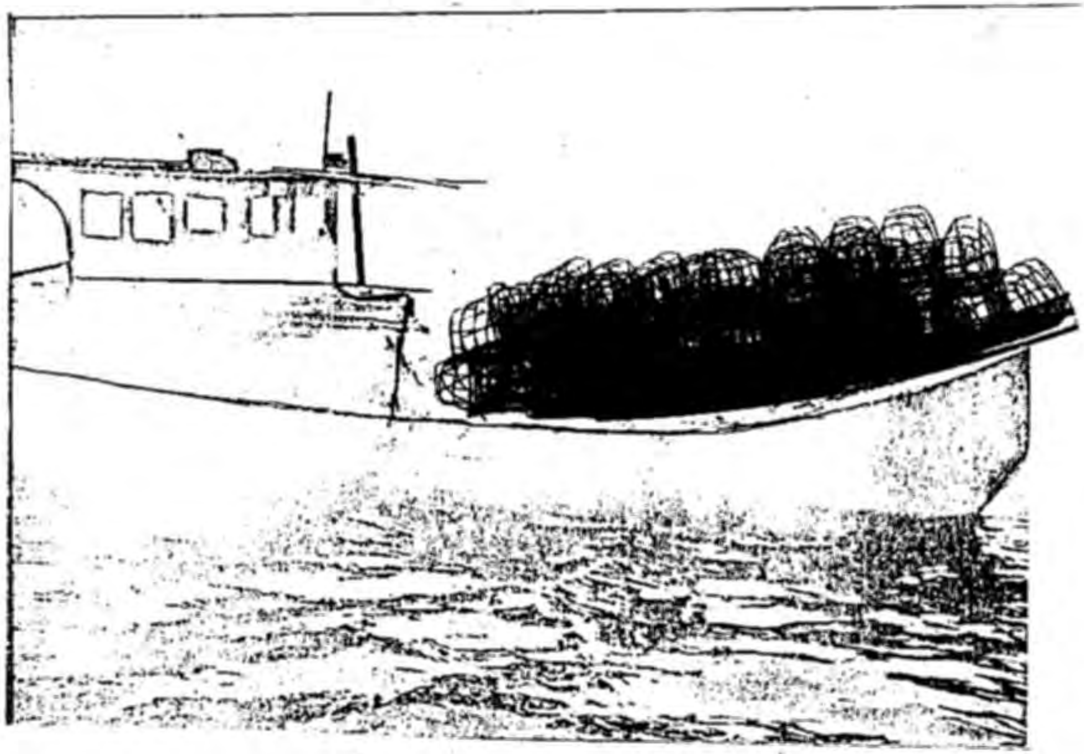


FIGURE 3

THE OPERATION AND HAULING OF FISH TRAPS

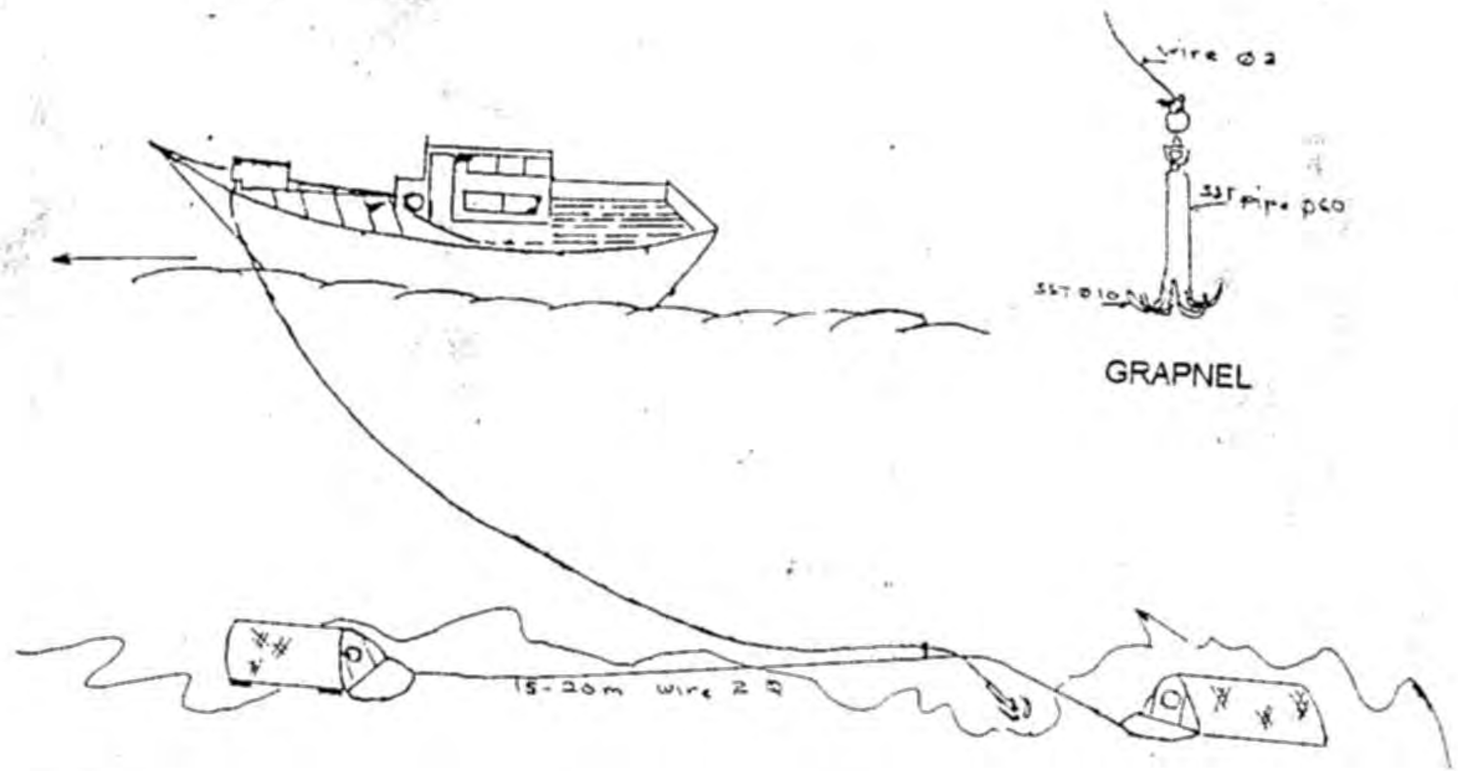
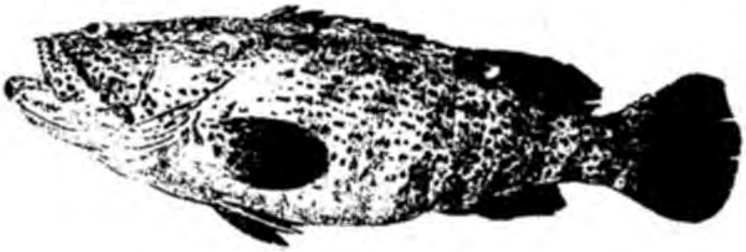
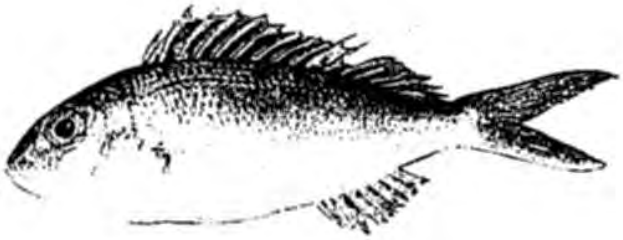


FIGURE 4

Type of Fish



GROUPERS



TREADFIN BREAMS

SEA BASS

FIGURE 5

SNAPPERS

Study Report

on

TUNA PURSE SEINE FISHING IN THAILAND

By

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DEPARTMENT OF FISHERY OF THAILAND

The Regional Training Course in Fishing Technology and Resource Conservation

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Training Department South East Asian Fisheries Development Center
Phrasamutchedi Samutprakan 10290 , Thailand

INTRODUCTION

In the past, tuna were not the main target, but caught incidentally by gill netter and purse seiner, untill 1981 these resources become the main target for some fisherman who try to improve their fishing technique as well as expand fishing areas to offshore.The development is not subject to the need for additional protein of population,but to the increasing demand for canning industries."When the tuna canning industry was first introduced to Thailand,plant and equipment were invested in accordance with the quantity of raw materials supplied (catch quantity).So,such the rapidly increase tuna demand as well as the development of purse seiners, (Yutaka,1988)

The purse seine is one of the most advanced type of fishing gear for surrounding fish school and the major type of fishing gear for tuna catching is purse seine while other commercial fishing gear and traditional gear are considered,the minor gear as refered to the percentage of tuna caught.In 1985-1990 tuna catch was exploited about 97% by purse seine (37% from narmal purse seine and 60% from luring purse seine) (Dhammasak,1991)

FISHING BOAT,GEAR AND METHOD

1.FISHING BOAT OR PURSE-SEINER

The popular size of purse seiner in Thailand varies from 80 tons(24m) to 150 tons(32m)that is middle-scale,and large-scale boats.Most boats are of the standard poop type with a big main deck to facilitate fishing operation.Purse seiners have fish holds and storage for fishing gear under the main deck and the deck is utilized as a place for nets.Thai purse seiners are made of wood and their service life is about 10 to 15 years.Equipment onboard develops year by year.

At present.There are used large vessel of over 100 grosstonage(28-32 m. long)with over 500 h.p. main engine,with small motor boat(6m.long,145 h.p. engine) and 35 fishermans are need for operation.the fishing vessel have modern equipment onbroad,such as radar,sona,echo-sounder,fish finder,wireless set radio comunication,satellite navigation and many auxiliary fishing gear were used on broad,such as capstan winch (mechanical or hidrualic);boom crane,electric generator,davit pully and power block.

2.FISHING GEAR

PURSE SEINE

The purse seine consists of pieces of ractanggular netting (the net is black,about 800-1800 m. long and 100-300 m. deep), float line with floats attached and sinker line with sinker attached.At both end of the seine there are side line to which hand rope are fixed. closing the bottom either by purse line which passes through purse rings fixed to the ends of bridles attached to the sinker line at regular intervals,thus preventing the fish escaping downward.The bunt or cod end part of the net is gennerally located at the end of one of the wing

CONSTUCTION

1.The webbing

The materials used in the construction of each part of the purse seine net differ and are:

1.1 bunt or cod end

The bunt is the important part of the net where the fish collect in the last step of the fishing operation before being scooped into the fish hold.The material of the webbing used for this part should be strong and thicker than the other parts.Usually in the Thai purse sein,the bunt is located at a point 2/5 of the net length and it is 20-30 metres deep. Over the bunt, at the float line the bigger float attached,Polyethylene net 380d/9 or 380/12,with a mesh size of 1" or 0.75" is used.

1.2 net under the bunt

The upper rim of this section is joined to the bunt while the lower rim is joined to the lower selvage. The mesh size of this part should be the same as that of the wing or body part. Usually a mesh size cf 1" and nylon No.210/9 are used.

1.3 wing net or body net

In a purse seine net,the wing or body net is the largest part of the net for surrounding the fish school. There are many sizes of twine used in this part,especially since the part located near the bunt should be bigger than that on the outside.The size of webbing twins used for this part are 210d/4, 210d/6,210d/9 and a 1" mesh size is generally used.

2. Selvage

This part of the net acts like a frame to prevent the body net and the bunt being damaged during use.So the larger size and stronger webbing twine should be used. The selvage is devided into three parts.

2.1 Upper selvage

The upper rim of the upper selvage is joined to the float line,while the lower rim is joined to the body of the net and the bunt. Usually,Thai purse seine use polyethylene webbing twine No.3802/9,or 3802/12 or 380d/15 for the selvage. The mesh size used for selvage is usually the same as that of the body net or slightly bigger,The length of the selvage must be equal to the length of the body net and the bunt,while the depth should be about 6-35 meshes.

2.2 Lower selvage

The lower rim is joined to the sinker line,the webbing materail and size of twin are the same as those of the upper selvage.However,the mesh size of the lower selvage is the same as that of the body netting,though it can be twice as much or a little more,Generally twice the size mesh is used in this part.Similarly,the length of the lower selvage is equal to the body net and the depth is 6-30 meshes.

2.3 Side selvage

The side net is jioned to the wing net on one side and on the other it is attached to the side line.Usually the depth of this part should be less than that of the net by 3 to 3.5 times.Most of purse seine nets,use polyethylene webbing,with the twine size and mesh size equal to that of the upper selvage. The number of mesh width used varies from 20 to 35 meshes or somtime ever 100 to 150 meshes

3. Rope

3.1 Float line

twist polyethylene rope,diameter 8-10 mm are used for the purse line. One rope is inserted into the meshes of the rim of the upper selvage while the another piece has the floats and is attached to the rope.

3.2 Sinker line

Two pieces of twist polyethylene rope,diameter 8-10 mm are used for the sinker line.One rope is inserted through the meshes of the lower selvage while the another piece is attached to it with twine.

3.3 Side line

twist polyethylene rope of the same size as the float line rope is used for the side line . One rope is inserted into the meshes of the rim of the side selvage while the another is attached to the first rope. There are also the rings,0.5 cm.thick,diameter (inside) 3 cm,which are attached to the side line.

3.4 Hand rope

Polyethylene rope,diameter 10-12 mm is used for the hand rope.This hand rope is for pulling the side net by passing it through the ring when hauling the purse seine net.

3.5 Bridle rope

Polyethylene rope,diameter 6-12 mm is used for the bridle rope.One end of the bridle rope is tied to the sinker line while the other end is tied to the purse ring. The length of the bridle rope is 3 to 20 cm

Usually the bridle rope has a ring on one end and is fastened to the sinker line at the other. There are two kinds of bridle materails: one is synthetic fiber such as polyethylene and kumona,and the other is iron chain.The former is used mainly for conventional Japanese purse seines and is about 10 to 18 mm in diameter and the latter is used mainly for modern large one boat purse seines for tuna and skipjack.The chains used are 124 mm to 240 mm in length.

3.6 Auxiliary float line

Usually,this line is only used for the big size net.The float line will be pulled using this line and winched up.Sometime the crew jump down into the water to fasten this line to the float line,then they pull it up slowly,or use plastic rings,0.8 cm thick,diameter(inside) 3 cm attached to the float line at interval of 1.50-2 m between the rings. The polyethylene rope, diameter 10-12 mm.and 20-30 m in length,isused for this line which is inserted through the rings and the end of the line is fastened to the float line.

3.7 Purse line

To close the bottom of purse seine net during fishing operations,the purse line will be inserted through the purse rings and pulled at both side.The purse line be thick and strong and not twist or curl during use.Usually polyethylene braided rope,diameter 22-40 mm is used for the purse line.

3.8 Extra rope

This rope connects with the float line at the end of the right wing. it is 50-100 m long.When shooting the net to surround the fish school sometime the ends of the net cannot meet,then this rope will be used. Usually polyethylene rope,diameter 22-30 mm is used.

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The upper rim of the upper selvage is joined to the float line,while the lower rim is joined to the body of the net and the bunt. Usually,Thai purse seine use polyethylene webbing twine No.3802/9,or 3802/12 or 380d/15 for the selvage. The mesh size used for selvage is usually the same as that of the body net or slightly bigger,The length of the selvage must be equal to the length of the body net and the bunt,while the depth should be about 6-35 meshes.

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4. Floats

Long and flat in shape,the circular ends of the floats made of fiber are attached to the float line of the purse seine net.Usually, fiber floats No.3 are attached to the float line over the wing or body on both sides,while floats No. 9 are attached over the bunt or cod end,at least 50 floats. sometime rubber or plastic floats,cylinderical in shape are attached as extra float over the bunt float line to avoid sinking when a big school of fish is in the bunt.Many purse seine nets have one to three round plastic floats,r 8"-10" tied to the float line at the end of the left wing as a marker.

5. Sinker and Purse ring

5.1 Sinker

The sinker used to weight the net for sinking rapidly are usually round in shape and made of lead with a hole in the center.They weigh 0.5 to 1 kg/each and are attached to the bridle rope over the purse ring or to the sinker line near the bridle rope on both or just one side.For the modern large purse seine the iron chain are used.

5.2 Purse ring

Generally purse ring must be made out of non-rust material such as brass,stainless steel or iron cover with zinc. Several sizes of purse ring are used.The diameter of the inside of the ring is 6 to 9 cm and the thickness of the material is 1-2 cm.The interval between each purse ring should be 2.30-2.50 m.Some purse seine net have a rope ring,diameter inside 30 cm,made as polyethylene rope,diameter 16-20 mm.This is used after 30 to 40 purse rings have been attached.These rope rings are used for pulling the purse rings up on broad easily.

6. Hang-in

A purse seine with too much hang-in gets entangled with the netting or floats or sinker during fishing operations,and accidents are caused.Normal hang-in is about 20-30% in the upper part of the purse seine and 10-20% in the lower part. A purse seine which is hauled up by power block,should have a smaller hang-in.

In a Thai purse seine usually,6 m stretch meshes need 4 m of float line and 6 m stretch meshes need 4.2 m of sinker line. This means the hang-in of the float line is 33.4% and 30% for the sinker line.From the measurement of the net at float line of many fishing boat,

However the length of the float line should be shorter than the sinker line.For example,the float line is 500 metres,the sinker line should be 530 metres.

LURING FISH

Using the luring to shelter and tuna fish aggregation devices.kind of luring fish have many type,some purse seiner used light rafts, underwater lamps,shelter raft luring (PAYAO) with constructed of bamboo pole, wire and coconut leaf and fastened to a concrete block for anchore,This is a popular method among purse seiners to catch tuna,Usually tuna fish and other species will concentrate at the payao after leave 1-2 week

two type of PAYAO

a) drifting type

b) anchored type

The luring fish are used include the light and radio buoy

RADIO BOUY

When the fisherman throw the payao into the sea for tuna fish aggregation devices(FAD).After several hours,they will find payao or FAD for fishing operation.But the distance between the fishing boat and payao or FAD in the sea may reach more than 200 km.It is very difficult to find locate the position of the payao,radio bouy was developed in order to solve this problem.Use of the radio buoy prevents the payao from being lost and increases fishing efficiency.By receiving the radio transmission from radio buoy with the direction finder on the ship, the fisherman can understand the direction of the FAD in the sea.

LIGHT

When the masterfisherman decides fishing operation,he will give order attach the light at the payao for remark the position,in the case of early morning or during twilight operations.

FISHING OPERATION

when the fisherman found the fish school,the masterfisherman will order the steersman to slow down and sail toward the school.Then stop while he consider the species,size of the school,swimming speed,direction current,win and bottom of the sea.

If the masterfisherman decides to operate he will give order to stand by all hands in position,attach the light at the payao.for shooting in early morning 05.00 A.M

For the first shooting,The vessel moves at full speed while releasing the skiff with the net to surround the fish school in a circular or oval shape.The speed will be

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reduced when about three quarters(3/4) of the net length has been released.when the large vessel meet skiff,skiff will bring back the end of the float line and purse seine to the large vessel.Once the purse rings are on broad,the net is hauled up on both sides by power block and rearranged by fisherman.

At the end,all of fish will go down and concentrate at the bunt.After that fish are scooped from the bunt and kept in the fish hold. The net will be arranged,after finishing puting in the fish hold for the next operation.

FISHING GROUND AND SEASON

Thailand is situated in the Southeast Asian.It is bounded by Myanmar in the north and west , Laos in the north and northeast , Combodia in the east and Malaysia in the south. The Gulf of Thailand has an area of about 320,000 km and coastline of 1,874 km.In the west is the Andaman Sea with an area of 116,280 km and coastline of 740 km,along both coasts with a total length of 2,614 km.according to the Departmentment of fisheries,the MSY(maximum Sustainable Yield)of tuna in waters belonging to Thailand is 80,000 tons/year, that in the Gulf of Thailand 60,000 tons/year and 20,000 tons/year in the Andaman Sea.(Yutaka,1988)

About 10 years ago tuna fishing grounds and seasonss were well defined. Fishing operation started near the border between Thailand and Combodia in the Gulf of Thailand in September,in the inner part of the Gulf in October and November,and in the south in December,and finished off Samui island in about February.Recentry fisherman have expanded the fishing ground to where they can operate all the year round owing to the development of large - scale fishing boats and gear, equipment and technology.

In the Andaman sea on the side of the Indian ocean fishing operations start near the border between the Thailand and Malaysia(to the north of Penang island) in January,to the south (off Phuket island) in February and finish near the border between Thailand and Myenmar in March.

According to the available information,Kawakawa and frigate tuna almost have been occured and combined together in the same area or near by along the continental shelf of 30-100 m. depth,Normally,they were found in high density at the upper part along Phe Phe Island and the fishing areas between Trang and Satul province;For longtail tuna and skipjack,they have been found widely in the scattering from.,particulary,at the lower part of thai EEZ. (Exclusive Economic Zone)

It is belive that the tuna fisheries of Thailand must be greatly advanced expecially in the exclusive economic zone (EEZ) of Thailand along the deeper area of the Andaman Sea where resources are almost untouch. (Dhammasak,1991)

Regarding to tuna fishing season in Thailand,purse seine can be operated throughout the year,However, most of tuna catch manly depend on meteorological conditions,particulary,high catch clearly appeared in northeast monsoon season (clam sea) more than southwest monsoon season (rough sea).

TUNA PRODUCTION

Catch of tuna is mainly composed of longtail tuna and mackerel in Thai waters.The catch of tuna families is so small (that it is not recorded in the statistical data of the Department of Fisheries of Thailand,).

The tuna catch of Thailand has increase from 13,685 MT in 1980 to 166,520 MT in 1991,mainly by purse seiners.The tuna expoitation in Andaman Sea was about 9% of total tuna landing (other from the high sea) which composed of frigate tuna 39%,kawakawa 36%,longtail tuna 24%, and skipjack 1%,respectively of the catch in 1985-1991.(Dhamamsak,1991)

FISHERIES DEVELOPMENT

Since the depth of the Gulf of Thailand is less than 100m,migratory tunas such as yellowfin tuna,bigeye tuna,and blue tuna do not appear there.On the other hand,there are migratory bonito such as oriental bonito,frigate mackerel,bullet mackerel and skipjack but only is very small quantities.

In Thai waters,namely the Gulf of Thailand and the Andaman Sea.The fishery statistics show that 35 percent of the MSY is the Andaman Sea is utilized while in the Gulf of Thailand the actual catch exceeds by 20 percent the MSY level.this overfishing has effected the size of fish caught. (Yutaku,1988)

Even now overfishing is apparent from the size of both tuna schools and individual which have been becoming smaller and smaller.Therefore,some action should be taken immidiately to preserve tuna resources.

- Controling fishing effort,catch and effort data collection must be improved,collecttion of biological data should be improved and extended to all fishing areas.

- selection kind of fishing gear,there is a need for a study on gear selectivity.Work on the status of the stock using different assessment method such as age-structure should be continued.

Indeveloping fisheries,the first and foremost requirement is to introduce suitable modern fishing gear of greater efficiancy,in order to increase the effectiveness of fishing operation on the resource and environment.

However,in most cases,the introduction of foreign or modern fishing gear may not be appropriate owing to it high cost .Modification of the existing traditional fishing gear to improve it catchability is recommended in particular in the fisheries development.

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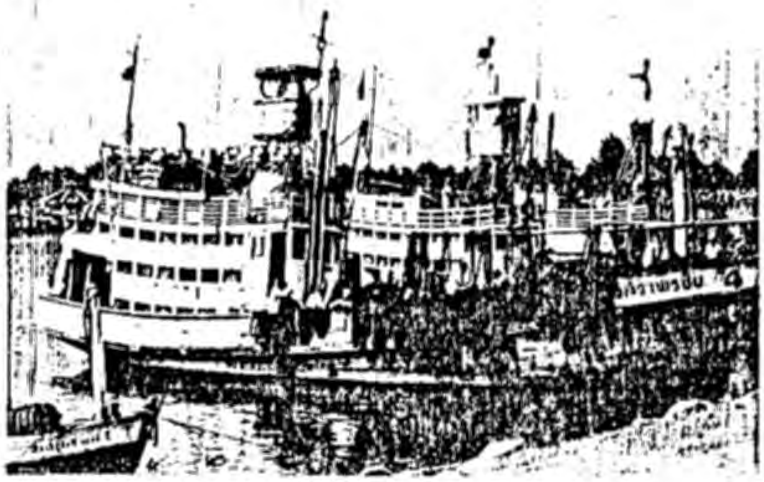
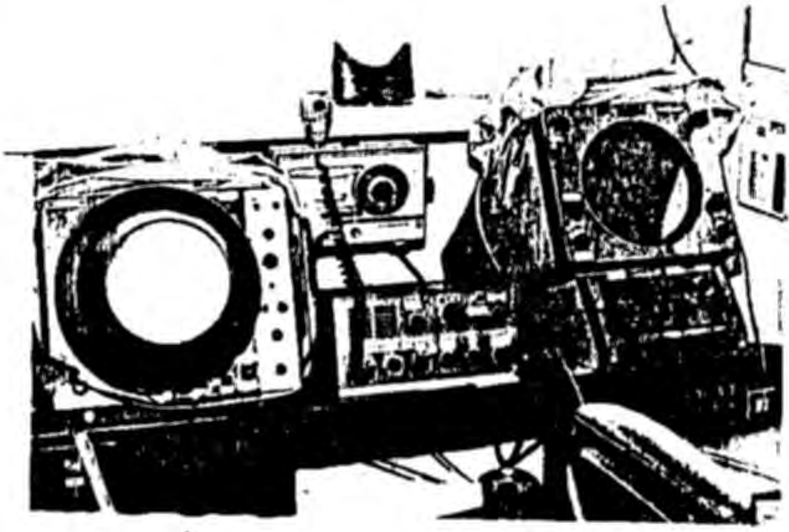
Accompanying documents : Pictures of Thai fishing boats

Typical Thai luring purse seiner.

Fleet of Thai purse seiners in a fishing port.



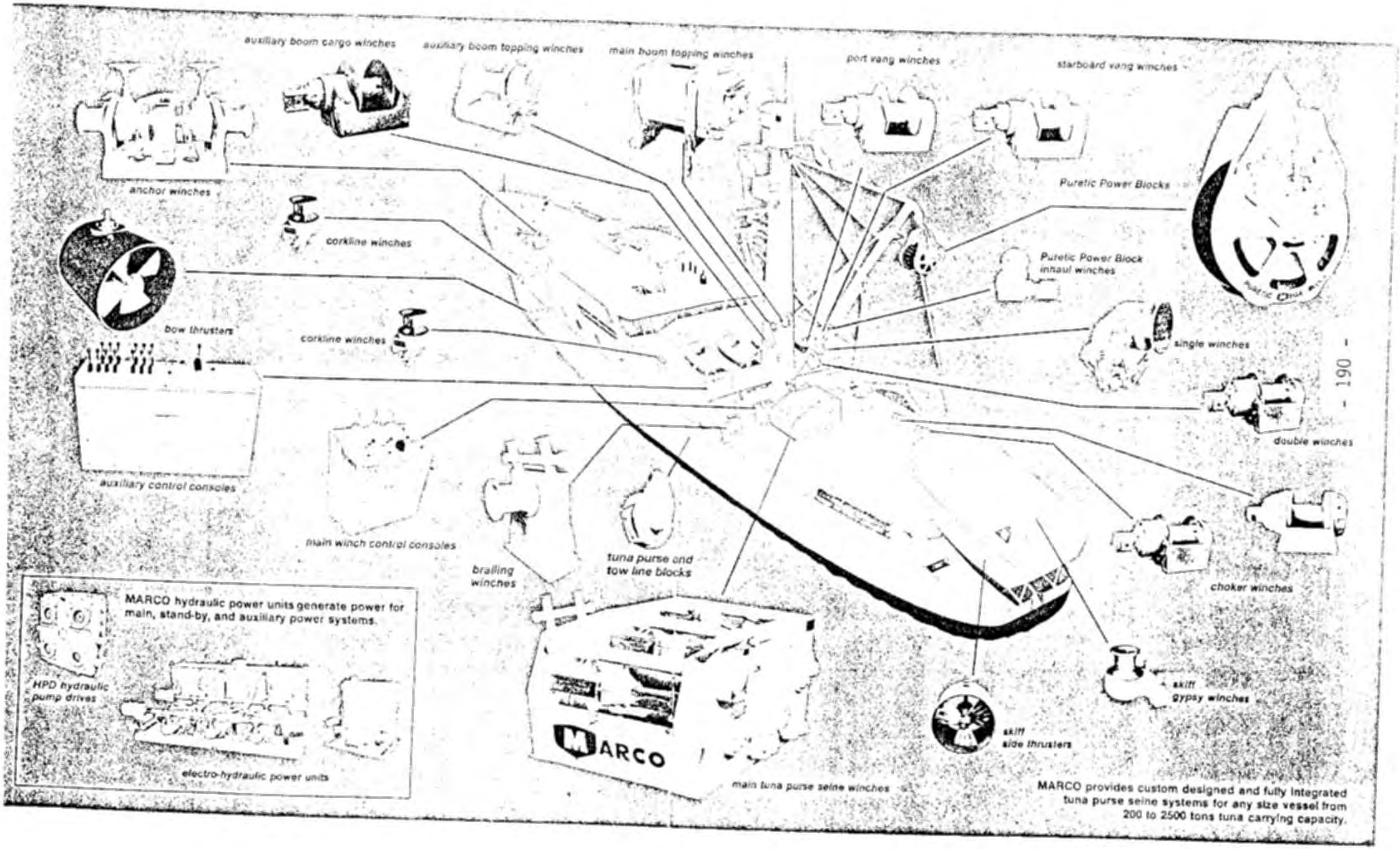
Thai luring purse seiner whose net is under repair.
Upper bridge is the control-tower.



Control tower of Thai bonito purse seine with equipment such as : fish-finder, sonar and radar.

Light boat of a luring purse seiner

Middle-size otter board trawler.


auxiliary boom cargo winches
auxiliary boom topping winches
main boom topping winches
port vang winches
starboard vang winches
anchor winches
Puretic Power Blocks
corkline winches
Puretic Power Block
inhaul winches
bow thrusters
corkline winches
single winches
double winches
auxiliary control consoles
main winch control consoles
brailing
winches
tuna purse and
tow line blocks
choker winches
MARCO hydraulic power units generate power for
main, stand-by, and auxiliary power systems.
HPD hydraulic
pump drives
electro-hydraulic power units
MARCO
skiff
gypsy winches
skiff
side thrusters
main tuna purse seine winches
MARCO provides custom designed and fully integrated
tuna purse seine systems for any size vessel from
200 to 2500 tons tuna carrying capacity.

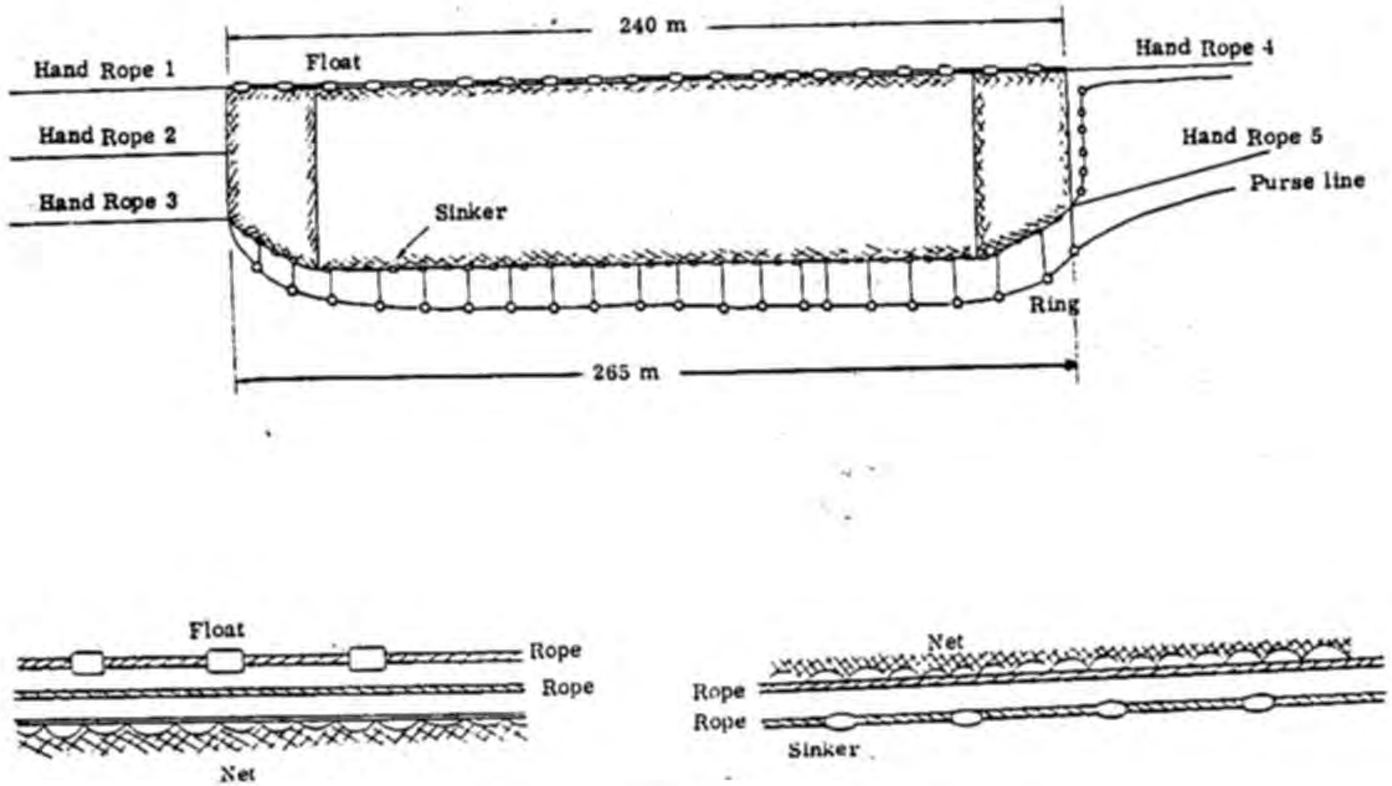
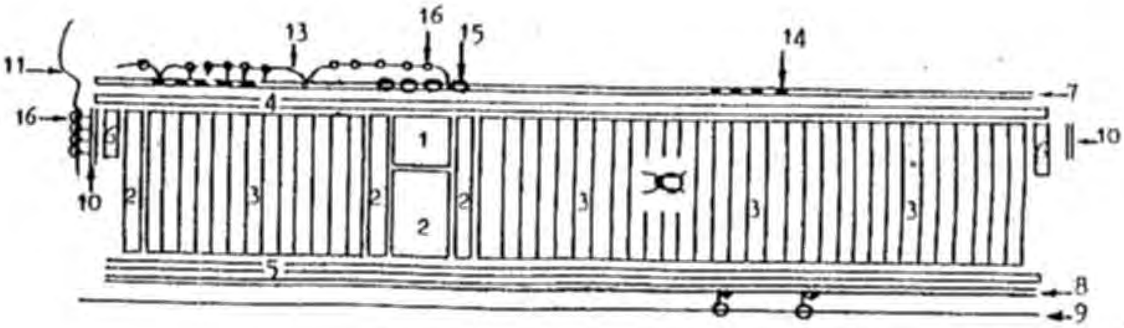


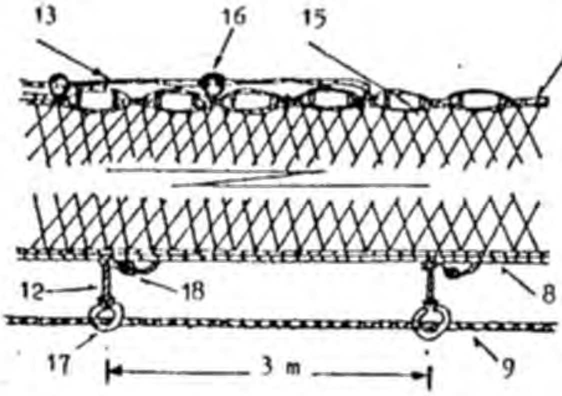
Fig. Float line and Sinker line

CONSTRUCTION OF PURSE SEINE NET

The length and depth of the net depend on the size of the fishing boat, the fishing method, and in the case of the fish school the detection method used. If the luring method is used, the net should not too be long The mesh size used for a purse seine net depends on the fish to be caught, e.g. sardine, mackerel, round scad, etc., the 1" to 1.5" mesh are suitable, however, for catching bonito, skipjack, etc., the 2.5"-3.7" mesh are suitable, are for catching anchovy, a minow net is required. The shape, construction and material of the nets used to catch fish in conjuction with coconut-leaf shelter, luring lights or by simply using traditional visual sighting are mainly the same (see Figure below).



(Not to scale)



1. Bunt or cod end;
2. Net under cod end;
3. Main net;
4. Upper selvage net;
5. Lower selvage net;
6. Side selvage net;
7. Float line;
8. Sinker line;
9. Purse line;
10. Side line;
11. Hand rope;
12. Breast line or Bridle;
13. Auxiliary float line;
14. Small float;
15. Big float;
16. Plastic ring;
17. Purse ring;
18. Sinker.

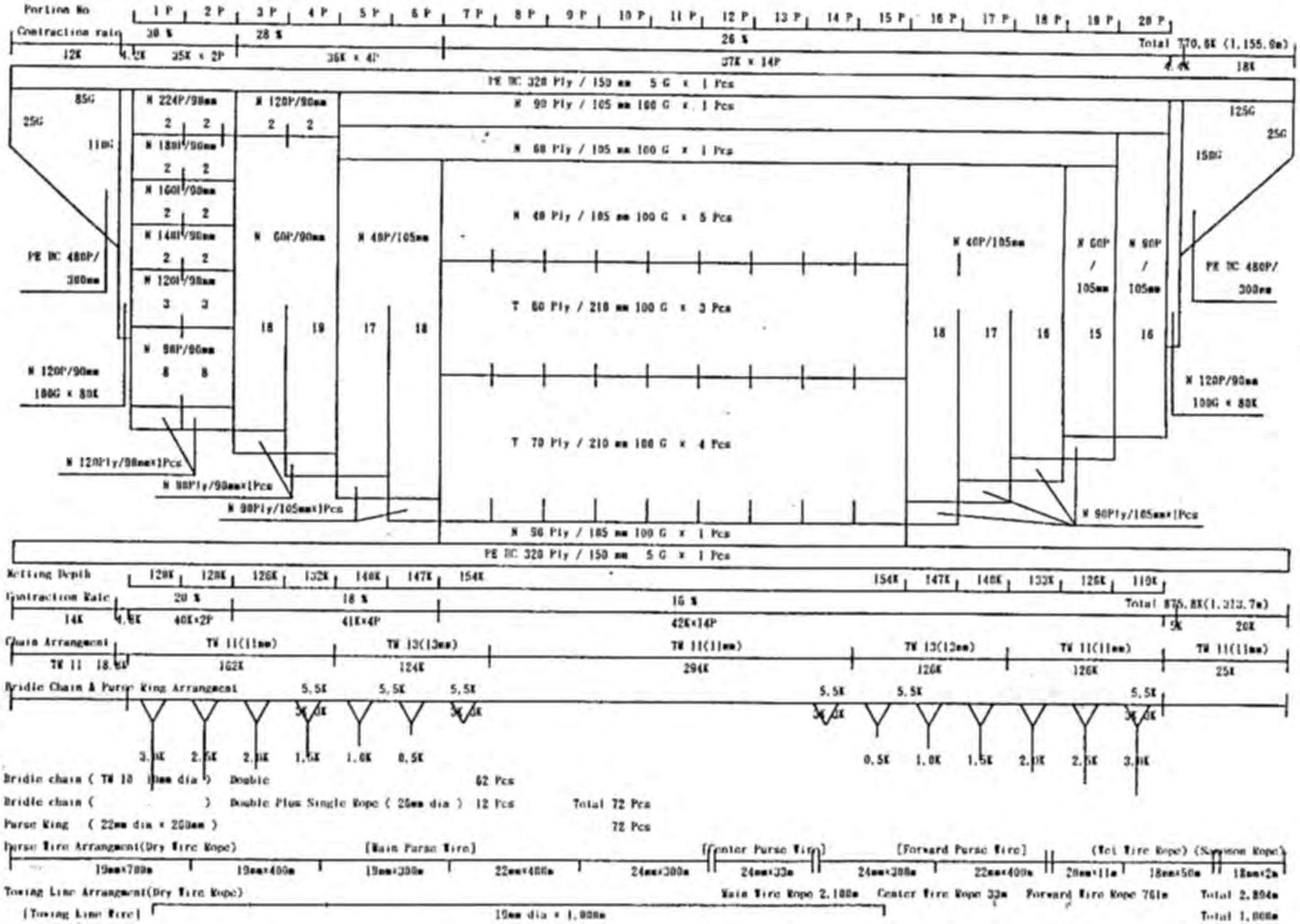
Fig. Design of purse seine net.

TUNA and SKIPJACK PURSE SEINE NET

(Netting: 1,000 K Long × 154 K Depth)

(13 Jun ~ 1 Jul 1994 The First Improve Purse Seine Net)

* 1 K : 1.5 m
* 1 Portion(P) : 50 K
* N : Nylon Net
* T : Tetron Net
* PE UC : Polyethylene Ultra Cross Net



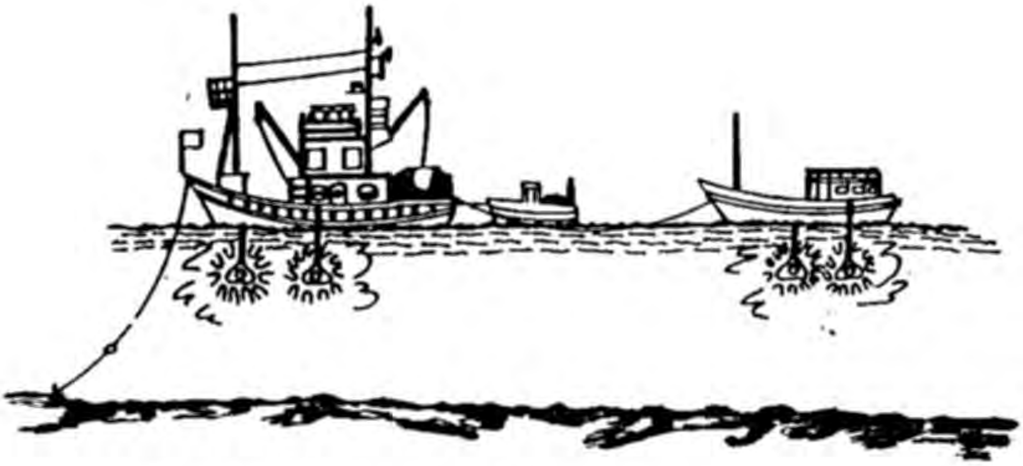


Fig. 16. Luring by underwater lamp

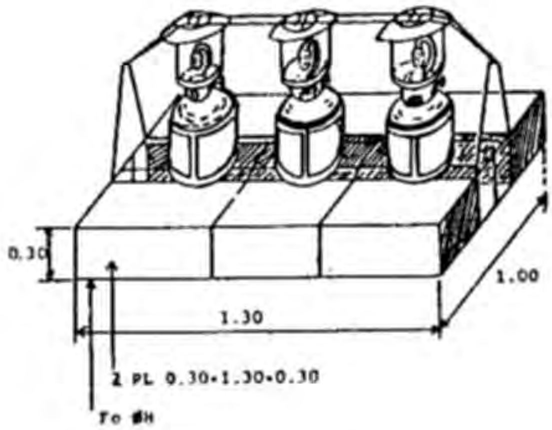
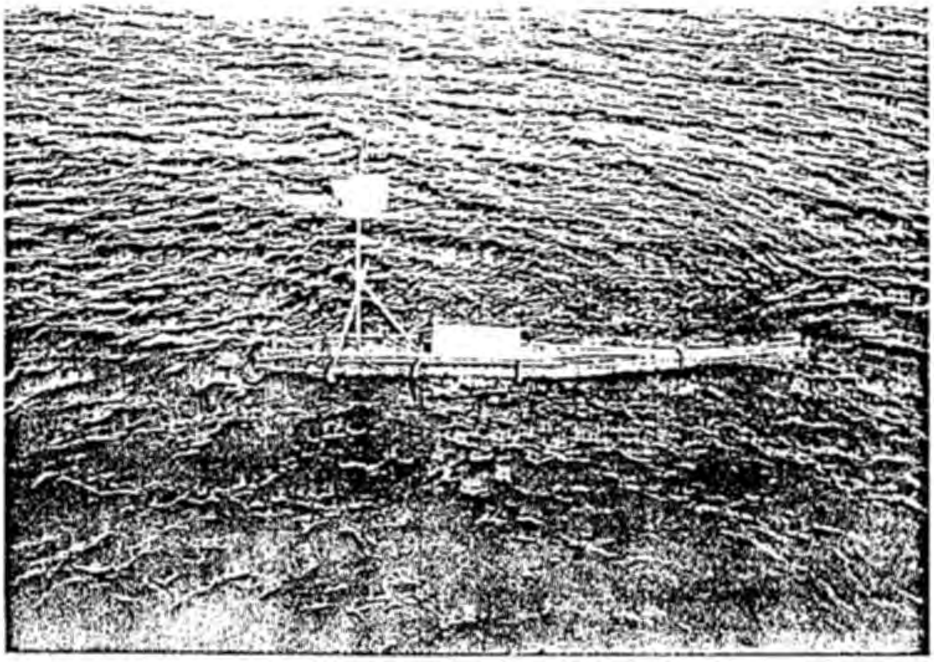
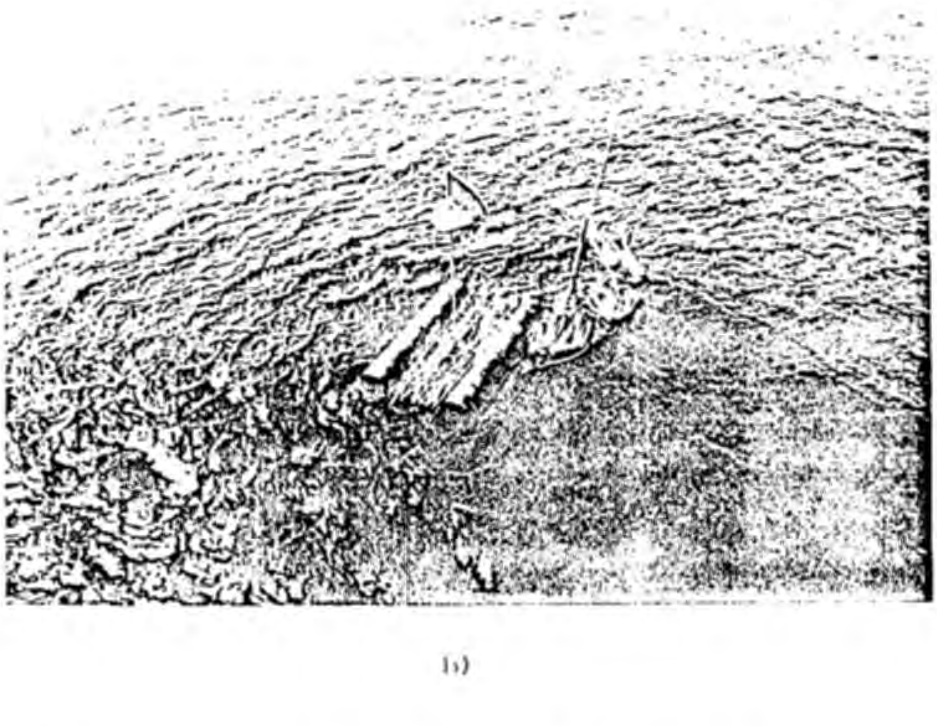


Fig. Light raft



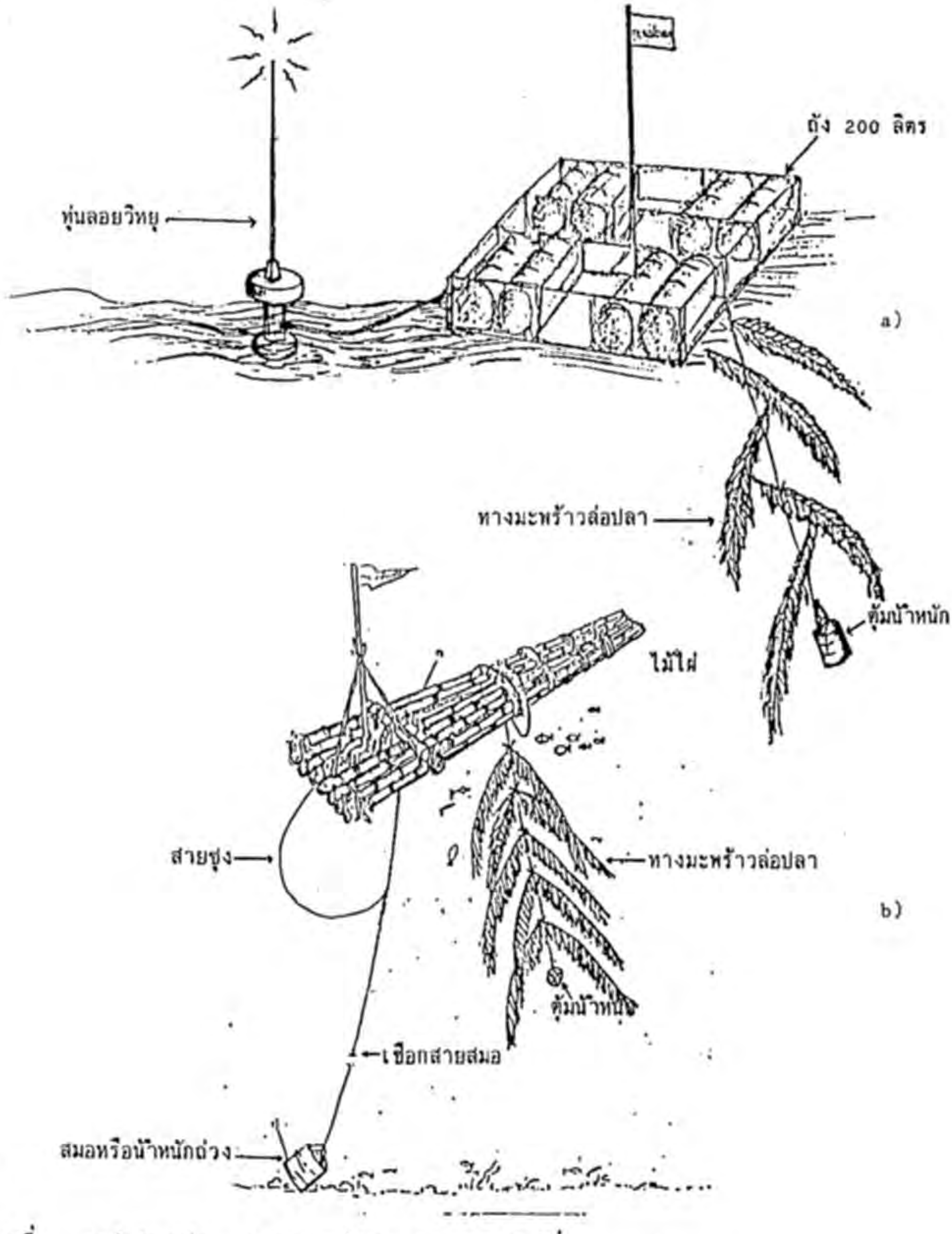
a)



b)

<u>รูปที่</u> แพล่อปลาทูน่า a) โครงสร้างไม้ไผ่ b) โครงสร้างถังน้ำมัน

<u>Fig</u> Fish aggregating devices (FADs). a) Bamboo FAD; b) Oil drum FAD.



รูปที่ แหล่อปลาทูน่า a) แบบลอยอิสระ b) แบบประจำที่

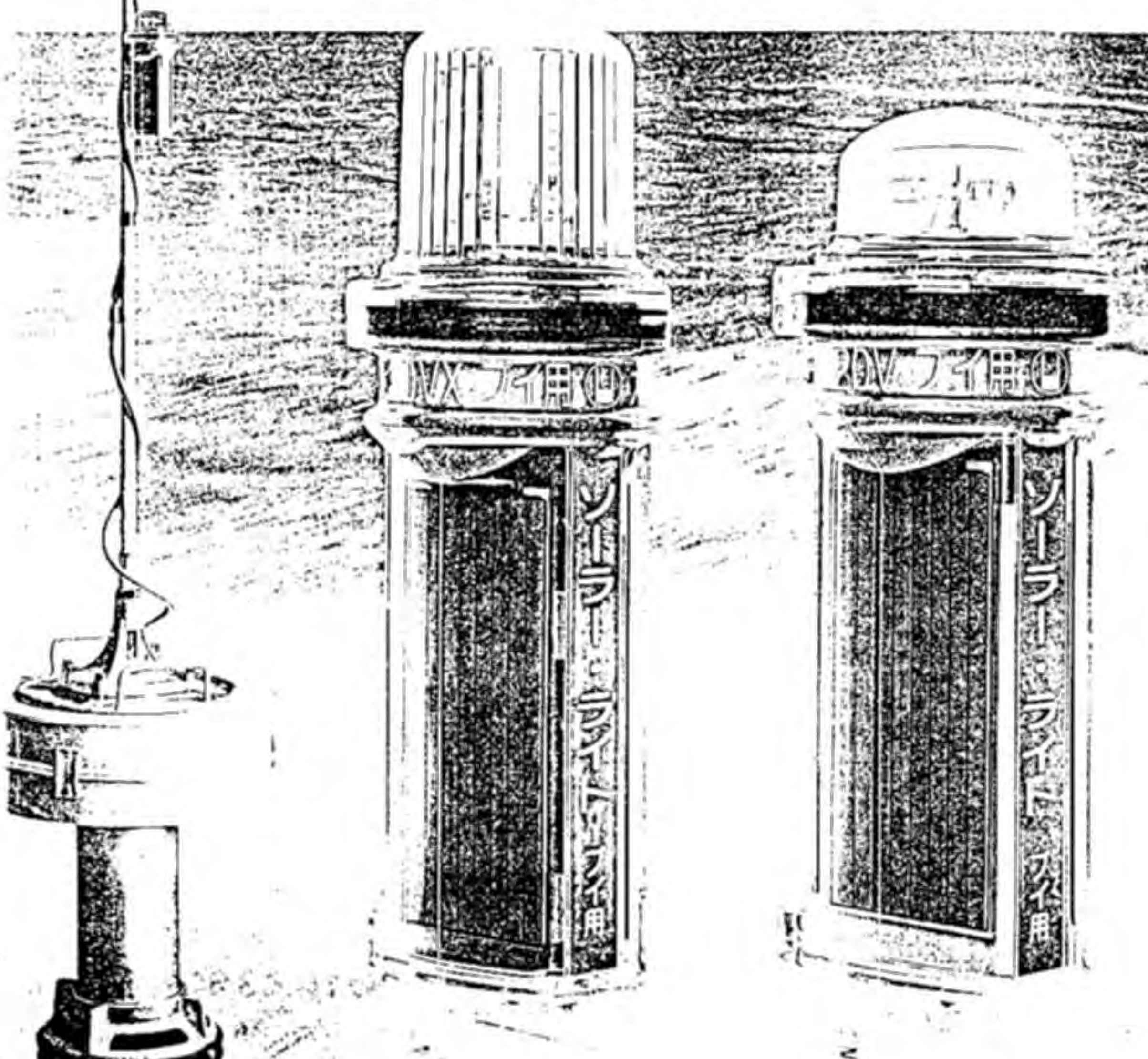
Fig. Tuna fish aggregating devices(FAD). a) Drifting type b) Anchored type.

地球環境にやさしい

ソーラー・ライト

セルコールブイ用

太陽電池で昼間充電し、夜間セルコールブイの送信と同時に一定時間点滅します。(普通式ラジオブイには一般用を御使用下さい)



特徴

- メンテナンスフリー
- 経済性抜群
- 乾電池不要
- 完全防水
- 耐水圧型
- 小型軽量

ODL−20VX型　　ODL−20V型

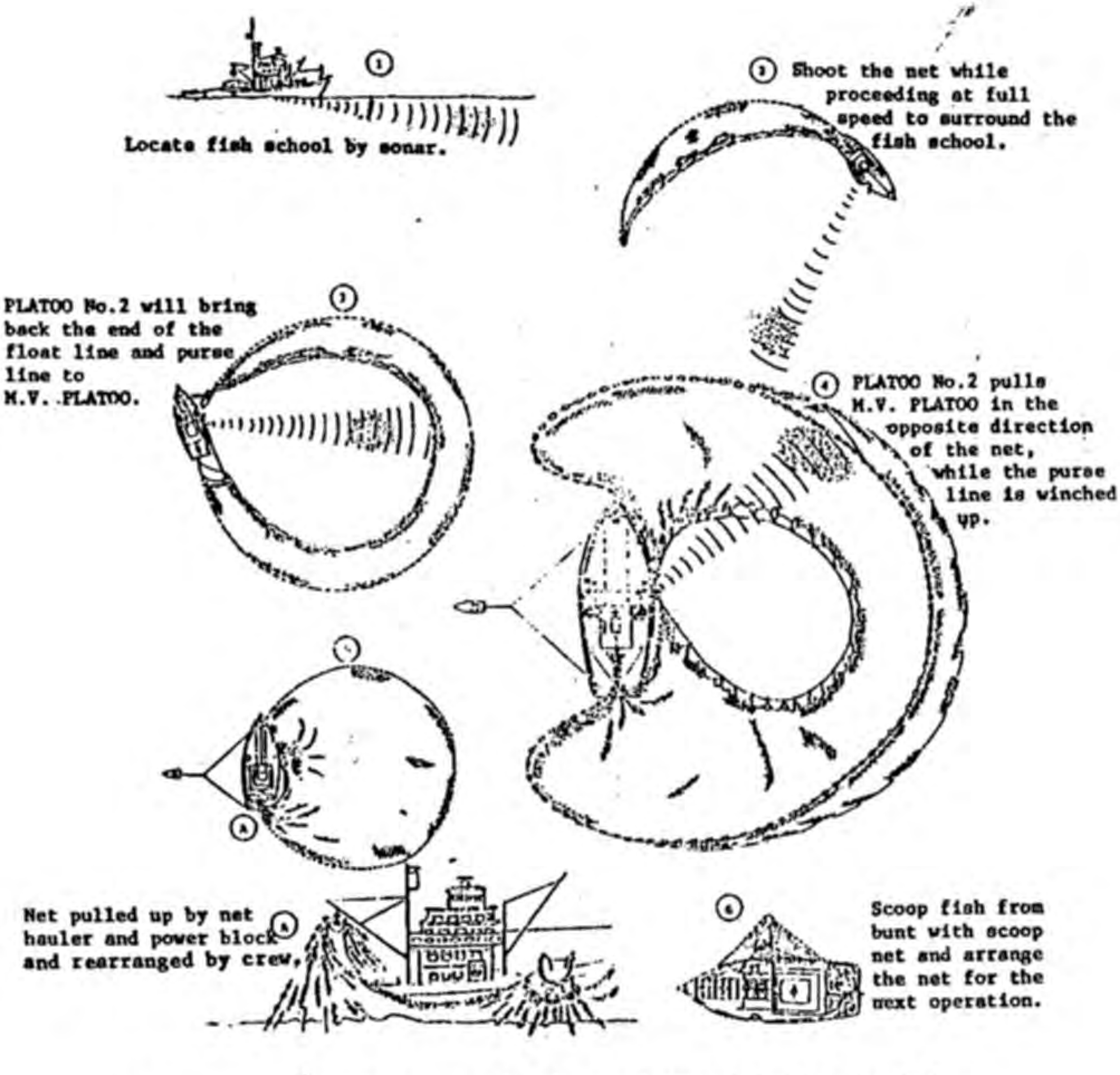
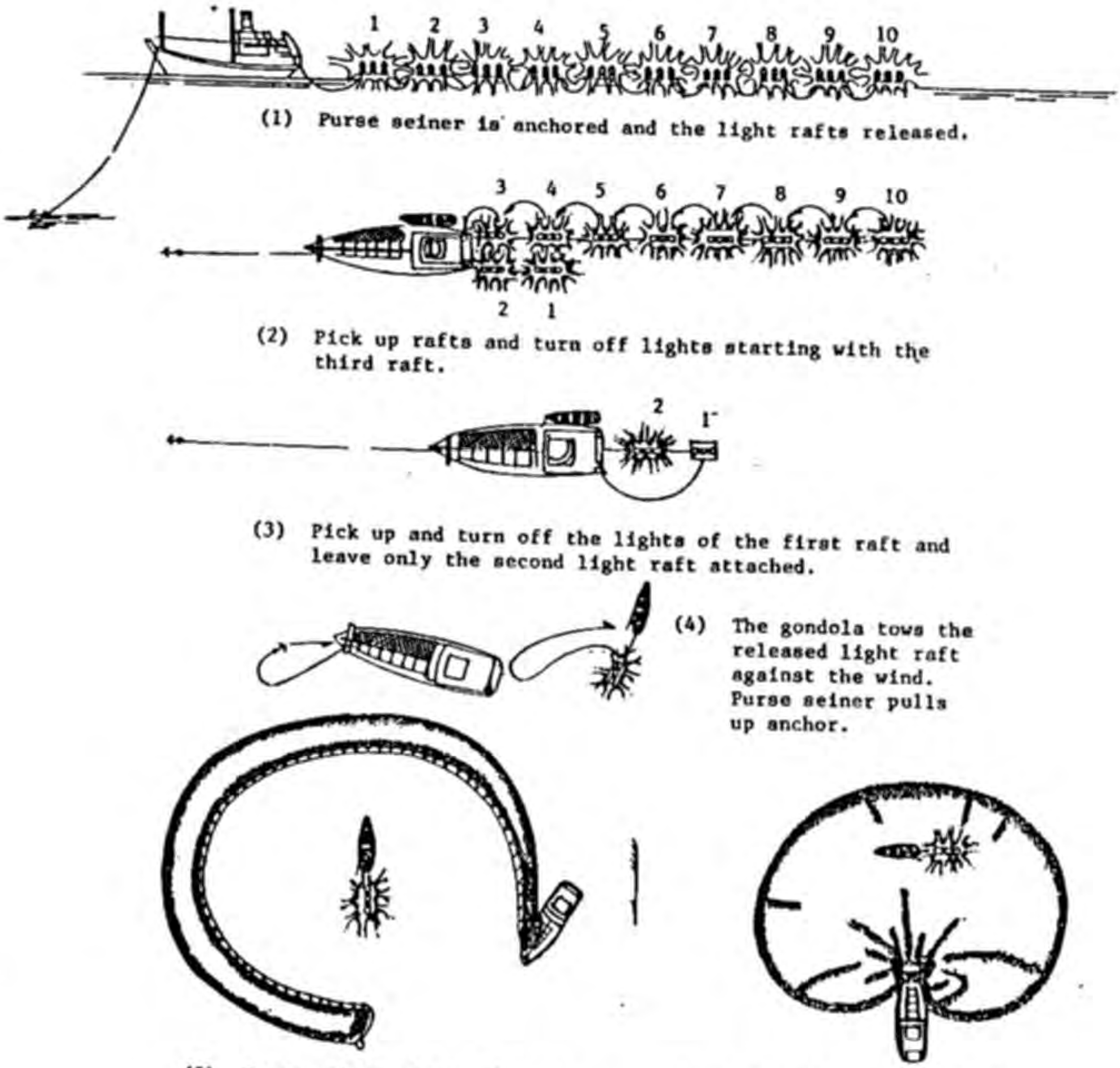


Fig. Fishing operation by training ship M.V. PLATOO



(1) Purse seiner is anchored and the light rafts released.

(2) Pick up rafts and turn off lights starting with the third raft.

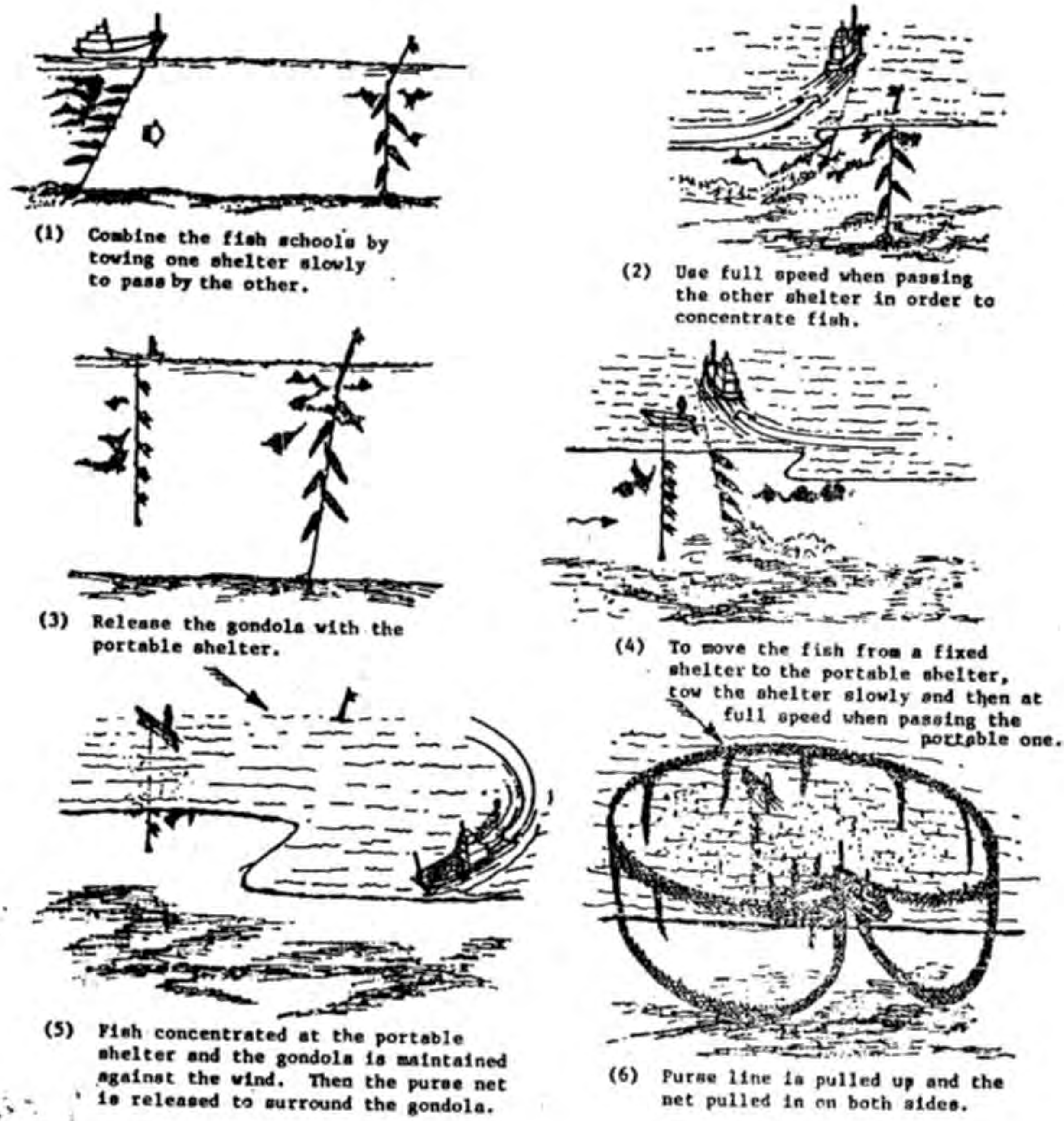
(3) Pick up and turn off the lights of the first raft and leave only the second light raft attached.

(4) The gondola tows the released light raft against the wind. Purse seiner pulls up anchor.

(5) Purse seiner shoots the net and surrounds the light raft maintained in the center.

(6) Once the purse rings are on board, the net is pulled-up on both sides.

Fig. Steps to a fishing operation using light rafts



(1) Combine the fish schools by towing one shelter slowly to pass by the other.

(2) Use full speed when passing the other shelter in order to concentrate fish.

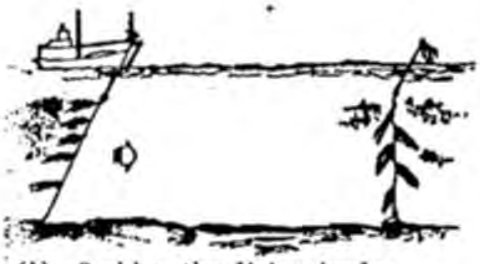
(3) Release the gondola with the portable shelter.

(4) To move the fish from a fixed shelter to the portable shelter, tow the shelter slowly and then at full speed when passing the portable one.

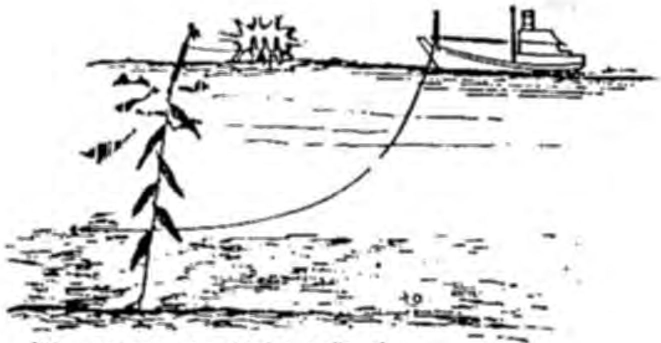
(5) Fish concentrated at the portable shelter and the gondola is maintained against the wind. Then the purse net is released to surround the gondola.

(6) Purse line is pulled up and the net pulled in on both sides.

Fig. 1 Steps for daytime fishing operations using coconut-leaf shelters



(1) Combine the fish schools during the day.

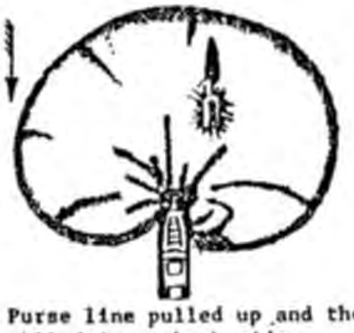


(2) Attach the light raft the to bamboo of the shelters to be used in the operations.

(3) Before the operation, attach the light raft to the gondola and portable shelter.

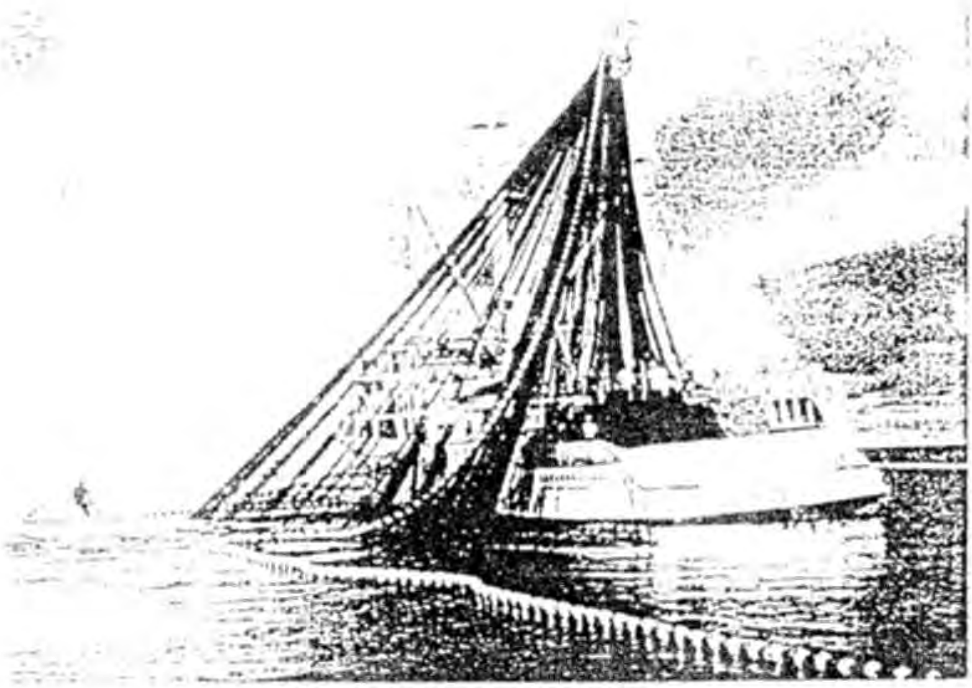
(4) Tow the shelter slowly towards the portable one and use full speed when passing in order to concentrate the fish at the portable shelter.

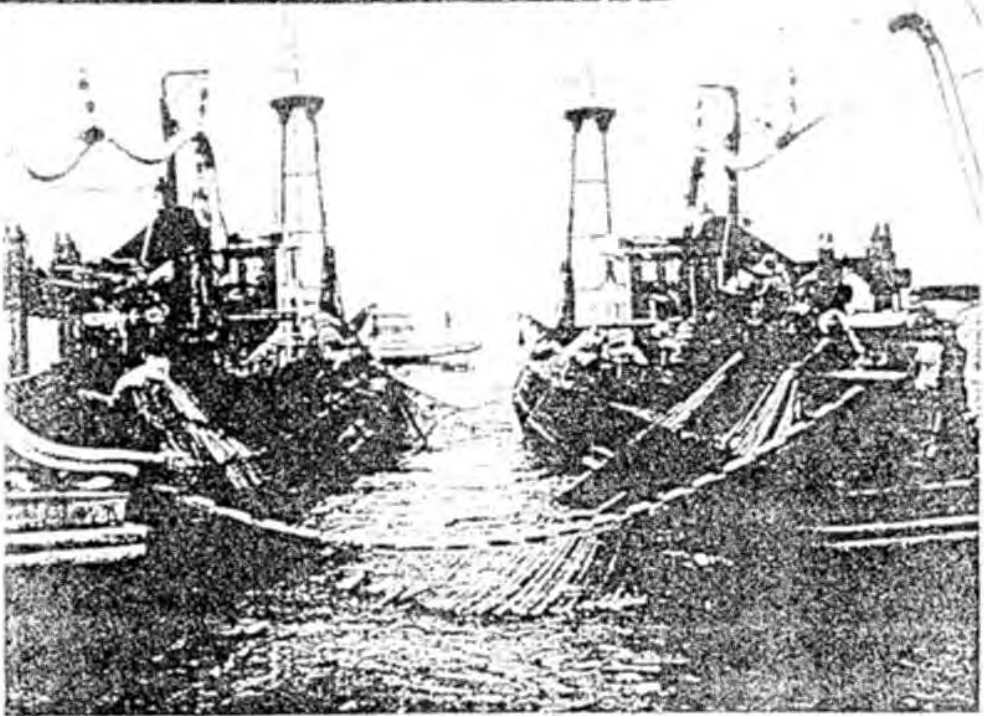
(5) Gondola is maintained with light raft and portable shelter against the wind while purse seiner shoots the net to surround them.

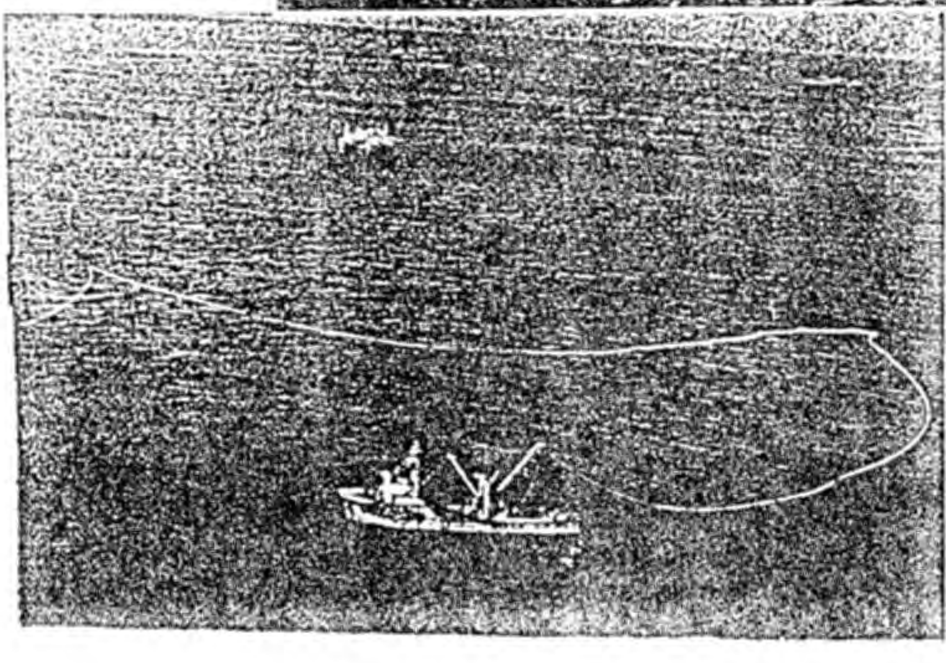


(6) Purse line pulled up and the net pulled in on both sides.

Fig. Steps for night-time fishing operations using coconut-leaf shelters







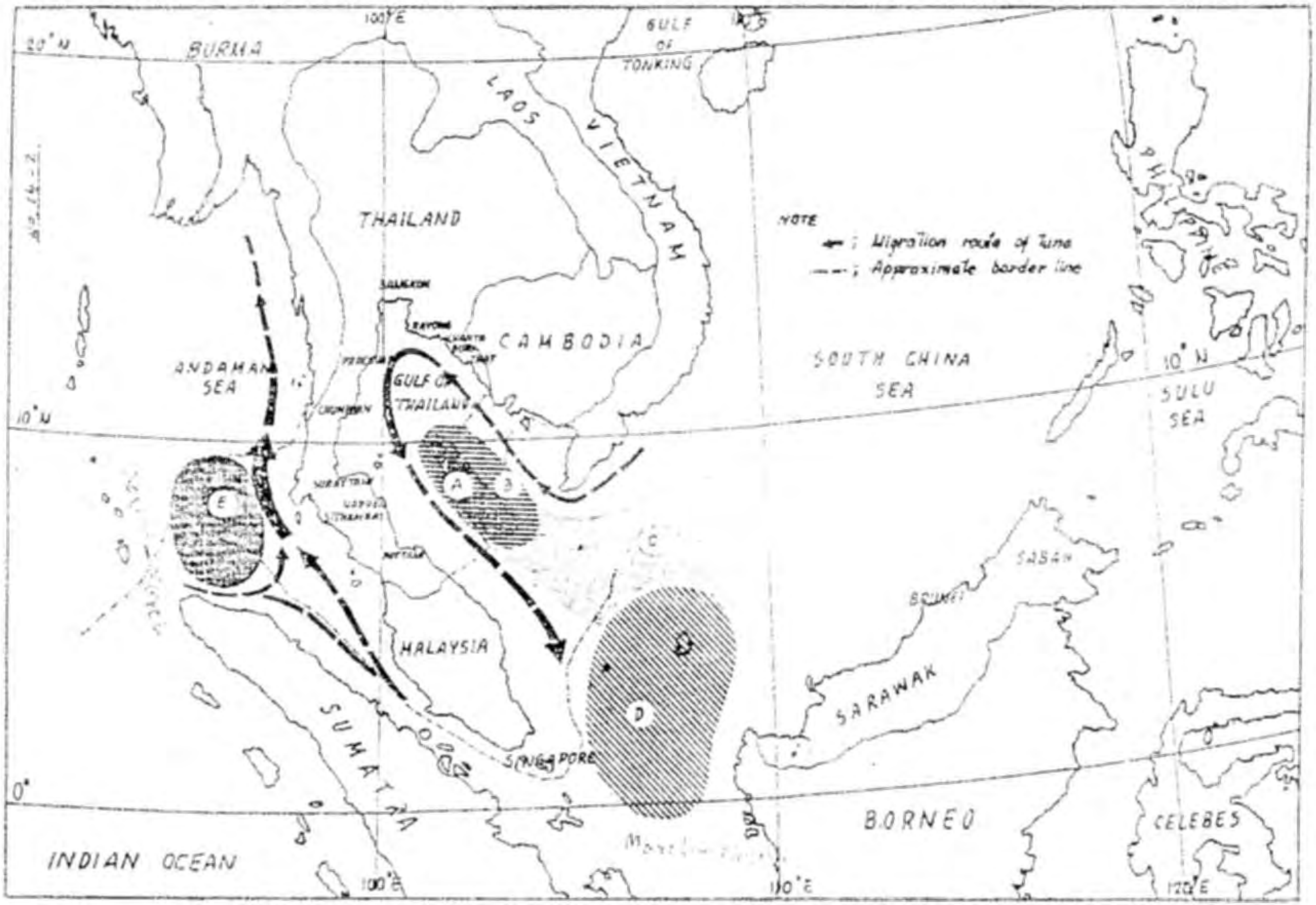


Fig. Tuna fishing grounds and seasons around Thai waters

Accompanying documents:

7 Drawing of tuna fish found in Thai waters

Source : Department of Fisheries, Thailand.

1

Thunnus tonggol

Longtail tuna ([illegible])

2

Thunnus albacora

Yellowfin tuna ([illegible])

3

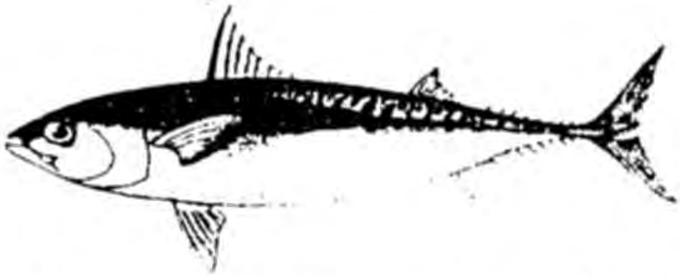
Euthynnus affinis

Eastern little tuna, ([illegible])

Kawakawa.

④

⑤

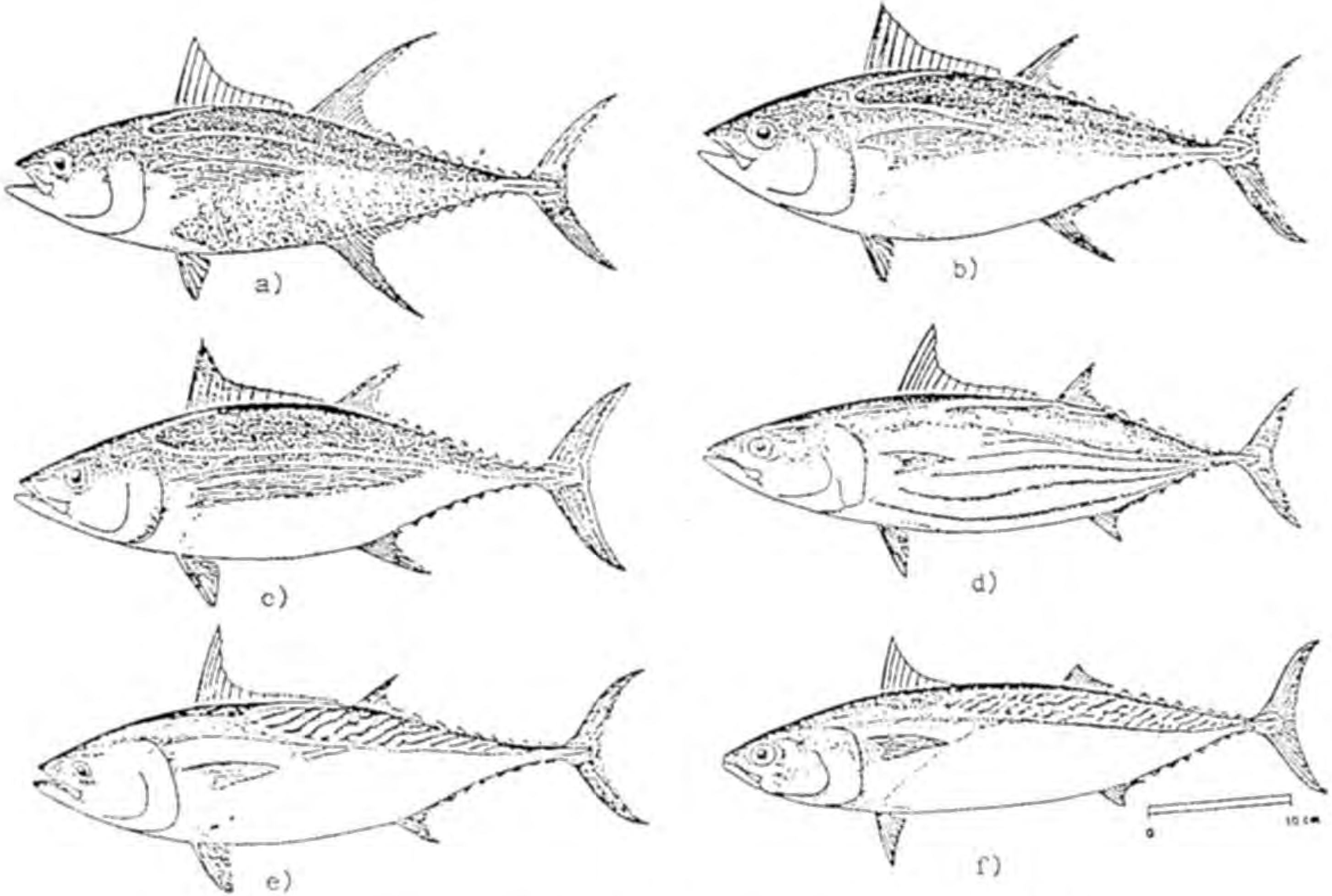


④ Auxis thazard — fugate tuna ([illegible])
⑤ Auxis rochei — Bullet tuna ([illegible])

⑥

⑦

⑥ Katsuwonus pelamis — Skipjack ([illegible])
⑦ Sarda orientalis — Striped bonito ([illegible])



รูปที่ แสดงรูปลักษณะของปลาทูน่าที่สำรวจจับได้ในทะเลอันดามันน่านน้ำไทย และน่านน้ำสากลมหาสมุทรอินเดีย

a) ปลาทูน่าครีบเหลือง b) ปลาทูน่าตาโต c) ปลาทูน่าครีบยาว d) ปลาโอท้องแถบ e) ปลาโอลาย f) ปลาโอแกลบ

Fig. Showing the features of tuna caught in the Andaman Sea EEZ of Thailand and high sea of the Indain Ocean.

a) Yellowfin tuna b) Bigeye tuna c) Albacore d) Skipjack e) Kawakawa f) Frigate tuna

Fig. 1. Map showing places visited during the field survey.

I. INRODUCTION

Among the fishing gears in the counry, the most controversial and the most popular in harvesting demersal species is the trawl. Small trawlers or "baby trawl" as locally known, ranks 5th among the municipal fishing gears for marine capture. Many small- scale fishers are operating the said gear because of sure catch per operation. The target species aimed for are shrimps because of its high-market value and demand for local consumption. Thus, these baby trawl are popularized further and now referred to as Shrimp Trawl. Technically, the gear is classified as bottom otter trawl since otter boards are being used to spread the mouth opening of the net.

Shrimp trawl is most prominent in central part of the country because of good trawling ground for shrimps, more particularly in the Visayan sea. The area is about 100 square kilometers with an average depth of 40 meters.It is located on the north coast of Masbate and Panay Island. These are areas, where, aside from rich fishery resources also abounds rock formations in the uplands. It is very interesting to note that stones or rocks are being utilized as raw material or accessory for fishing. This paper aims to provide information about shrimp trawl fishing in Masbate, Philippines.

II. BOAT

This is operated by a small outriggered banca (commonly less than 3 G.T.). The boat is 7 to 9 meters in lenght, 1.0 to 1.25 in width and 0.7 to 1.0 meter depth. The hull of the boat is wooden or made of marine plywood, with inboard powered gasoline engine (single cylinder) from 16 to 22 horse power. Engine types commonly used are Kohler, Robin, Briggs and straton.

III. THE GEAR

The design of the net is V-shaped and the cutting is usually all bars. The lenght of the net measures around 7 meters with width of about 5 meters. Netting material used is polyethylene (PE) with mesh size in the bunt about 21.7mm(400/ 24 twine size) and other portion of the net ranges from 27.7 mm to 60.9 mm. The ground rope is longer by 1 meter than the headrope. Illustration is shown in fig. 2. The specifications of the materials used is listed in Table 1.

The otterboard is made up of wood and measures 60 cm long by 30 cm wide. It has iron plates at the lateral side to protect from abrassion. Towing line is made of polyethylene (PE) rope with 12 mm. diameter. Floatline used is PE with 8 mm diameter and rubber floats (120 mm) are placed every 1 meter interval. Sinker line is made of PE rope with 12 mm diameter where stones as sinker materials are attached. The distance between sinker is 120 mm. Rounded edged stones are oftenly used by shrimp trawlers because of the abundance of materials, cheap cost and drags well at the bottom.

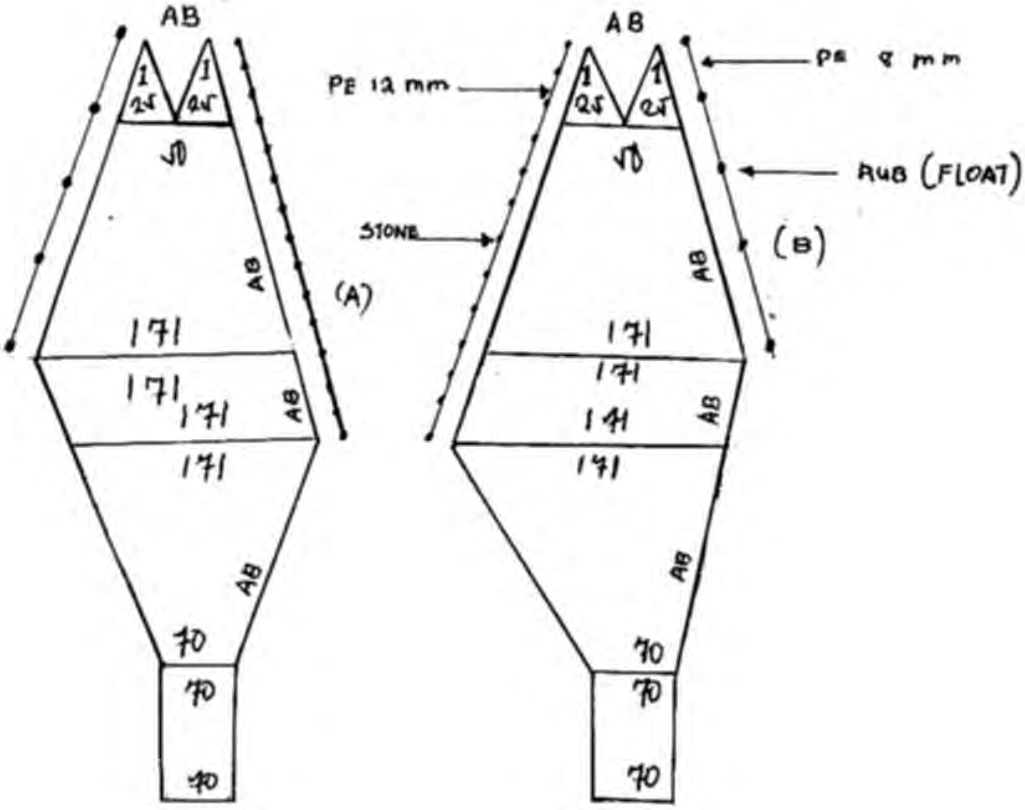
IV. FISHING OPERATION

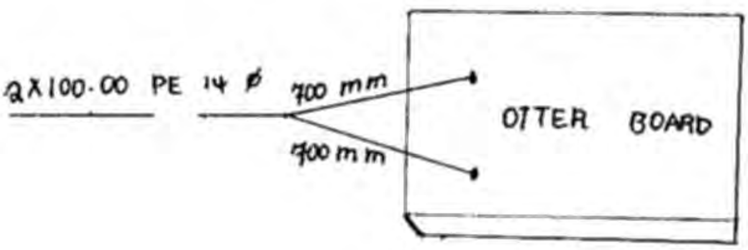
Operation is conducted by two (2) fishermen, operating in shallow waters with sandy, sandy-muddy or muddy bottom at water depth of 10-20 meters. Operation start at dusk and ends at dawn. Usually, the fishing ground is not so far with distance of about 2- 4 kilometers away from shore and it takes around 30 minutes to 1 hour for navigation. One hour dragging time is commonly observed

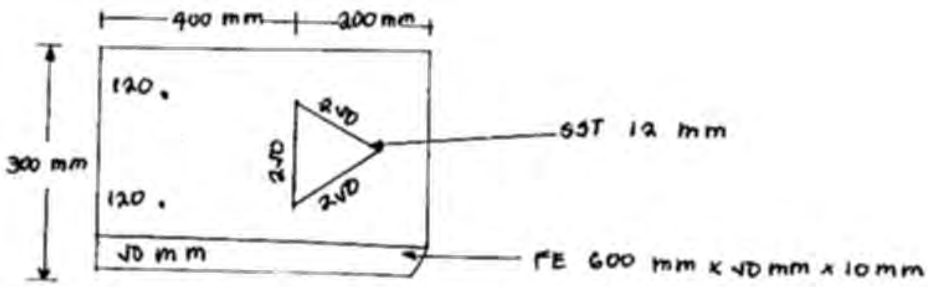
Table 1. Gear specifications.

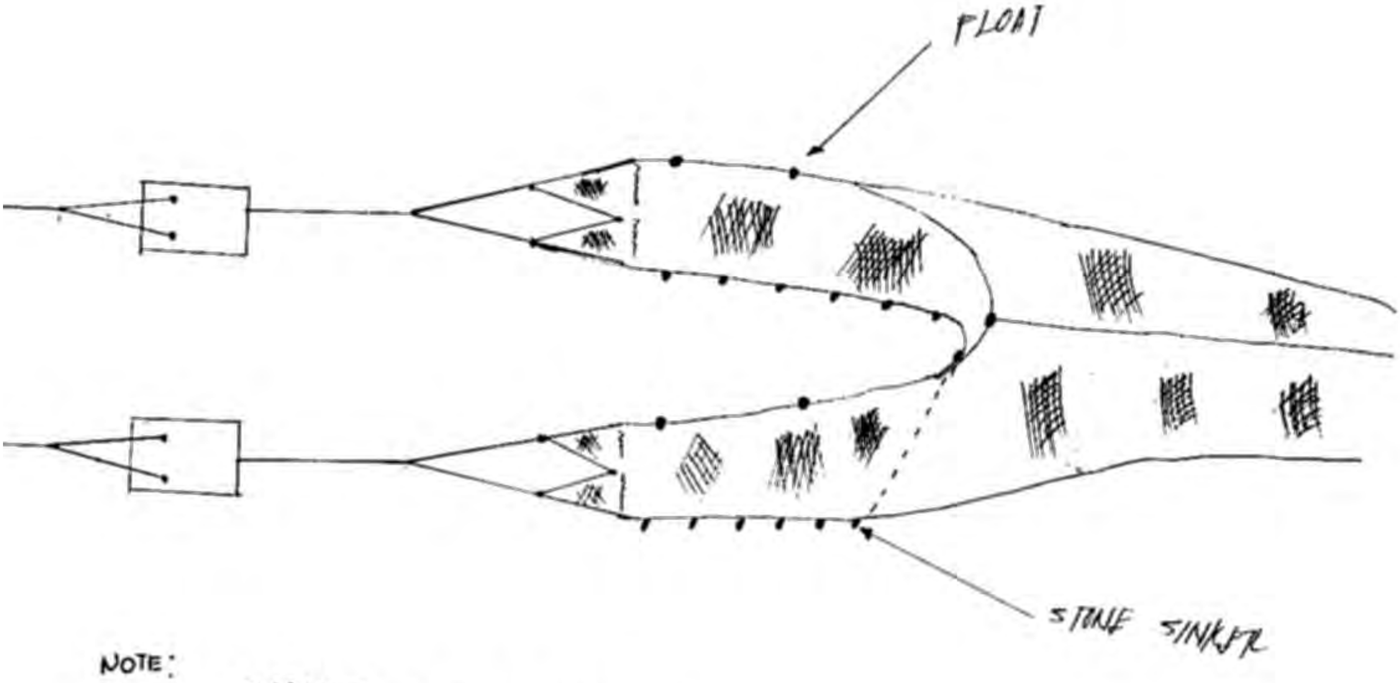
PARTICULAR	MATERIAL	MESH SIZE (mm)	MESH DEPTH (MD)
WING	PE 400/ 18	60.9	12
BODY (A)	PE 400/ 12	33.8	60
(B)	PE 400/ 12	27.7	20
(C)	PE 400/ 12	27.7	50
COD END	PE 400/ 24	21.7	100
WARP LINE	PE	14mm dia	2x100 m
GROUND ROPE	PE	12 mm	6.62 m
HEAD ROPE	PE	8 mm	5.51 m
SWEEP LINE	PE	14 mm	2x8 m
FLOATS	RUBBER	120mm dia	5pcs.
SINKER	ROCK(stone)	20 kg.	20 pcs.
OTTER BOARD	WOOD	LENTGH	2pcs.
		600 x 300 cm	
IRON		600 x 50 x 10mm	

TRAWL	VESSEL	LOCATION
Shimp trawl	Lo : 7.92 m.	Placer Masbate
Pang-hipon	Hp : 16	
Shimp	crew : 2	





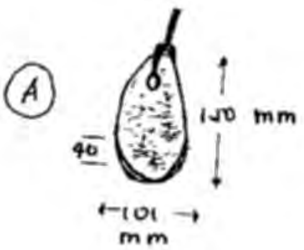


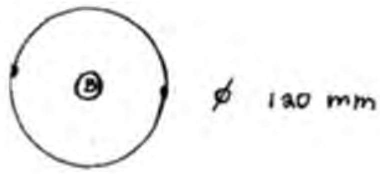


NOTE:

DISTANCE BET. SINKER = 120 mm

DISTANCE BET. FLOAT = 1.00 m.





before hauling and the average number of dragging is around 6 to 7 times for a night.

Fishing operation is conducted throughout the year except when there is a weather disturbance occuring in this area. Approximate number of units operating this kind of gear in Placer, Masbate (Visayan Sea) is around 200 units. Alternative gears being used when trawl could not be operated are gill net and hand line.

(A) SETTING METHOD

Trawls normally consist of boat, towline, buoyline, otter boards, sinker and a trawl net. The end portion net is payed out until while the boat is moving at low speed. Then, the otter boards follow and pulled lightly to upright its balance in water. The towline is paid out slowly to the desired length and secured to capstan or any strong part of the boat such as aft or astern section of the boat.

(B) HAULING METHOD

Hauling is done manually by pulling the towline until the whole net aboards the banca. The catch is sorted and marketable species are placed in containers. Debris and non-marketable species are discarded in the sea. In case of net damage, net are sewn.

V . SPECIES CAUGHT

The main target of this gear are tiger shrimp (***Penaeus semisulcatus***) and hard back shrimp (Trachypenaeus fulvus). Some demersal fishes, such as threadfin breams, lizard fishes, goat fishes, pony fishes, and crustaceans are also collected whenever size is marketable enough or can be used for home consumption. Average catch during peak month is around 20 kilos per night.

The relative percentage composition of catch at nightime operation are as follows : shrimps with 60- 70%; demersal fishes with 25% and crustaceans of about 5%.

VI . SUMMARY AND RECOMMENDATIONS

Shrimp trawling in Visayan sea could be descibed as a good source of livelihood for small-scale fishermen in Masbate and Panay Island. Since the catch is composed primarily of shrimps and less of by-catch as compared to other trawling grounds in the country, said fishing activity proliferated. However, the controversy and continuous conflicts among other types of fisheries is still stirring up concern among fisheries managers of the local government. Although, the use of trawl in the area is now being regulated in terms of quantity. It is in this manner that other type of fisheries in the area increases, whereby, shifting to other gears such as gill net and hook and line could be observed. One of the most convenient tool in managing the fishery resources, aside from absolute stop from illegal fishing practices, is limiting the number of units pressuring the fishing ground. Shrimp trawling may not produce a great threat to resource only if appropriate units are granted to fish at certain zones of the country.

STUDY REPORT

ON

ARTIFICIAL REEFS FOR MARINE HABITAT ENHANCEMENT

BY

Nopparattana Ruangpatikorn

THAILAND

THE REGIONAL TRAINING COURSE IN

FISHING TECHNOLOGY AND RESOURCE CONSERVATION 1997

Training Department

Southeast Asian Fisheries Development Center

THAILAND

ARTIFICIAL REEFS FOR MARINE HABITAT ENHANCEMENT

I. Introduction

Artificial reefs are structures that serve as shelter and habitat, source of food, breeding area and shoreline protection. They are normally placed in areas with low productivity or where has habitat that been degraded. They have been successful habitats for benthic organisms such as lobster, sea cucumber, oyster, abalone, top shell and seaweed, in addition to fish. They have also been used effectively in preventing trawling in specific areas. Their major functions are to:

1. concentrate organisms to allow for more efficient fishing ;
2. protect small / juvenile organisms and nursery areas from some fishing gear ;
3. increase the natural productivity eventually by supplying new habitats for permanently attached or sessile organisms and by allowing the establishment of an associated food chain ; and
4. create habitats and simulate natural reefs for desired target species.

Artificial reefs enhance marine systems. Enhancement occurs through the additional surface area and spaces created by structures in the water column. Additional surface area and space provide an opportunity for marine plants and animals to attach and seek shelter. The overall effect is to increase the amount of habitat available to marine life.

II. History of Artificial Reef Structures

Artificial reefs have been used to enhance coastal fisheries in Japan and in other countries for several hundred years, but their widespread construction and application are recent , spanning the last 15 to 20 years. The concept of artificial reefs originated in Japan about the turn of the 18th century. Fishermen observed that fish catches were more productive in waters containing sunken ship. The catches declined as the wrecks disintegrated. In 1785, fishermen constructed large wooden frames and mounted them with bamboo and wooden sticks, weighted with sandbags, and sunk them in the sea. They discovered that their catches around these structures were better than those around the ship wrecks. This prompted them to sink more such structures. The use of designed reefs made from fabricated materials started more than 30 years ago. The first generation of these designed reefs have since the undergone various modifications.

In the United States, an artificial reef was constructed in 1860. It was observed that fish could be caught in large numbers from inlets where trees had fallen and barnacles had grown. It was also discovered that fish numbers could be kept in areas where stacked configurations of oak and pine logs had been sunk. More reefs using a variety of other materials such as old ship were constructed in coastal waters throughout the United States.

Widespread interest of Southeast Asian countries in artificial reef construction as apart of coastal zone management for resources enhancement developed only in the late 1970s.

Thailand initiated an artificial reef program in 1978, covering seven coastal provinces along the Gulf of Thailand and the Andaman Sea. Thirty-four reefs set in area 300 m2 were constructed between 1978 to 1986. Materials used have been old tire, open concrete tubes, steel pipes and wood.

In Malaysia, artificial reefs were established in the early 1970s , where they started as initiatives of the small-scale fishermen in east coast of Peninsular Malaysia. The government is launching reefs. Ninety percent of reefs are made of tires while the rest are of concrete culverts and scrap vessels.

The Philippines started a national program in 1981 and has established 70 small-scale artificial reefs in different parts of the country. Between 1990 and 1994, the Fisheries

Sector Program of the Philippines were deploy more than 50,000 tires for artificial reefs in major bays around the country.

In Brunei Darussalam, artificial reef construction began in about 1984 for fish aggregation and habitat enhancement. These tire reefs are being monitored for their effects on fishing. The country has also used two oil rig jackets as experimental artificial reefs.

Although the history of artificial reefs is quite long, it is only very recently that large-scale programs have been developed by national governments. The relative abundance of used and waste materials has also reduced the cost involved and, to a large extent, made it possible to build artificial reefs in developing countries. In Japan, most artificial reef development has been with newly fabricated materials and such large investments might not be economically feasible in other Asian countries

III. Ecology of Natural and Artificial Reefs

A. Productivity and Diversity

Many studies have compared artificial reefs to natural reefs in term of community structure, density, biomass of fish diversity of organisms. Similar community structure and diversity is generally found on nature and artificial reefs depending on site specific factors. Studies in tropical areas have generally found fewer species on artificial reefs as compared with natural coral reefs. Natural reef communities in most studies have had lower density and biomass than artificial reefs in almost all case, that have also been conducted on temperate reefs where the reef complexity is naturally less than those in tropical waters. It has been concluded by several observers that the ability of fish and invertebrates to use both artificial and natural reefs depended on the species.

situation. The different environments, types of organisms and management approaches will fall in different places on the range of production to attraction for particular reef. In general, artificial reefs may increase carrying capacity but do not necessarily increase standing stock in an exploited situation. In this regard, attraction by itself is an acceptable function as long as there is a surplus populations to harvest and as long as it harvest and as long as it does not lead to overfishing.

IV. Artificial Reefs Design

Part of the challenge to designers of artificial reef is to raise the productivity envelope set by local limitations to its maximum through clever design and optimum location. Part of the reason for the success of benthic artificial reefs in supporting high densities of organisms is related to increased habitat complexity, defined as the quantity and type of structural elements on a specified spatial scale. The increased of habitat complexity (number of reef units per area resulted in increased average numbers of individuals and numbers of species; however, these numbers leveled off with higher habitat complexity.

Design elements recognized to be most important include physical shape, material composition, surface texture, reef size and dispersion.

A. Material Composition and Surface Texture

The materials used in artificial reef construction can affect fouling assemblage development. Some scientists reported ; some differences in species preferences and rates of colonization between reefs made from concrete blocks and from coal waste materials, although overall fouling assemblages were similar ; higher coral recruitment to metal surface than to rubber and that concrete provided fouling assemblages most similar to natural coral substrate ; artificial nontoxic polyvinylchloride plastic substrate supported the same fouling assemblages as natural dead coral rock substrate for invertebrate abundance and algal biomass, coverage, diversity and species composition ; some differences were noted at high grazing intensities due to difference in substrate softness and porosity(surface texture), in which irregular substrate provided refuge from grazing for some setting benthic organism.

Studies have shown that rough surface texture enhances benthic settlement and influences fish composition. Irregular surface provided refuge for benthic organisms and supported greater fouling diversity at high fish-grazing intensities. Researcher rejected the hypothesis that irregular surfaces would support greater benthic diversity in flat surfaces at low-grazing intensities because of greater microhabitat partitioning, by potentially competing benthic species. Despite these differences, material composition and surface texture seem to be minor factors compared to other variables for most organisms

B. Shape, Height and Profile

For this discussion, shape refers to three-dimensional structure ; reef height is the distance between the substrate and the highest point on the reef ; and profile (or reef relief) refers to how up-and-down the reef outline is. All can be important.

- Conflicting attitudes exist concerning the importance of the three-dimensional shape of an artificial reef. Some programs, especially those that rely on scrap materials, seem to pay little attention to reef structural shape except in terms of hydrodynamic stability, reef persistence, and potential as navigational hazard. Some programs insist on only carefully engineered and located structures designed for particular species and locations. Practitioners of both approaches seem contend with the results based on user satisfaction, although rarely have quantitative biological or economic evaluations been made. Japanese programs have been based on a simple comparison of costs of artificial reefs compared to catches.

❑ Vertical relief has been correlated with more benthic reef fish species for reefs less than 1 m. high but was less effective at elevations greater than 1 m.. It is likely that increased exposure to water currents on high profile reefs would favor planktivores over other species. A review of Japanese studies reported that most demersal fishes remain within 3 m. of the sea floor and higher reefs might not be effective for these species. Horizontal extension was more important for attracting demersal fishes, whereas greater vertical extension was more important for midwater species, although reef height did not need to exceed 5 m.. Reefs with the same total relief but with nearly vertical sides were better at attracting fishes.

C. Hole Size

For small-hole reefs, little or no effect of hole size or diversity was found on fish species composition or diversity. Some experimental studies show that hole size and number do effect fish assemblages. A review of American studies reported ; the hole composition had little effect on fish assemblages during the day but it was important at night for sheltering fishes also ; the holes provides shelter from predation and can increase juvenile recruitment, number of species and total fish density on small reefs ;

Other studies indicate that reefs will large holes provided less shelter from predation to small fishes, resulting in lower fish abundance and fewer fish species. Japanese scientist noted that fishes did not inhabit chambers with opening 2 m. or larger, and recommended that 0.15 to 1.5 m. opening were best for fishery purposes.

D. Size

Reef size is an important consideration affecting total volume, bottom coverage, and surface area. As noted previously, small reefs may have insufficient food for certain species to establish permanent populations. However, small reefs may have a higher density than large reefs because they may attract fishes from a proportionally larger are due to a higher perimeter to area ratio. A review of Japanese study report that the minimum effective size for fishery purpose was 400 m^3, and that peak fish harvests occurred with reef bulk volumes of about 3,000 m^3/km^2. Harvest declined with larger reefs.

E. Scale

Besides reef size, the spatial and temporal scale used in artificial reef studies is an important and often overlooked consideration. Controversy and confusion in reefs studies can often be traced to differences in the scales in the time and space at operation. Noise at one scale may be critical to processes operating at another scale. For example, different perceptions of assemblage stability have occurred because of different time intervals between samples. Short time intervals between samples implied high variability, whereas longer time intervals implied more stability in artificial reef assemblages.

F. Dispersion

The arrangement of reef material within or between reefs can be important ecologically. In Japan , large nonreef areas are left between artificial reefs to maximize fish production . In the United State, California rock reefs are frequently constructed in multiple modules. Because many fishes feed away from a reef or on passing plankton, reef materials that are too concentrated may limit plankton availability or may lead to overgrazing for surrounding bottom. Roving predators may be an advantage or disadvantage depending on management goals. Possibly, ecotonal species are favored by clumped patterns, according to our observations.

Despite these suggestions regarding the importance of dispersion patterns on artificial reef communities, no conclusive experimental studies exist showing that particular patterns are best.

V. Conclusion

Artificial structures in the marine environment are intended to enhance marine habitat and productivity. They may act as aggregation devices to existing scattered individuals and/or allow secondary biomass production through increased survival and growth of new individuals by providing new or additional habitat space. Artificial reefs have also been considered as a practical means of limiting trawling in nearshore areas where commercial trawling competes with small scale fisherman. Sensitive areas such as spawning and nursery grounds have been protected by artificial reefs which serve as barriers.

Nations concerned with conservation and enhancement of marine resources are looking at artificial reefs as mechanisms to alleviate problems of resource availability, and as sources of food, employment, income and recreation. It is equally recognized that artificial reefs can not replace well-managed natural reef ecosystems but can only enhance degraded systems or provided for the extension of the productivity of natural reefs or emulate them in areas where reefs never existed.

Table 1. Comparison of characteristics of coral and artificial reefs.

Coral reefs	Artificial reefs
Natural living structures depend on specific environmental factors such as light, salinity, temperature and suitable substrate for basic framework development.	Artificial structures are independent of environmental conditions for basic framework development.
Shape, size, location and orientation depend on environment and age.	Shape, size, location and orientation do not depend on environment and age.
Basic framework of $CaCo_3$. Development is slow as coral growth is approximately 15-20 cm/yr at best. No cost involved.	Basic framework of metal, concrete, tires, wood, etc. Rate of framework development could be fast but cost-related except as natural growth occurs.
Longevity of basic framework is indefinite.	Longevity of basic framework depends on materials.
Recruitment of marine life is dependent on environmental conditions, shape, size and biological health of coral reef.	Recruitment of marine life is dependent on environmental conditions and the nature of framework.
High primary production from algae, corals, etc.	Primary production is dependent on area available for photosynthetic marine organisms to grow on basic framework.
Recesses and crevices naturally present in the framework provide shelter and hiding spaces for a large variety of marine organisms.	Hiding space provision is limited by the basic framework. The size and species attracted will depend largely on the size and nature of hiding spaces provided which depend on cost.
Establishment of new coral reefs through transplanting and other techniques is slow, time-consuming and of limited application.	Establishment of artificial reefs is relatively fast and has proven to be cost-effective in specific instances.
Fish production figures of 9.7-32 $t/km^2/yr$ of coral have been recorded.[38,64]	Very little actual detailed work carried out on fish yield, etc. However, definite enhancement in fish aggregation has been recorded. In the Philippines, 312 m^2 of bottom area of artificial reef has produced yields of 2 kg/week.

Table 2. Comparison of materials used in artificial reef construction.

Material	Lifespan	Relative cost material	Shipping and handling	No. of crevices and surfaces
Old car bodies	3-5 years	low	high	high
Piles of rock	long	medium	high	very high
Building rubble	long	low	high	high
Concrete structures	long	high	high	very high
Old boats	medium	high	medium	high
Old tires	long	free	low	very high
Obsolete oil rigs	long	free	high	medium
Fiberglass	20 years	high	medium	high

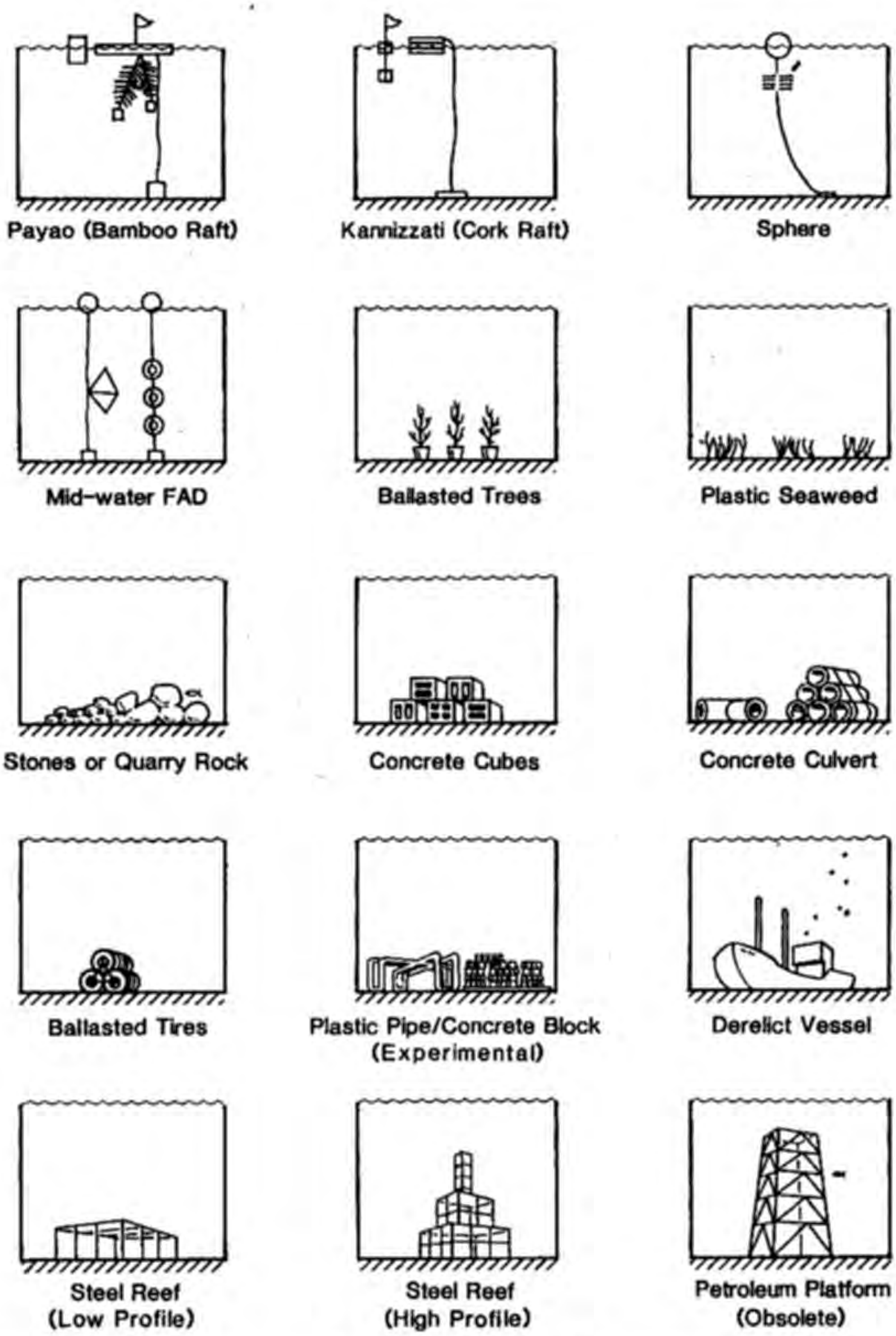


Figure 1. Representative examples of widely used artificial aquatic habitat materials and structures.

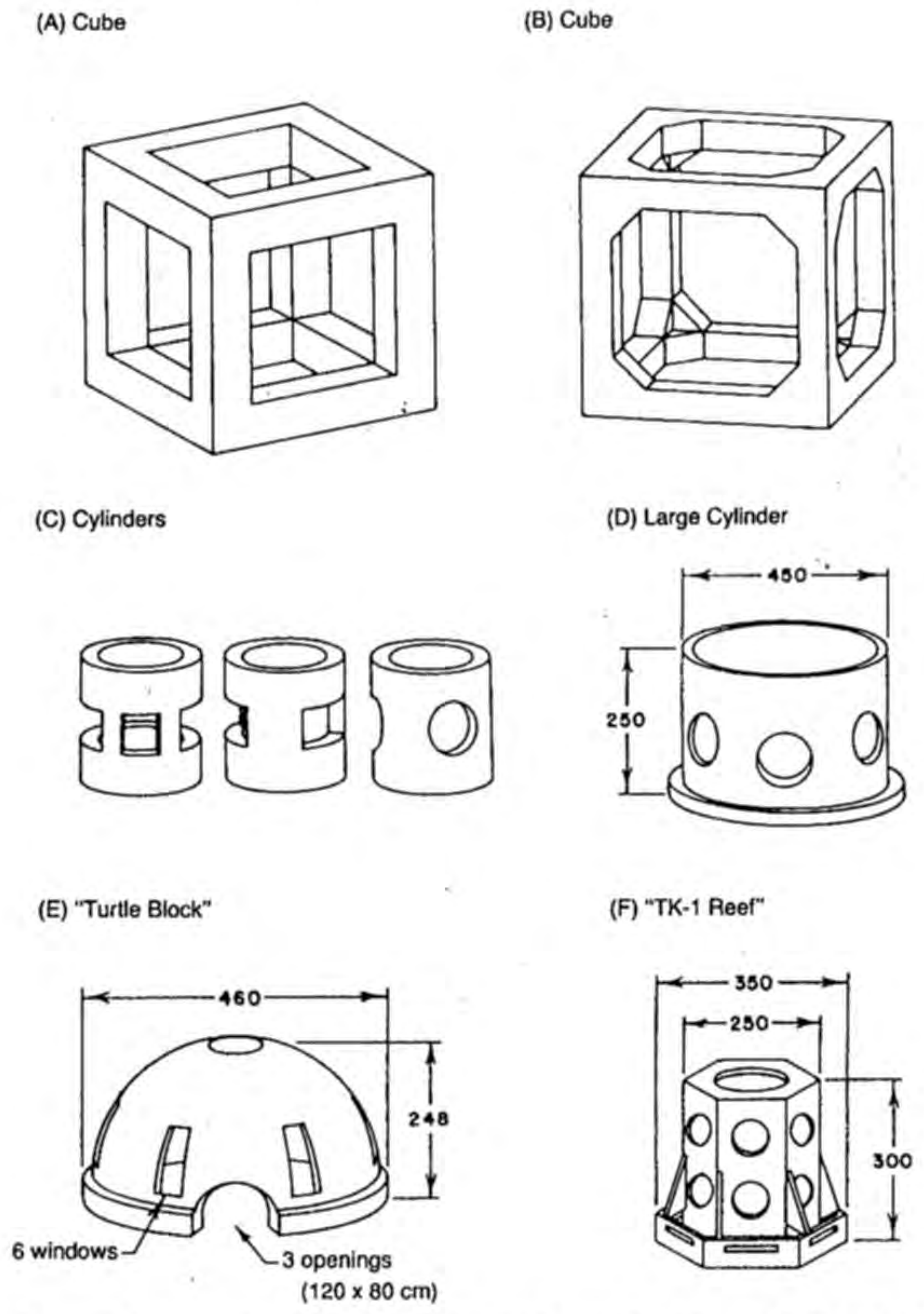


Figure 4.1 Representative reef blocks: (A) Cube, (1 to 5 m on a side; 1 to 125 m^3); (B) Cube, (1 to 4 m on a side; 1 to 64 m^3); (C) Cylinders, (diameters and heights 0.6 to 1.8 m; 0.17 to 4.6 m^3); (D) Large Cylinder, (39.76 m^3); (E) "Turtle Block," (13 tons; 27.3 m^3); (F) "TK-1 Reef," (13.1 tons; 28.9 m^3), which can be deployed separately or in groups. These can be made of concrete or fiberglass (Unit: mm)

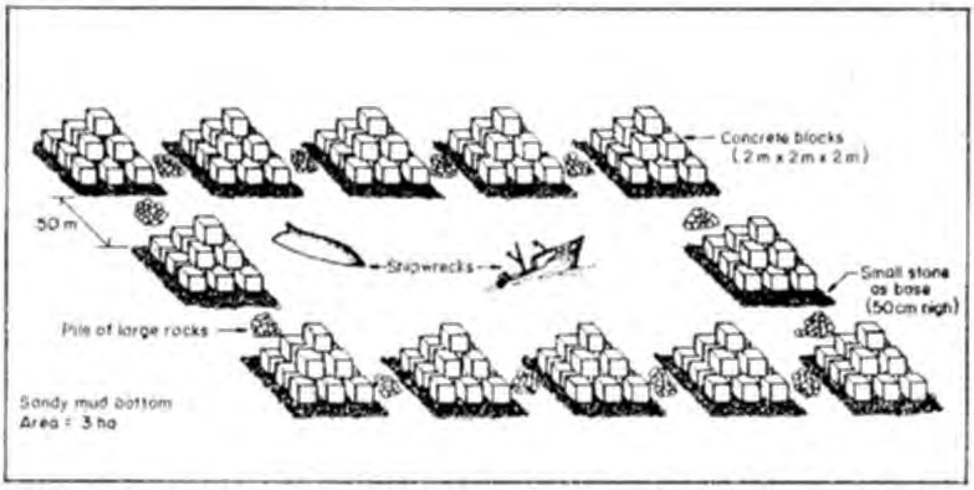


Fig. 2. Concrete block reef complex in the mid-Adriatic Sea, off the coast of Italy.[12]

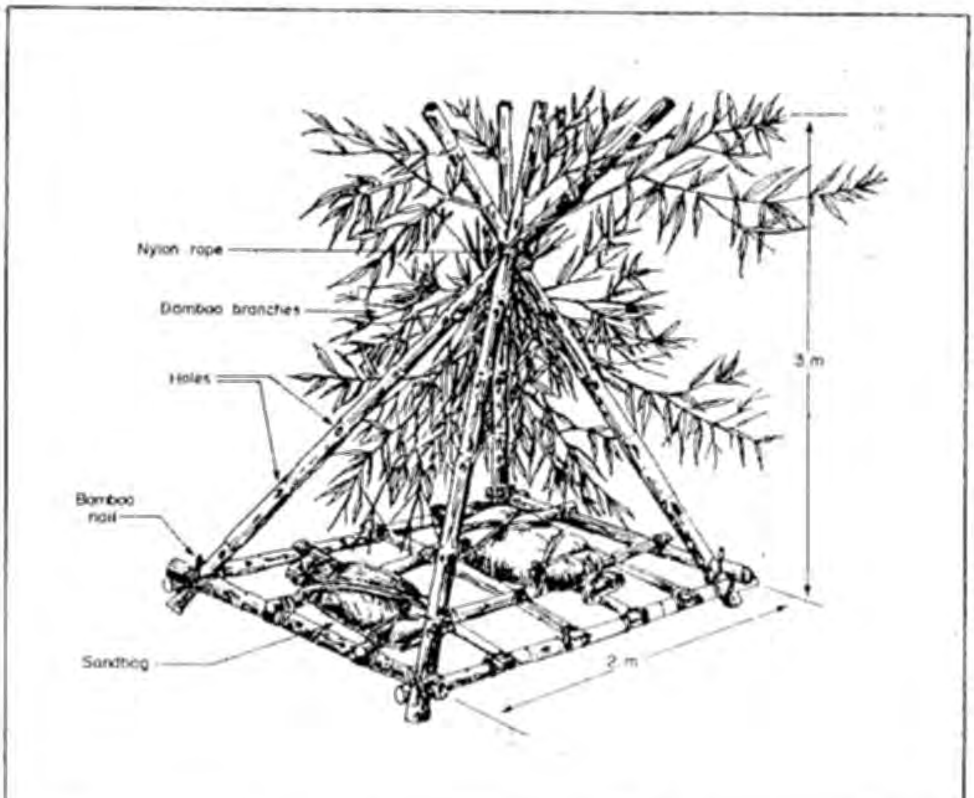


Fig. 3. A pyramid bamboo module used in the Philippines.[34]

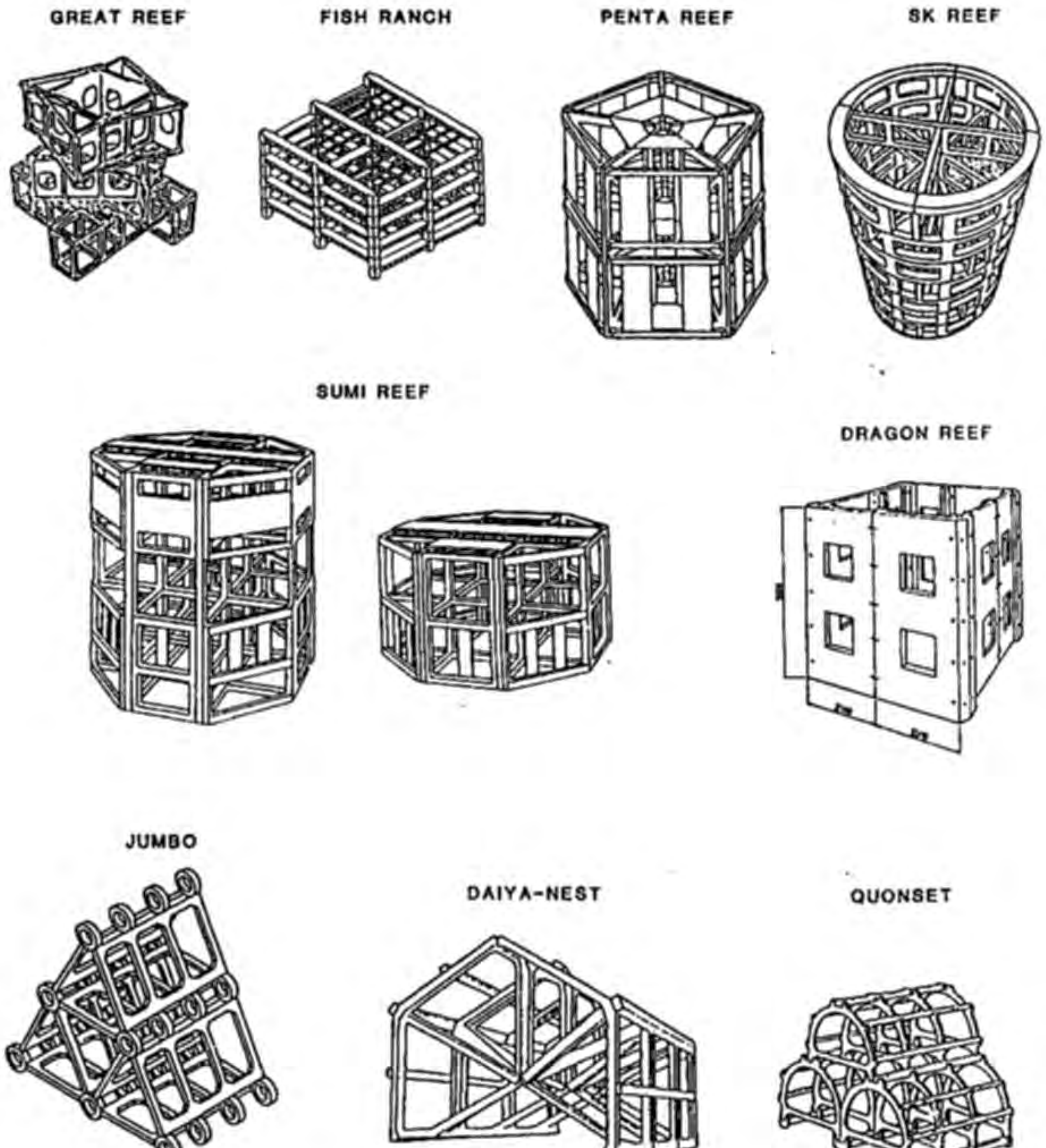


Figure 4.2 Representative reef modules. These benthic structures are considerably larger than the blocks in the preceding figure, and development is correspondingly more complex.

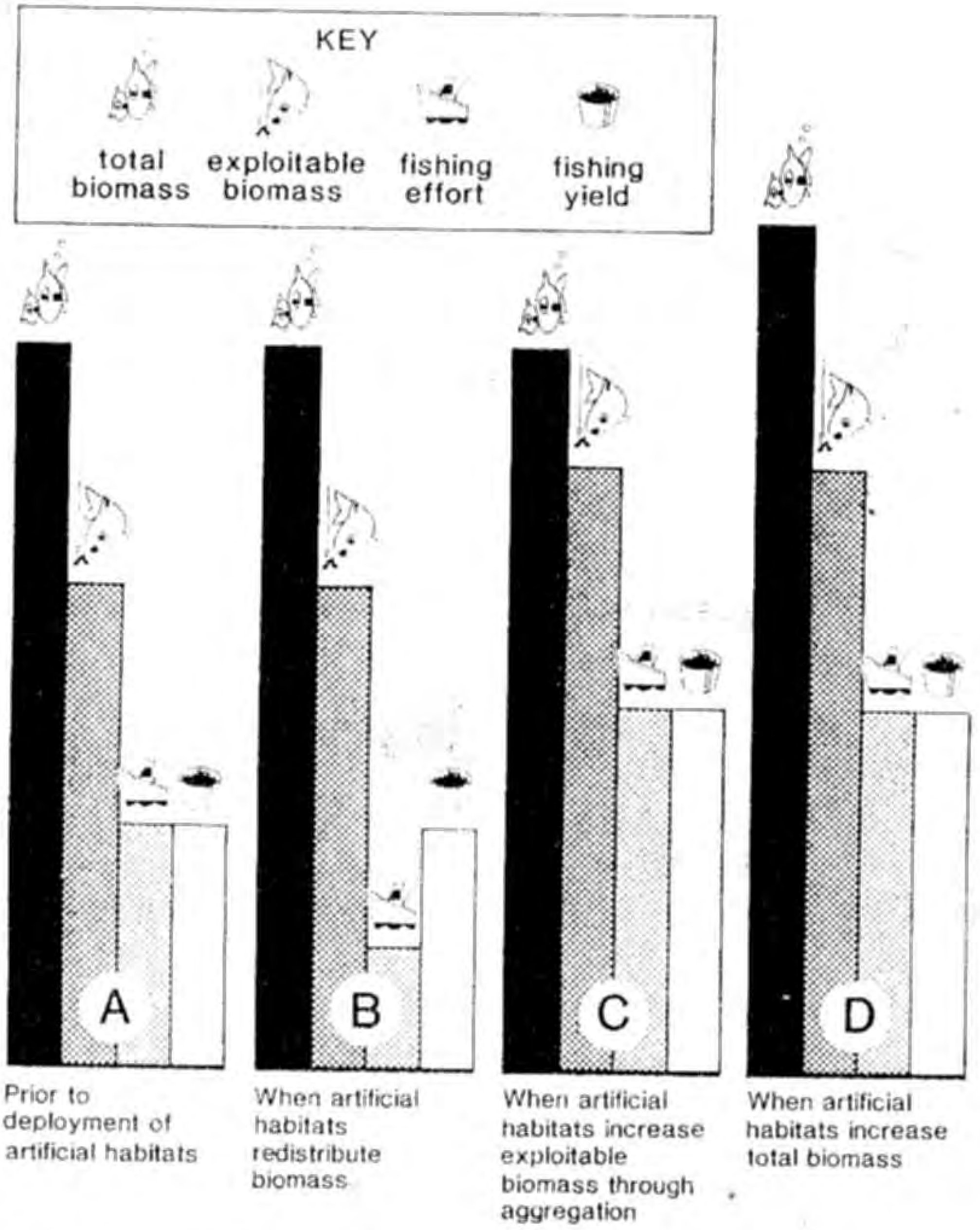


Figure 5. Three possible impacts of artificial habitat. (A) Total biomass, exploitable biomass, fishing effort, and yield for a resource prior to deployment of artificial habitats. Note the catch rate (yield:effort) is 1.0, and the yield is about one third of the total biomass. (B) When artificial habitats just redistribute the exploitable biomass to make it easier to catch, the same catch can be obtained with lower effort. (C) When artificial habitats increase the exploitable biomass but not the total biomass, an increase in catch can be achieved with greater effort without a reduction in catch rate, assuming that recruitment overfishing does not occur. (D) When artificial habitats increase the total biomass, the levels of all the variables in part (A) increase. Note that the only difference between (C) and (D) is the increase in total biomass.

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STUDY REPORT

ON

LIFTNETS IN THAILAND

BY

PITOON KAEWSAI

Country : THAILAND

TRAINING FISHING TECHNOLOGY AND
RESOURCES CONSERVATION

LIFTNETS IN THAILAND

The liftnet is traditonally a small-scale fishing gear that has been used in all coastal areas for catching crabs, planktonic shrimp and shallow-water fishes. In the late1970s, and the early 1980s, a modified liftnet, better known as the stick-held dip-net, became very popular for squid and anchovy fishing with luring lights.

There are no independt statistical records for lift net fishing. The data appear either as a part of the general small-scale fisheries, or else they are inseparable from the records of the squid castnet fishery, since most castnet vessels operate both methods. We can, however, roughly classify lift nets into four basic types:

FISHING GEAR AND METHODS

A. CRAB LIFTNETS

B. FISH LIFTNETS

C. STATIONARY LIFTNET

D. STICK - HELD DIP NET

CRAB LIFTNETS

This is one of the oldest fishing gears in Thailand, as well as in other parts of the world . The materials of which the gear is made may have changed, but the shape and the technique of use have remained the same.

The gear consists of the bamboo or metal frame for the net, and a bamboo pole or a rope with a buoy. The frame is usually round, 40-50 cm in diameter, or square with 45 cm long sides. The height of the frame is 15 cm. Nowadays, the net is polyethylene or nylon, with 70-140 mm mesh size. The fisherman can use this gear in very shallow water, from a rowing boat or a long-tail boat, or simply walk along the shore. The catch is usually mangrove crab and blue swimming crab. Fishing is done intake day or night-time, all the year round.

FISH LIFTNET

This gear is a modification of the crab liftnet. The metal frame is round, 50-80 cm in diameter, and contianes a 1 m deep nylon net that looks like a scoop net, with 25 mm mesh size. A rope is attached to the frame, for lifting the gear to the surface. Before the net is lowered to the bottom, a small piece of fish or crab is hung in the center of the frame as bait. The net is lifted frequently sometimes a young often sees this gear used by children or occasional fishermen, in fishing ports.

A kind of fish liftnet is used for catching planktonic shrimp. The net in this case is either cotton, nylon or polyethylene minnow or rachel net, mesh size 2 x 2 mm or 6-8 mm. A bamboo handle, 2-3 m long, is commonly used for gear with a square frame, whereas a round frame has a rope attached for lifting. The net is operated so that it is placed at the bottom in very shallow water, and the fisherman waits until he sees a school of plankton shrimp pass , then he lifts the net. No bait is required.

STATIONARY LIFTNET

This is a comparatively large liftnet, rarely used in Thailand. The type of stationary liftnet found in Songkhla has a leader net or a fence to guide the fish into the main net, which is suspended on a wooden frame in the water 0.5-2 meters deep. An observation platform, 8-10 meters high, is built so that the fisherman can see a passing fish school and operate the net from a good vantage point. The net is made of nylon 210 d/6, with 25 mm mesh-size. Fishing can be done by a single person, in the daytime between high and low tide. The catch is mostly mullet. Similar gear can be found in Nakhon Si Thammarat province. The shrimp liftnet consists of two bamboo leaders, funnel - shaped, and a net hung on two poles which are tied like a see-saw on vertical wooden frame, so that the net can easily be lifted out of the water. The net is polyethylene 250d/6, 15 mm mesh-size, the size of net is 4x7 squired meters. The net is set so as to face the current.

The mullet net, also found in Nakhon Si Thammarat, is rather larger: 10.7x15.3 square meter. It is hung on four stilts. There is a platform at each corner, from which the net is raised or lowered through a system of pulleys. A leader net is set on wooden stakes between the beech and the liftnet. Five men are required to operate the net.

STICK-HELD DIP-NET

Derived from the stationary liftnet, the stick-held dip-net is smaller and simple to operate. Fishing takes place on board a small to medium-sized vessel (8-14 m) equipped with electric luring lamps. The gear itself consists of a square or rectangular net, two bamboo poles, sinkers and ropes. The size of gear depends on the size of the fishing vessel. The net is usually black nylon 210d/3-6, 20-30 mm mesh-size,. and 0.4-0.5 hanging ratio. Fishing is done on moonless nights. During the operation the boat is allowed to drift with the current, a drift gill-net is used as a parachute anchor. The lift net is operated either by "pulling" or "pushing", depending on how it is hung on the bamboo poles at the start of operation. The main catch are squids and cuttlefishes. Anchovies are caught by the same gear and a similar method, except that the main net must have a smaller mesh-size and it is customary to operate a "pulling type" net.

The number of fishing vessels still engaged exclusively in squid stick-held dip-net fishing has been declining ever since the more effective squid stick-held castnet appeared. This kind of fishing, however, still continues along the eastern seaboard in Chon Buri and Rayong province.

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1. FISHING GEAR AND METHODS IN SOUTHEAST ASIA: I. THAILAND.

LIFTNET

Crap liftnet, portable
Raew Poo

Mangrove crab, Blue swimming crab

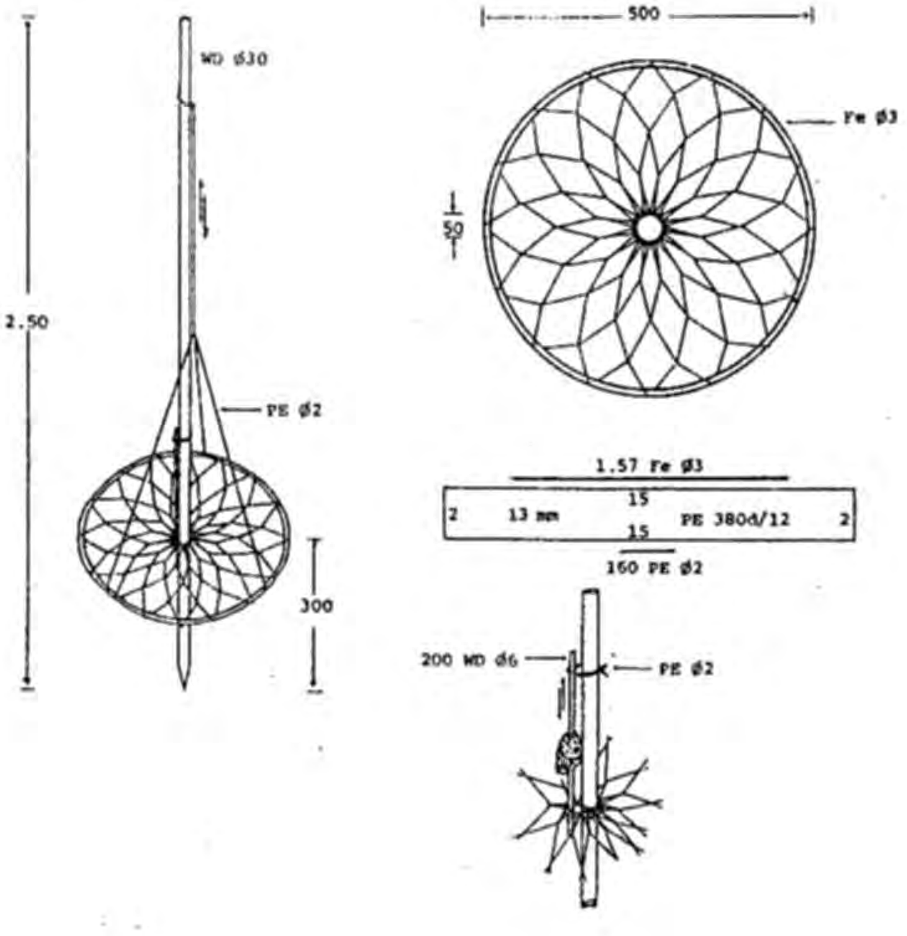
VESSEL

Loa 3-5 m
hp 1-3 LT

LOCATION

Paknamchumphon

Chumphon



LIFTNET

Crab liftnet, Portable
Chan Poo

Mangrove crab, Blue swimming crab

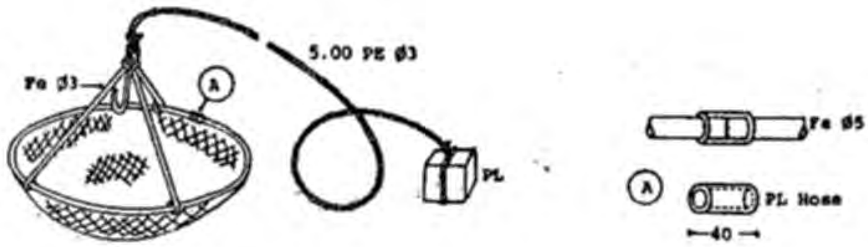
VESSEL

Loa 3-5 m
hp 1-3 LT

LOCATION

Bangchagrang

Samut Songkhram



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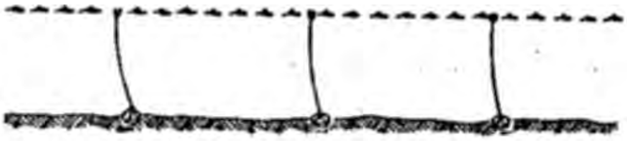
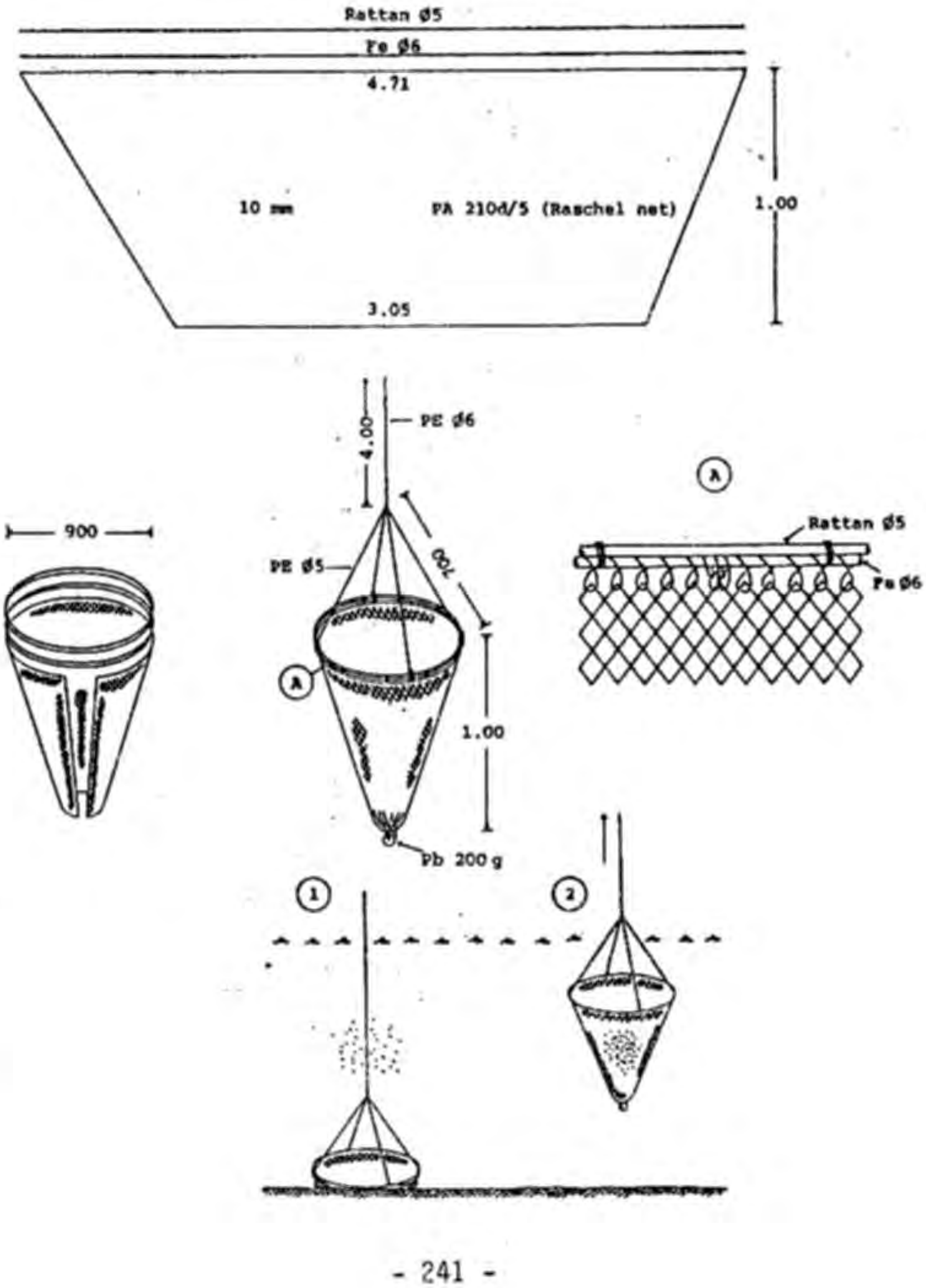


LIFTNET	VESSEL	LOCATION
Acetes liftnet, portable	Loa -	Langsuan
	hp -	Chumphon
Planktonic shrimp		



LIFTNET

Fish liftnet, portable

Rabbit fish, striped sea catfish

VESSEL

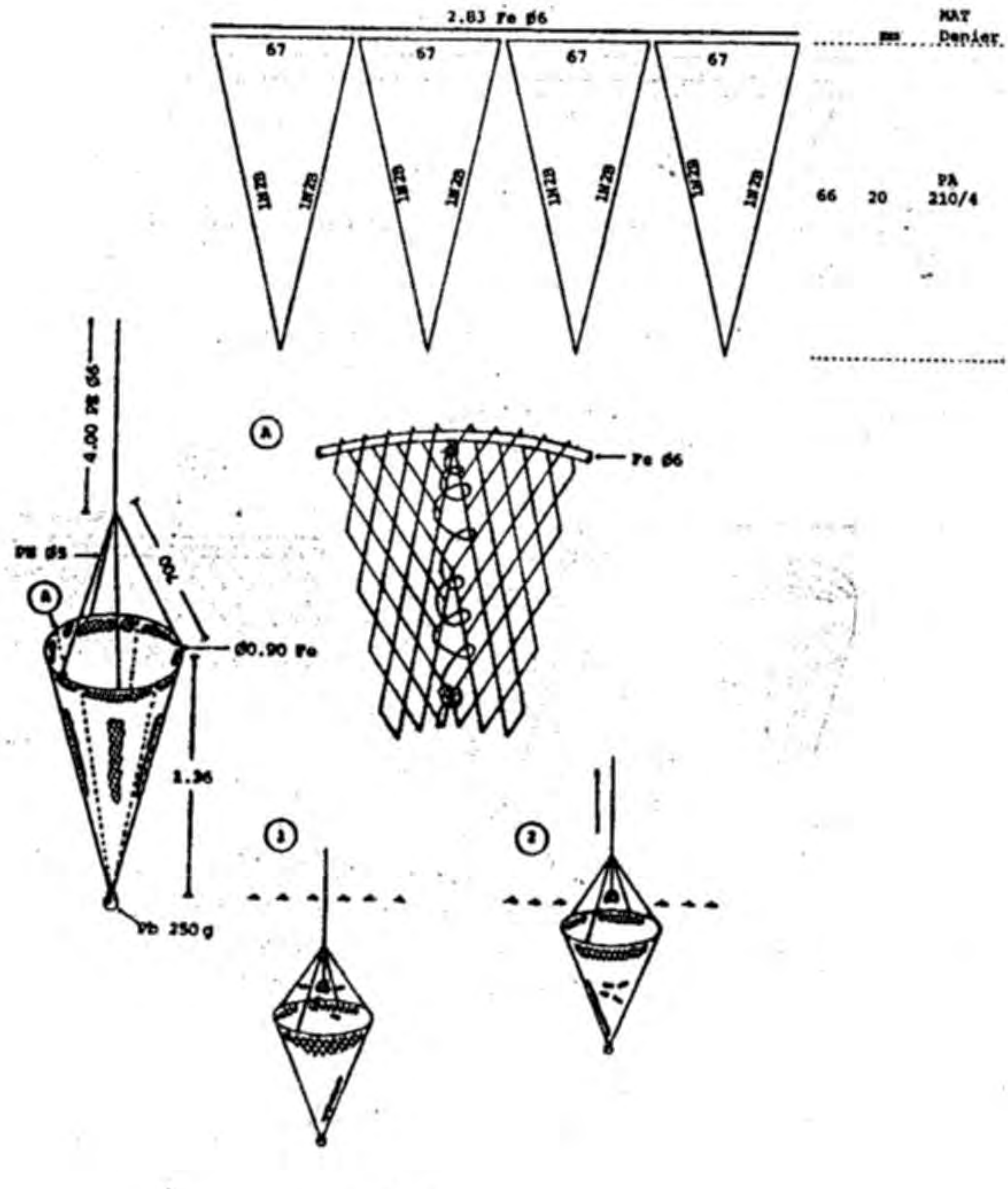
Loa -

hp -

LOCATION

Langsuan

Chumphon



LIFTNET

Stationary Lift net with wing
Yoh Peah

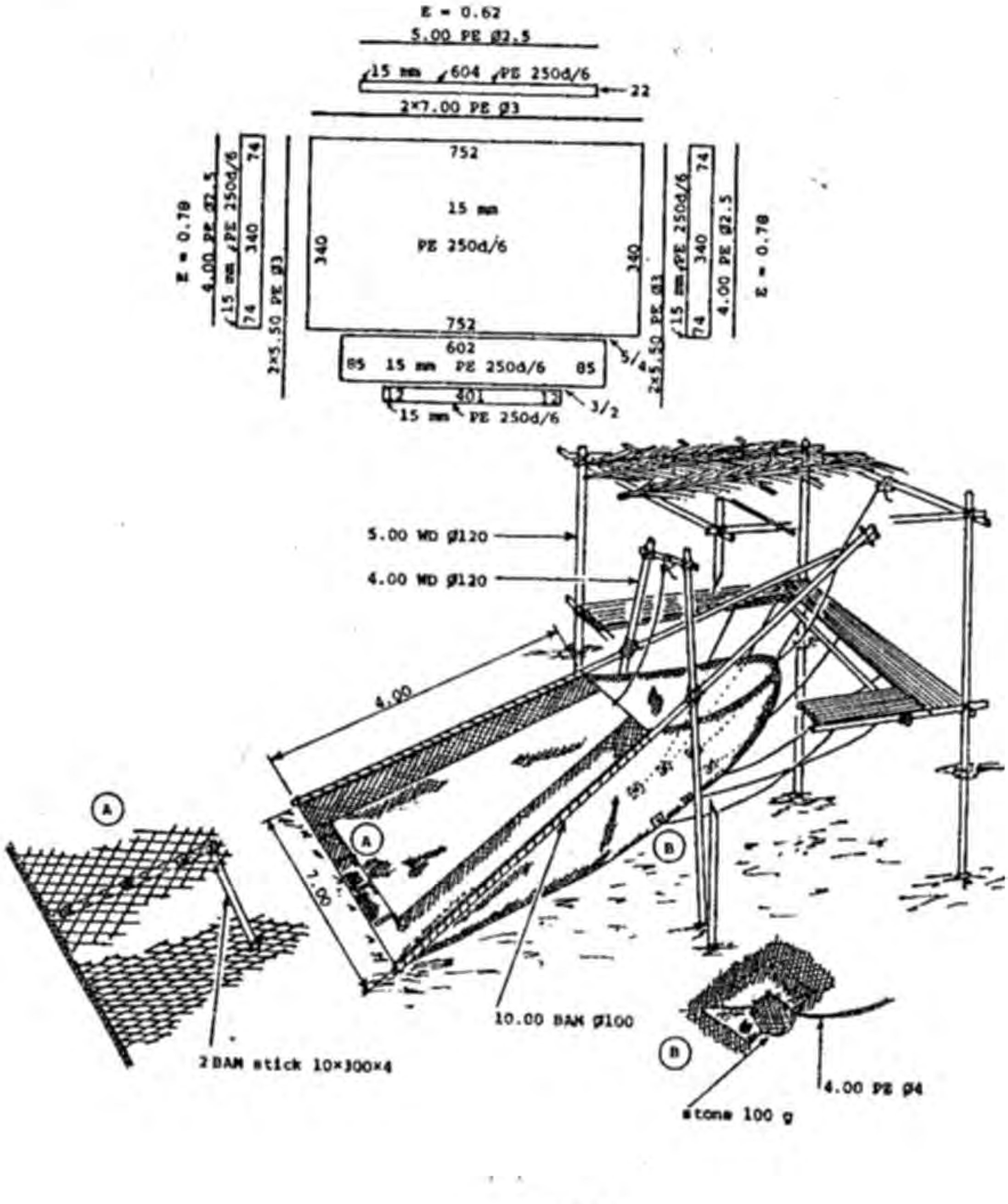
Shrimp

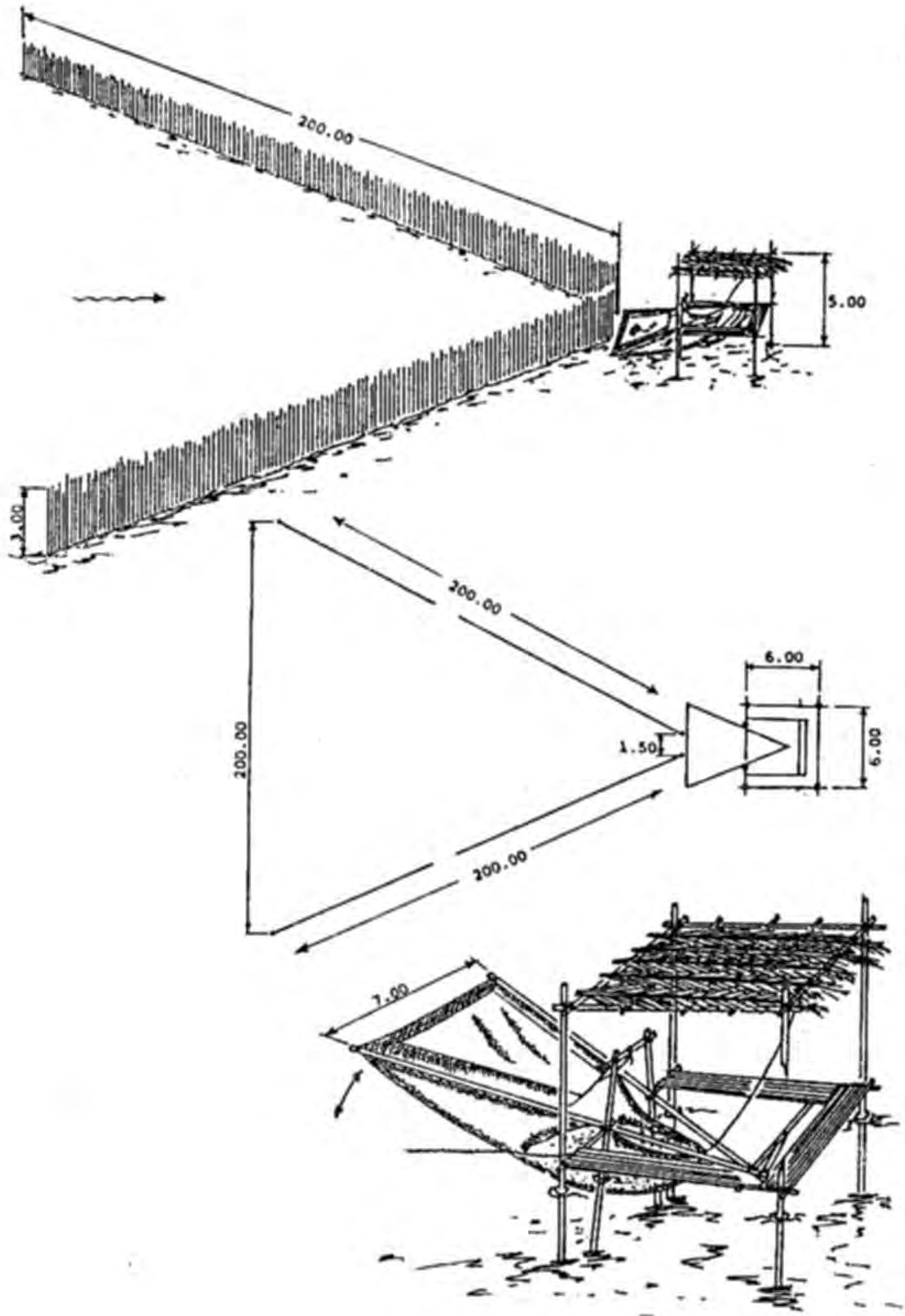
VESSEL

Loa -
hp -

LOCATION

Pak Nakhon
Nakhon Si Tammarat

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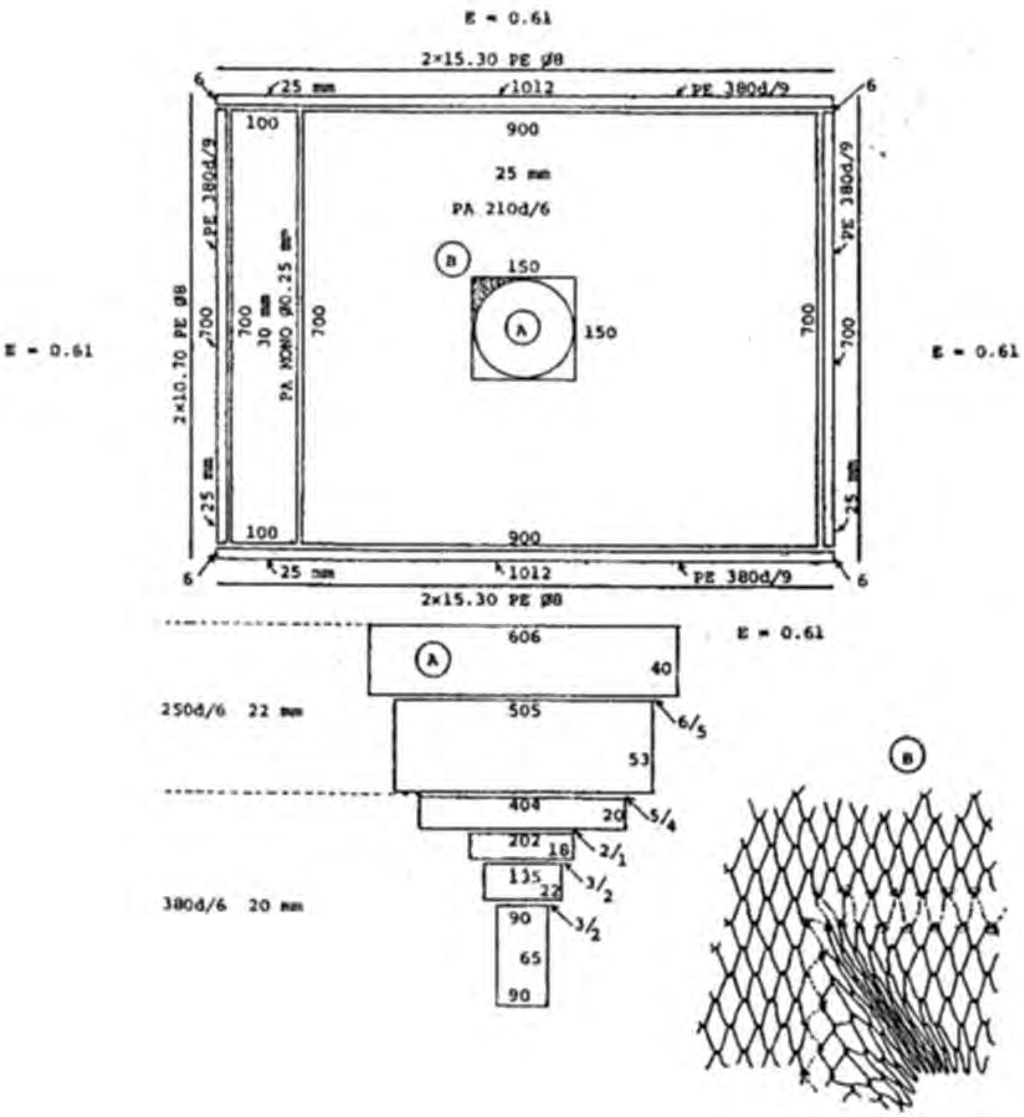
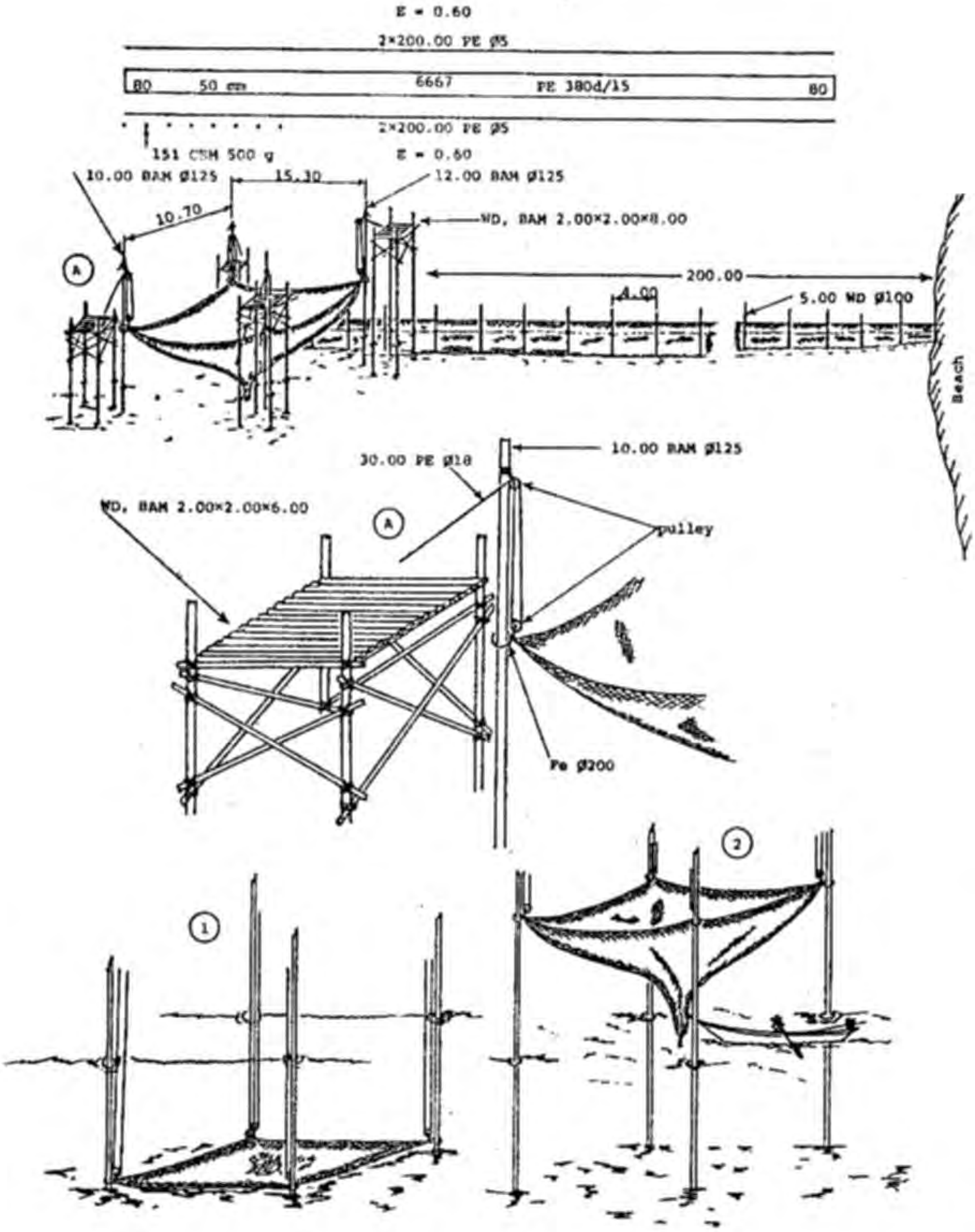
LIFTNET	VESSEL		LOCATION
Stationary Liftnet	Loa	6 m	Laem Talumphuk
Barm Pla Kabong	hp	-	Nakhon Si Thammarat

Mullet

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2×200.00 PE Ø5
80
50 mm
6667
PE 380d/15
80
2×200.00 PE Ø5
151 CSH 500 g
E = 0.60
10.00 BAM Ø125
15.30
12.00 BAM Ø125
10.70
WD, BAM 2.00×2.00×8.00
A
200.00
4.00
5.00 WD Ø100
Beach
30.00 PE Ø18
10.00 BAM Ø125
WD, BAM 2.00×2.00×6.00
A
pulley
Fe Ø200
1
2

LIFTNET

Stationary liftnet,
Barm Plakabong

Mullet

VESSEL

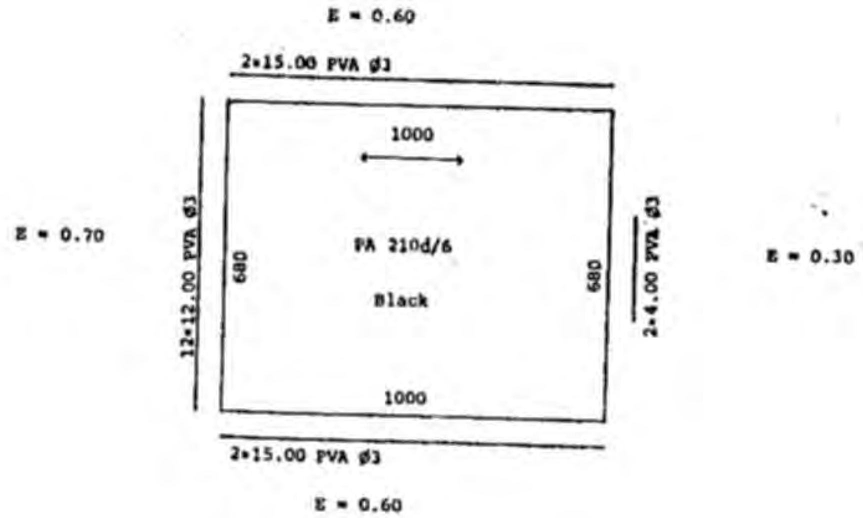
Loa 3 - 5 m

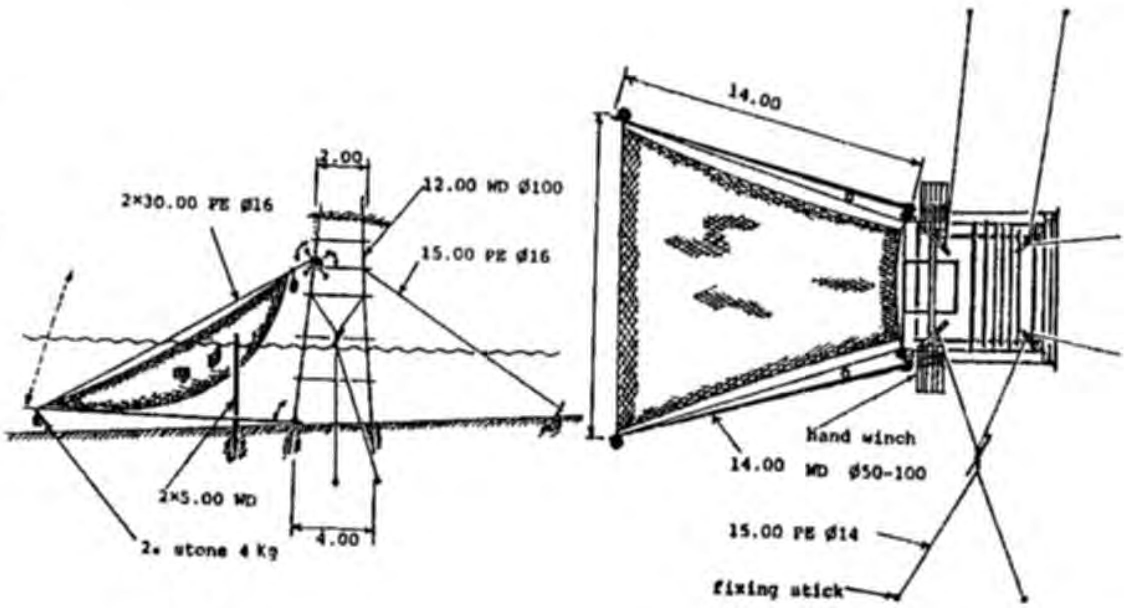
hp 3-5 LT or None

LOCATION

Laem Samihla

Songkhla





LIFTNET

Stick held dip net
Uan Yok Pla Katak

Anchovy

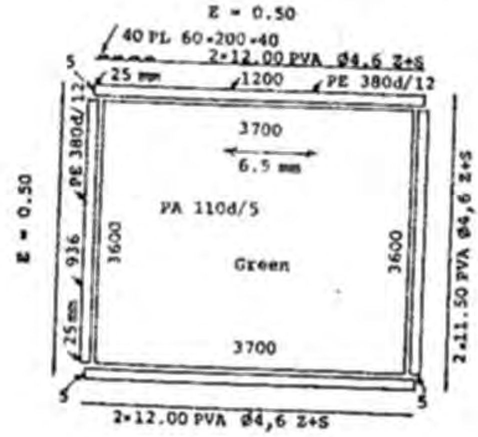
VESSEL

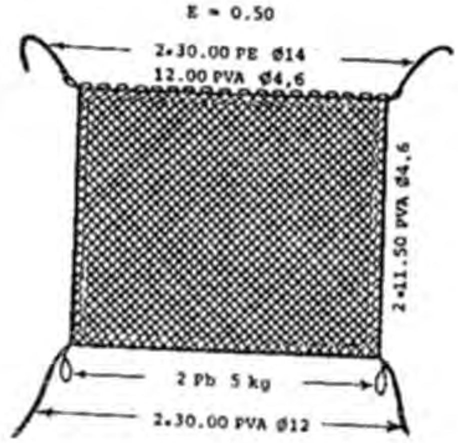
Loa	15 m
hp	75
EG	2 • 6 KVA dynamo
LL	18 • 500 W + 5 • 500 W spotlight

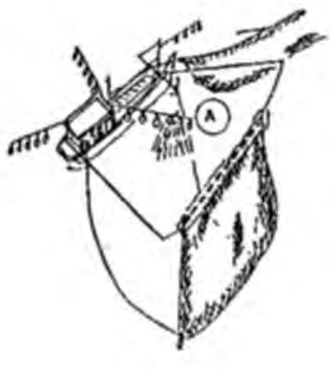
LOCATION

Banphe

Rayong







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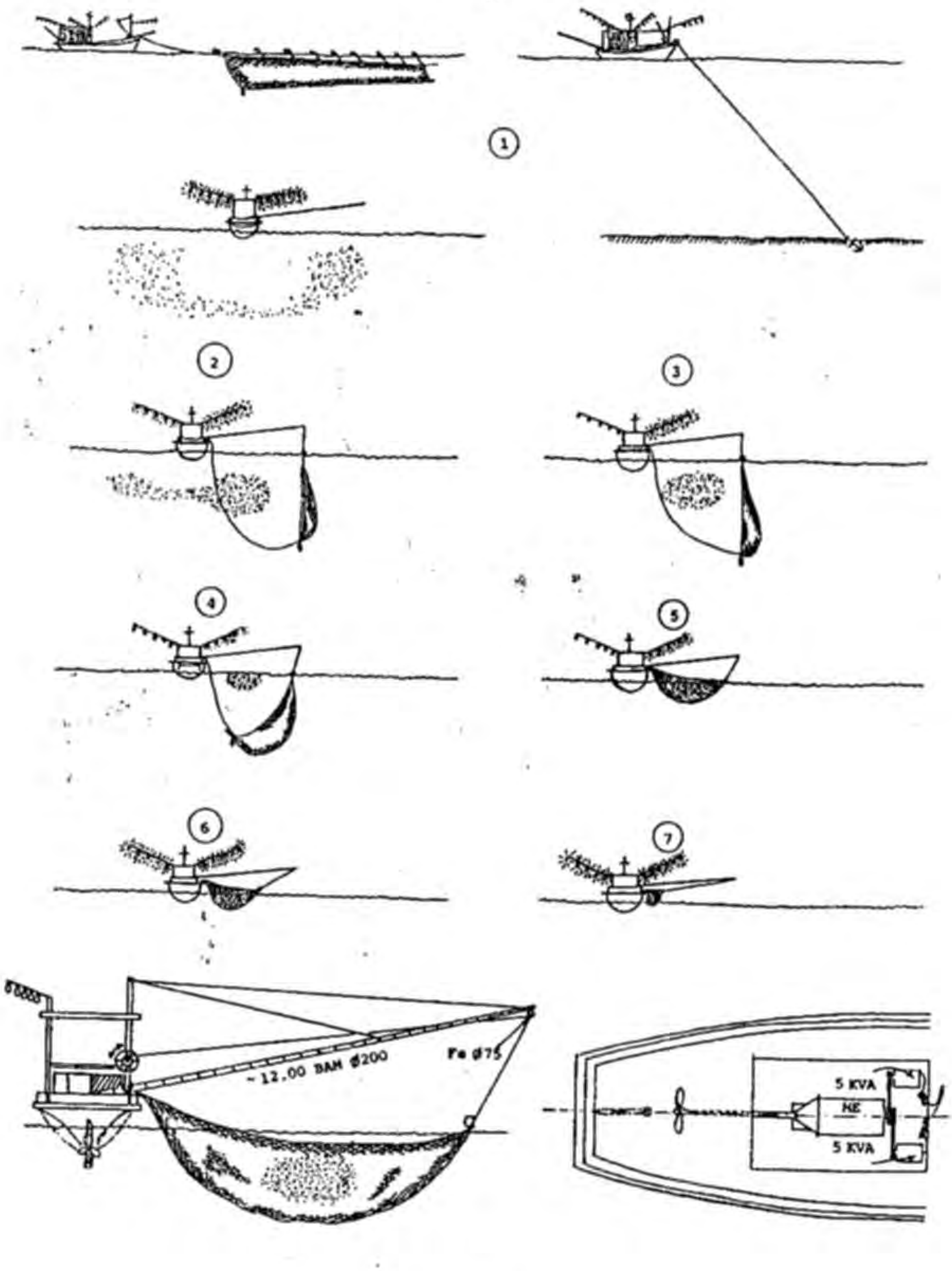

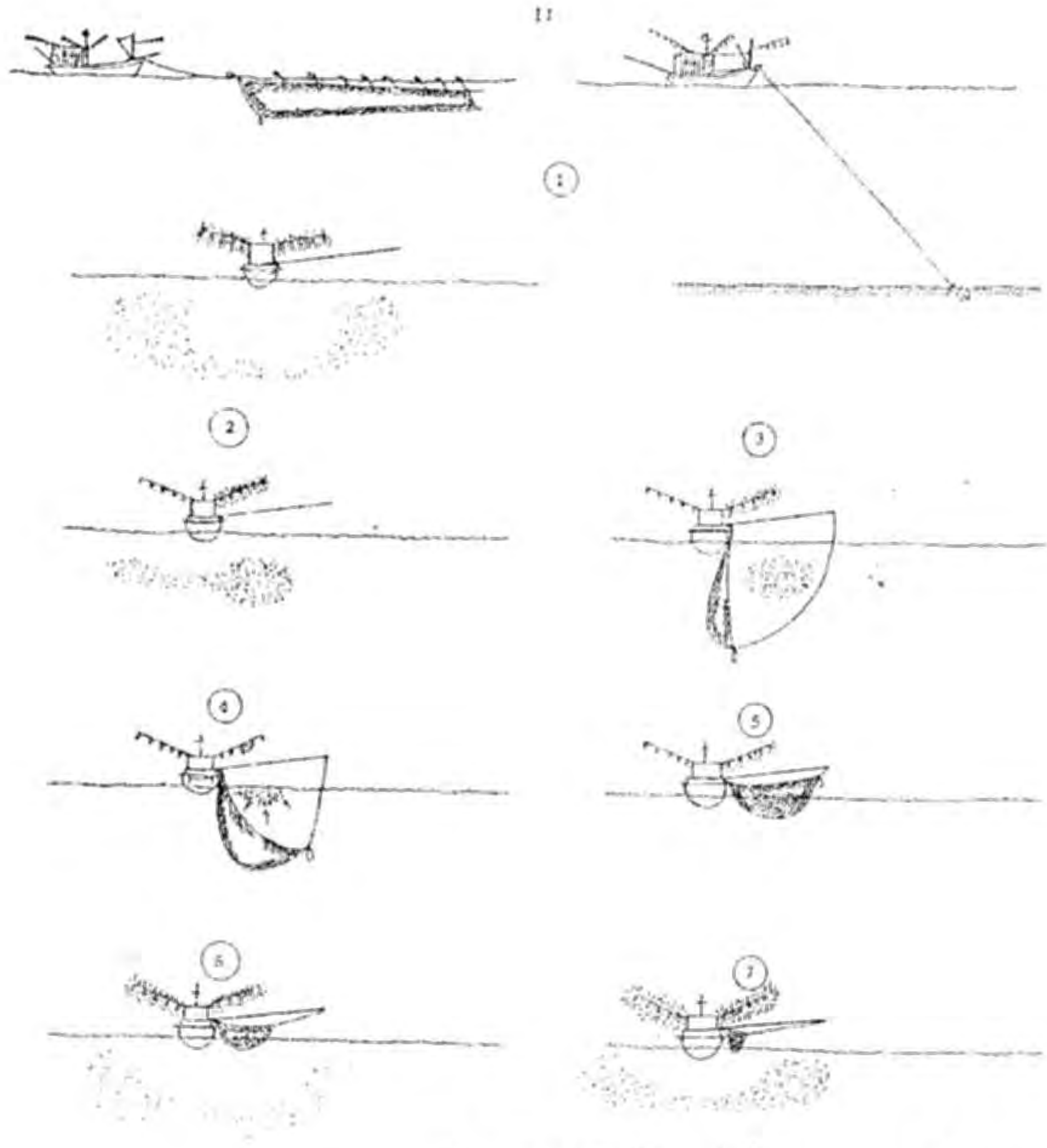
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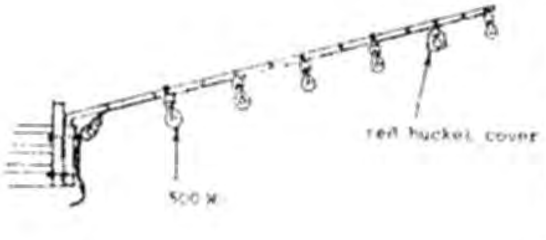
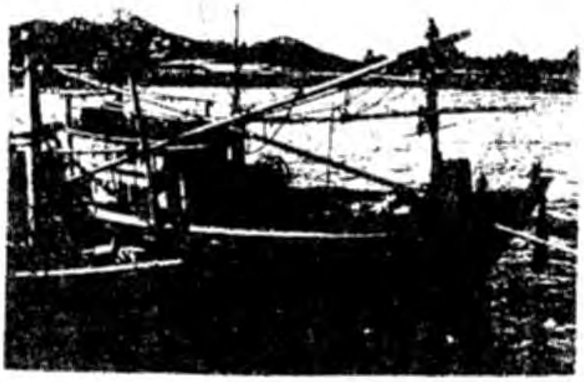
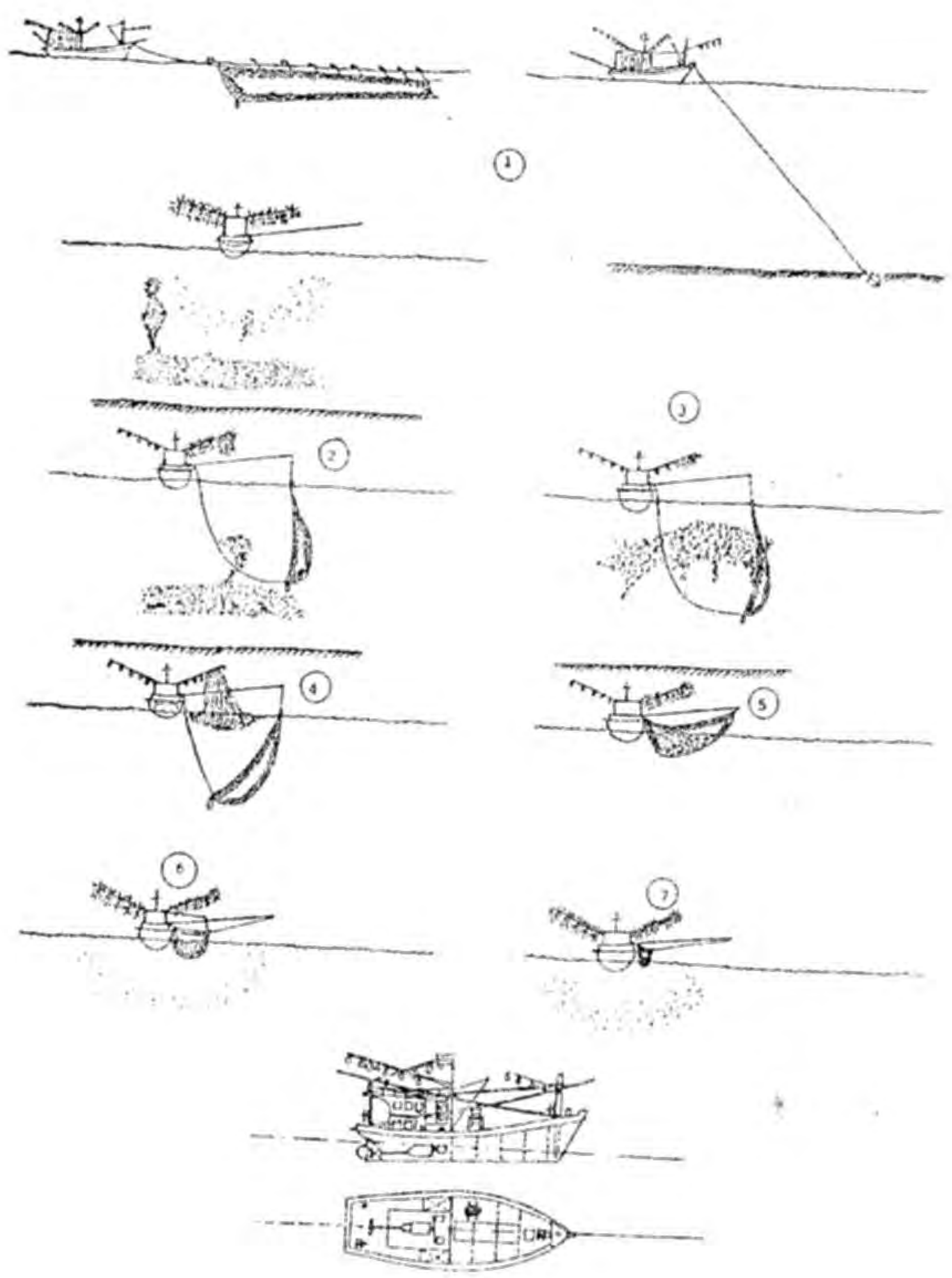

red bucket cover
500 W

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STUDY REPORT
ON

COASTAL FISHERIES MANAGEMENT IN INDIA

DR P. LAXMILATHA

REGIONAL TRAINING COURSE
IN
FISHING TECHNOLOGY AND RESOURCE CONSERVATION
1997

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER
SAMUT PRAKAN
THAILAND

CONTENTS

COASTAL FISHERIES MANAGEMENT IN INDIA

Fisheries have been of significant social and economic importance in that they provide potential benefits as food, income and employment to humankind. The total production from capture fisheries and aquaculture during the nineties has reached about 100 million tonnes and provided employment to over 12.5 million people in the fisheries sector, besides providing protein-rich food to the coastal population.

However, at present, a large proportion of the worlds' fishery stocks are fully exploited, over-exploited or depleted and many are affected by environmental degradation, particularly in the inland and coastal areas. New technological developments, such as the geographical positioning system (GPS), radar, echosounders, more powerful vessels and improved processing methods have enhanced the ability of fishers to exploit more living resources more intensively, thereby aggravating the problem. This has been compounded by the lack of initiative or the failure on part of the fisheries planners and managers in implementing and enforcing effective management of their fisheries.

The ***imperative need*** for fisheries management has been felt the world-over to adopt and implement responsible fisheries management practices to reduce, prevent and protect from the negative consequences of irresponsible fishery practices, inorder to ensure the continued productivity of resources on a sustainable level.

FISHERIES SCENARIO IN INDIA

1. COASTAL FISHERIES

1.1 Introduction

India ranks seventh in the world in fish production with an estimated annual production of about 4 million tonnes, out of which marine fish production varies from 2.2 million tonnes to 2.6 million tonnes. Marine fisheries play a significant role in India's economy contributing about 1.28% to the total GDP. The production has been increasing steadily from 0.53 million tonnes in 1951 to the present 2.7 million tonnes (1995-96), due to increase in fishing fleet, use of mechanised trawlers, diversified gears, exploratory fishing and research and development programmes of several fishery organisations such as Central Marine Fisheries Research Institute, Fishery Survey of India, Department of Ocean Development and Maritime State Governments. Export of shrimps, lobsters, frozen fish, frozen squids and cuttlefish have also increased since the sixties with the development of fish processing facilities along the coasts. The present foreign exchange earnings through exports of marine products is 296.3 thousand tonnes valued at Rs. 3501 crores.

1.2 Resources, Potential and Status of exploitation

India has a coastline of 8192 Km with a continental shelf area of 512,000 Sq. km. and 2.20 million sq. km., within the Exclusive Economic Zone (EEZ). While the continental shelf is narrower towards the south east and north west coast, it becomes wider towards the north east and north west coast. The shelf area is shallow (not exceeding 16 m) of the south east coast (Tamil Nadu) but becomes deeper off the West Bengal and Andhra coasts (between 50 and 70 m). Off the west coast, the continental shelf is wider than the east coast. The nature of the continental shelf and continental slope exerts an influence on the fishery of the east and west coasts.

About 80% of the marine fish production comes from within the 50 m depth zone and the remaining from the depth upto 200 m. Over 98% of this production is contributed by the traditional and mechanised sectors, the balance from deep sea fishing. The contribution of the west coast to total marine fish production is 70% and that from the east coast 30%.

The estimated potential of marine fish production in the Indian EEZ is about 3.92 million tonnes, of which 2.28 million tonnes lie within the 0-50 m depth, 1367 million tonnes in the 50-200 m depth, 0.028 million tonnes in the 200-500m zone and 0.246 million tonnes in the oceanic region. While the fish potential within the 0-50 m is almost exploited to MSY levels, the potential beyond 50 m depth is grossly under-exploited.

Of the total marine fish landings, about 56% is contibuted by pelagic species and 44% by demersal species. The east coast contibutes about 7.45 million tons against 17.52 million tons from the west coast. Sardines, clupeids, sciaenids, carangids, mackerals and penaeid shrimps are the most dominant groups of fish. Other important species are Bombay duck, perches, ribbonfish, anchovies, sharks,seerfish, catfish, wolf herrings, goat fish, thread fins, bill fish, mullets, lobsters crabs, squids and cuttlefish.

1.3 Management of coastal fisheries - Present status

i) Organisations involved in management

Various organisations work in cooperation with each other with the objective of increasing marine fish production.

- Ministry of Agriculture, Government of India: The nodal ministry for fisheries and aquaculture development, through the respective State Governments have issued guidelines for optimum utilization of the coastal fishery resources; for classifications, use and lease of brackishwater areas; and assistance to set up BFFDAs'.
- Ministry of Food Processing, Government of India: Offshore fishery development, joint ventures with foreign fishing vessels.
- Indian Council of Agricultural Research: research, technology development, training, extension and human resource development for capture fisheries and aquaculture through Central Marine Fisheries Research Institute, Central Institute of Brackishwater Aquaculture, Central Institute of Fiaheries Technology, and Central Institute of Fisheries Education.
- State Fisheries departments: responsible for capture fisheries and aquaculture development within the States in conformity with the policies and regulations imposed by the Government of India.
- Department of Ocean Development: developing of living and non-living resources.
- Others such as Marine Products Development Agency, Brackishwater Fish Farmers Development Agencies and financial institutions: promotion through technical and financial assistance.
- Fishery cooperatives, Fishermens' Federations and environmental conservationists.

ii) Problems in coastal fisheries (Small-scale fisheries)
The coastal fisheries of India have the typical problems of the small scale fisheries of the tropical regions. These pose several constraints on the development and management of the coastal fisheries.

a) Resource constraints
i) Multi-species fishery: The multispecies composition of the stock causes several technological and biological interactions within the fishery. A single non-discriminatory gear is difficult to be applied (eg. trawl) to a stock comprising of several species in which case it is impossible to allocate the overall fishing effort between the constituent stocks. Also, there occurs complex interactions between two or more species for the same food or prey/predator relationship. Under these circumstances, trying to maximise sustainable catch becomes a complicated task. Therefore, for multi-species fishery management, the sustainable yeild or level can be attained by summing up the individual yeild curves of the component species. As the variability in the species composition and size of stock as well as the risk of irreversible changes, tend to increase with the intensity of fishing, the fishing rates and catch levels below the aggregate MSY is to be selected since it is also the level at which the economic yeild is maximum. In multi-species fisheries management this is probably the best optimum level for sustainable levels of exploitation.

Selection of a single optimum size for capture is also difficult since the optimum size for one species may be different from that of another species. The selection of a compromise mesh size in multi-species fisheries prevents the fishery from attaining its optimum MSY. Selection of an appropriate gear and methods to control gear selectivity to enhance productivity of resource base is still a challenge to multi-species fisheries management.

ii) Resource depletion in the inshore areas: The major concern in the small scale fisheries sector is the over-exploitation or increased fishing effort within the limited near-shore areas. The traditional small-scale fishermen, due to technological and economic limitations are confined to the narrow strip of coastal waters, often within the territorial waters. The open access nature of this zone induces fierce competition among the traditional and those with mechanised crafts leading to over-exploitation and pressure on the stocks.

The targetted fishing for high value species such as shrimps by the large mechanised boats in the inshore waters also leads to the destruction of juveniles/sub-adults thereby affecting recruitment to and long-term productivity of the fishery. Also, the large-scale fishing operations offshore , affects recruitment of fish stocks towards the inshore waters. The by-catch (low value fish) from these large scale fishing operations are often discarded, again adversely affecting the productivity of stocks. The exploitation of breeders of fish (catfish) and shellfish like shrimps and cephalopods also leads to resource depletion affects recruitment o the fishery.

b) Environmental constraints:
i)Habitat destruction/ alteration: The introduction of mechanised trawlers, while enhancing production has had disastrous effects on the environment and the resources. Excessive bottom trawling has led to the destruction of habitats or alterations in the

bottom nature, thereby causing destruction of benthic organisms most of which have low or currently no edible or economic value but are vital in the food web of exploitable resource. The incessant trawling operations also lead to disproportionate destruction of non-target groups along with juveniles and sub-adults of heterogenous species of commercially important shellfish and finfish. This also affects the livelihood and employment of small-scale fishermen.

Habitat destruction also occurs due to pollution and direct activities such as mangrove clearance, coral mining etc;. This affects the productivity of the fisheries sector. For instance, the clearance of mangroves upsets the delicate ecological balance. The mangroves are the nursery grounds for many commercial species such as shrimps, crabs and finfish and directly enhance the recruitment to the fishery. Large scale clearance of mangroves leads to loss of habitat for these species causing resource depletion and decreased productivity.

ii) ***Pollution***: Pollution of coastal waters from industrial or agricultural wastes dumped into rivers and carried to the coastal areas, pesticide and fertilizer run-off into rivers and sewage or sea-based such as oil-spills and ocean dumping of toxic wastes decrease the productivity of coastal waters. It also causes severe health hazards to humans (eg. concentration of toxic metals by shellfish). Coastal pollution also occurs through oil pollution from fishing vessels, effluent from fish processing plants and aquaculture systems.

c) Technological constraints

In the small-scale fisheries sector, often the technology developed cannot be easily adopted in all locations. For instance, the beach landing crafts were found to be popular and appropriate for east coast conditions but not in the west coast, neccessitating the designing and development of plywood canoes.

Although motorization has helped the traditional fishermen to extend their areas of operation, the heavy investment on crafts, gears, fuel and maintenance of these are often limiting factors in the adoption of these technological developments.

The other technological constraints include the lack of intermediate technologies for preservation, processing of fish, lack of infrastructures for storage and transportation, which hamper the development of small-scale fisheries.

d) Socio-economic constraints:

Social conflicts: The increased fishing pressure within the inshore waters for the limited or depleting resource exerted by the traditional and mechanised sectors has led to increased conflicts regarding fishing rights, for want of proper enforcement mechanisms.

The widening imbalance in the socio-economic conditions of the traditional fishermen is aggravated by the lack of alternate employment opportunities, lack of infrastructure facilities for preservation, processing, storage and transport and low returns due to intervention of middlemen in marketing.

The low level of literacy, poverty, increasing population pressures and lack of organisation of the fishing communities are other social factors which affect the development of the small-scale fisheries sector.

iii) Management measures: Policy and Practice

In order to manage the marine fisheries, the Government of India issued certain guidelines to all the Maritime States in 1978 to formulate regulations and conservation measures for the management of marine fisheries resources. These guidelines ere mainly intended to avoid confrontations between the traditional and mechanised sectors rather than the sustainability of the resources. The guidelines were first issued in 1978 and later modified in 1980 as given below.
1) The non-mechanised artisanal crafts may be allowed to operate exclusively upto a distance of 10 km from the coast.
2) The small mechanised boats should operate beyond 10 km distance from the coast.
3) The vessels of OAL 20 m and above should operate beyond 23 km from the coast.

As per the above guidelines, all Maritime States except West Bengal, Gujarat, Andhra Pradesh and the Union Territories of Pondicherry, Lakshadweep and Daman and Diu have enacted their respective Marine Fisheries Regulation Act (MFRA).

Under the MFRA, the State Governments are empowered to take necessary measures for management and conservation of their territorial waters. The MFR Act provides for
- the registration of all fishing vessels, including non-mechanised country craft at their respective base ports
- licensing fishing vessels for fishing in specified areas
- regulation, restriction or prohibition of fishing in any area by such class or classes of fishing vessels as may be specified
- regulation or restriction of the number of fishing vessels which may be used for fishing in any specified areas
- regulation, restriction or prohibition of catching in any specified area of such species of fish and such period as may be specified.

Although the Government of India guidelines have specified areas in terms of distances from the shore, many States have taken depth as the criterion for the purpose, because the fishermen can easily measure the depth rather than the distance from the shore.

These guidelines, however are not followed resulting in occasional conflicts between the artisanal and mechanised sector, as the mechanised vessels encroach into the fishing areas specified for the artisanal sector. Also, there have been occasional conflicts between fishermen from the contiguous States over fishing rights in their territory.

Also, at present, there is no Act or Law for the regulation of fishing activities in the extra-territorial waters.

2. COASTAL AQUACULTURE

2.1 Introduction

Aquaculture in India is fast developing in a successful bioindustry. Aquaculture in the past decade has contributed immensely in augmenting fish production besides providing alternate employment to the rural population. The tremendous growth of shrimp farming led to dramatic increase in the export trade and numerous auxillary industries providing gainful employment opportunities to the rural and urban beneficiaries.

However, the rapid , aggressive and unplanned growth of aquaculture, particularly shrimp farming, is now exerting disastrous effects on the coastal fisheries and coastal environment besides socio-economic impacts.

2.2 Present status

India has extensive resources along both the west and east coasts for coastal aquaculture. The total area surveyed and identified as potential for developing coastal aquaculture is 1190900 hectares of which only 118983 hectares have been presently utilized, primarily for shrimp farming. The total production is about 70573 t (1995-96) from this farmed area. West Bengal has the largest area under culture. The average production rate is highest for Tamil Nadu (2075 kg/ha/yr) (1992-93) followed by Andhra Pradesh (1347kg/ha/yr) due to adoption of scientific farming techniques.

In scientific shrimp farming, moderate levels of inputs such as artificial feeds, aeration, water exchange are adopted to enhance production. *Penaeus monodon* and *P. indicus* are the two species used for monoculture. These scientific extensive or semi-intensive practices are followed in Andhra Pradesh and Tamil Nadu. Farms are operated by individuals or small industrial groups or hi-tech integrated aquaculture units belonging to large industrial houses. In West Bengal and Kerala, traditional extensive or semi-intensive methods are followed.

Besides shrimp farming, in recent years, interest in crab farming and molluscan aquaculture is also increasing especially after the viral outbreak in shrimp farms which led to the collapse of many shrimp farms. There is immense scope for crab fattening, edible oyster culture, mussel culture , pearl culture, ornamental fish culture and other land-based aquaculture systems. Bivalve culture, particularly edible oyster, clam, mussel and pearl oyster culture are ecofriendly and require less inputs while ornamental fish culture and crab farming have immense export potential.

2.3 Problems and impacts on the coastal fisheries

The rapid growth and concentration of shrimp farms in the Coromondal coast (i.e. the Nellore district of Andhra Pradesh and Nagai-Quaide Millethe and Thanjavur districts of Tamil Nadu) have led to several environmental and socio-economic problems, which have disastrous impacts on the coastal fisheries.

Impacts on the Environment:

-conversion of agricultural fields into shrimp farms leading to pressure on the already depleting land resources available for agriculture.

- conversion of mangrove wetlands affecting the delicate balance of the mangrove ecosystems.

- conversion of salt pans - affecting the livelihood of those dependent on salt production..

- salination of fresh water aquifers due to excessive extraction of the sub-soil water and seepage of saline water from the feeder and drainage canals of shrimp farms.

- discharge of untreated effluents from shrimp farms into estuarine creeks, backwaters and saline lagoons which are predominantly nursery grounds for a large variety of commercially important species and the consequent degradation of environmental conditions, affecting the coastal fisheries as well as aquaculture ,since, many farms rely on these systems for their water input. The untreated effluents released from these systems also deter the entry of commercially important species. Residues of antibiotics and chemicals used in the farms are also likely to reach the environment.

- dumping of shrimps, shrimp heads, shells etc. into the estuarine systems leading to pollution.

Impacts on the resource

-intensive levels of production coupled with poor management techniques have led to severe outbreaks of viral diseases, drastically impeding the sustainability of the farms . It is also unknown to what extent these viral diseases from the farms have been transmitted to the natural populations in the nursery grounds to post-larvae, juveniles and subadults which may affect the coastal fishery.

-indiscriminate collection of seed of desired species of shrimps, *P. monodon* and *P. indicus*, from nursery grounds for culture leading to destruction of shrimp seed which will affect recruitment to the fishery.

- large scale exploitation of wild spawners for shrimp hatcheries is detrimental to the coastal fishery especially *P. monodon*.

Socio-economic impacts

-conversion of agricultural lands in the coastal belt to shrimp farms causes tension among the rural population who are compelled to sell their land due to salination from adjacent shrimp farms thereby depriving them of their source of income / livelihood.

-development of infrastucture for hatcheries farms affect free accessibility of the fishermen to transport of fishing materials, equipment, fish and marketing and drying of fish.

2.4 Management measures - Present status

Shrimp farming, a rapidly developing industry with enormous socio-economic benefits was poised for rapid growth. However, intensive scales of operations without regulatory measures led to drastic collapse of the shrimp farming sector besides causing drastic impacts on the environment and raising socio-economic issues. The urgent need has been felt for regulatory and management measures for promoting sustainable aquaculture practices and coastal fisheries development

The Ministry of Environment, Forest and Wildlife, Government of India, promulgated an Act in 1986 which was modified in September 1990. As per these guidelines, the coastal stretches of sea, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in the landward side upto 500 m from the High Tide Line (HTL) and the Low Tide Level (Spring Tide) are declared as Coastal Regulation Zones. This Zonation applies to rivers, creeks and backwaters as modified on a case by case basis for reasons to be recorded while preparing the Coastal Zone Management plans. However, this distance should not be less than 100 m or the width of the creek, river or backwater, whichever is less.

The following restrictions are imposed in setting up and expansion of industries.
1) Industries directly related to water front or directly feeding foreshore facilities, hactcheries and natural fish drying in permitted areas and facilities required for discharge of treated effluents into the water course are exempted.
2) discharge of untreated wastes and efluent from industries prohibited. Existing industries must implement these regulations within three years.
3) Harvesting or drawal of groundwater construction of mechanisms thereon within 200 m of HTL prohibited; in 200 to 500 m zone, it shall be permitted only for manual use for fisheries.
4) Areas that are ecologically sensitive and important such as national parks, marine parks, sanctuaries, reserve forests, mangroves, coral reefs, areas close to breeding and spawing grounds of fish and other marine life, areas rich in genetic diversity and such other areas as may be declared by the Central Government and the concerned authorities at the State / Union Territory level from time to time are prohibited for any industrial activity.

The State Governments have been required to prepare regulations within one year of the notification., Government of Andhra Pradesh and Tamil Nadu are to shortly issue specific regulations on Coastal Aquaculture and Coastal Zone Development.

The Ministry of Environment and Forests and the Government of States and Union Territories and other designated authorities shall monitor and enforce these provisions.

A very recent ruling by the Supreme Court of India to dismantle aquaculture installations within 500 m of the shoreline has awakened all concerned in the fisheries sector (fisheries scientists, fisheries managers, planners, entrepreneurs, farmers, extension workers) to identify and specifically spell out the provisions for developing aquaculture on a sustainable path, with due consideration to environment and the rural community.

3. FUTURE STRATEGIES FOR RESPONSIBLE FISHERIES FOR SUSTAINABLE DEVELOPMENT OF COASTAL FISHERIES

Marine fisheries depends on the coastal area in many ways. Capture fisheries are often based on the coastal fish stocks which in turn are dependent on the primary productivity in the coastal area as an important part of the food chain. Coastal aquaculture is also heavily dependent on the coastal area for space and resources. This dependency of the marine fisheries sector (Capture and coastal fisheries) on the coastal area makes it susceptible to activities which result in coastal environmental change which have major impacts on the fisheries sector. In turn the fisheries sector can affect other coastal activities through competition for space. Therefore, it is necessary to adopt an ***integrated coastal area mangement (ICM)*** and development plan for the protection of the resources, the environment and the activities of the coastal area.

A comprehensive program to attain an ecologically balanced utilization of marine resources as a basic strategy for long-term sustainable development in the fisheries would have the following objectives: 1) regeneration and conservation of aquatic resources with emphasis on balancing fishing effort to MSY. 2) rehabilitation and protection of the coastal environment . 3) alleviation of poverty among coastal population through diversification of sources of livelihood. 4) intensification of aquaculture production but within sustainable levels. 5) diversification of commercial fisheries including processing and marketing .

The ***Integrated Coastal Area Management*** Programme as postulated by GESAMP (1994) will have the primary goal of improving the quality of life of the communities that depend on the coastal resources while maintaining the biological diversity and productivity of the coastal ecosystems. The ***Code of Conduct for Responsible Fisheries*** outlined by FAO (1995) will serve as guiding principles in the designing and implementation of the ICM programme.

The simplified sequence of steps in the ICM process are as follows:
1) Issue identification and assessment: The initial requirements of the ICM process are defined and assessed. In this step, information regarding environmental, social and institutional aspects are compiled, integrated and prioritized.
2) Programme preparation: In this stage, different options for action are evaluated through a protracted consultative and planning process. The planning process is complex and may continue for several years and involving large numbers of people. The best approach may be to generate and test a variety of strategies to develop the most appropriate option.
3) Formal adoption and funding: This step is very critical , requiring a high-level administrative decision. Often, this process may change drastically from a technical to political process. Also factors such as cost reduction and interests of agencies involved in the project may affect the securing of funds.
4) Implementation: In this stage of the ICM process, the management plan becomes operational. The emphasis shifts to introduction of new forms of resource development and use, new institutional arrangements, monitoring systems, regulations etc..
During this stage of implementation, unforeseen challenges may develop and the ICM team must be able to respond to them. Priority areas include conflict resolution, inter-agency coordination, infrastructure development, education, training and research.
5) Evaluation: This last step is very critical to the continuation of the ICM process. It should provide the indicators to successful implementation as well as the baseline for design and focus of activities for the next cycle of the ICM process.

The ***strategies*** to be adopted in the ICM process for the sustainable development of the fisheries sector in the Indian context are outlined in Table 1.

Table 1 : Strategies for sustainable development through the ICM process.

KEY ISSUES	STRATEGIES
A. INSTITUTIONAL FRAMEWORK	1) Establish appropriate policy, legal, institutional frameworks and infrastructures for the integrated management of coastal areas. 2) Establish range of policies for ICMand identify and delegate roles and responsibilities of different agencies for effective coordination and implementation. 3) Establish adequate legislative measures for e1ffective implementation and enforcement of the ICM programme. 4) Improve awareness in all areas of the ICM process among all the participants/beneficiaries involved viz; policy makers, planners, managers, scientists, extension / development workers, enforcement agents and the general public. 5) Adopt a participatory approach in the planning and implementing process by involving the communities / beneficiaries concerned.
B. COASTAL FISHERIES	1) Physical parameters: Mapping of all coastal features, analyse problems and opportunities for shore use and prepare zone use plans. 2) Biological: Assessment of biodiversity, identification of stocks resource potential, exploitation levels, pollution levels, habitats /ecosystems. 3) Socio-economic: Assess population density, employment and unemployment levels, income levels, regional GDP, barriers to alternate occupation, exit from main occupation, resource allocation systems, social

KEY ISSUES	STRATEGIES
	conflicts, subsidies in different sectors. 4) Technological: Assess state of art of technologies available in different sectors, technological input requirements and identify research inputs and develop new appropriate, low-cost and ecofriendly technologies .
3. COASTAL AQUACULTURE	1) Assess present state of art of technologies, areas under culture, impacts on the environment and resource. 2) Assess capacities of production systems, resource use, employment potential or displacement factors and develop total information base on aquaculture. 3) Develop new sustainable technologies which are ecofriendly, low cost and appropriate to particular situations and locations. 4) Diversify culture techniques to include more species and diverse production dystems, especially endangered species to protect/enhance/rehabilitate these stocks to conserve genetic diversity.
D. ENVIRONMENT-AL PROTECTION	1) Design and implement environment impact assessment programmes to focus on effect of technology and unsustainable practices on the environment. 2) Develop adequate infrastructure facilities to monitor, evaluate and control environmental degradation and pollution. 3) Develop an integrated program to generate baseline data on environment aspects to set standards for monitoring and evaluation.

4. CONCLUSIONS

The integrated coastal management programme, is a dynamic process and the success of the programme will depend upon the continuous feedbacks among the various stages of the process to bring about the necessary adaptations for the subsequent stages. In view of the multiple use of the coastal resources, this **holistic Bio- Socio-Economic** approach is the logical basis for conservation and management and development of the coastal fisheries.

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STUDY REPORT

On

ROUND COLLAPSIBLE CRAB TRAP IN SARAWAK (MALAYSIA)

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Regional Training Course

In

Fishing Technology And Resource Conservation

(16th June - 15th December, 1997)

Training Department,

Southeast Asian Fisheries Development Center,

BANGKOK, THAILAND.

ROUND COLLAPSIBLE CRAB TRAP IN SARAWAK

(MALAYSIA)

1. Introduction.

Round collapsible crab trap has been introduced in Sarawak since 1992. It is classified as the tradisional smale-scale fishing gear and widely used near the mangrove and nipah area. Nowadays this type of crab trap is very well-known and popular among the crab-catchers in the region.

2. Construction.

2.1 *Material needed*

a. Netting PE 45 mm. 380 d/6 66 # x 27#

b. Galvanise wire (diameter 4-5) 165 cm. x 2 pieces

c. Trap stands (Galvanise wire diameter 4-5) 32 cm. x 4 pieces

d. Rope 600 cm.

e. Twine PE 700 d/4

f. Net needle

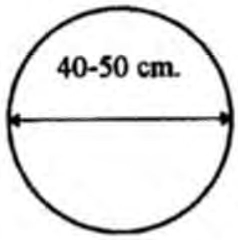
g. Vise

h. Hammer

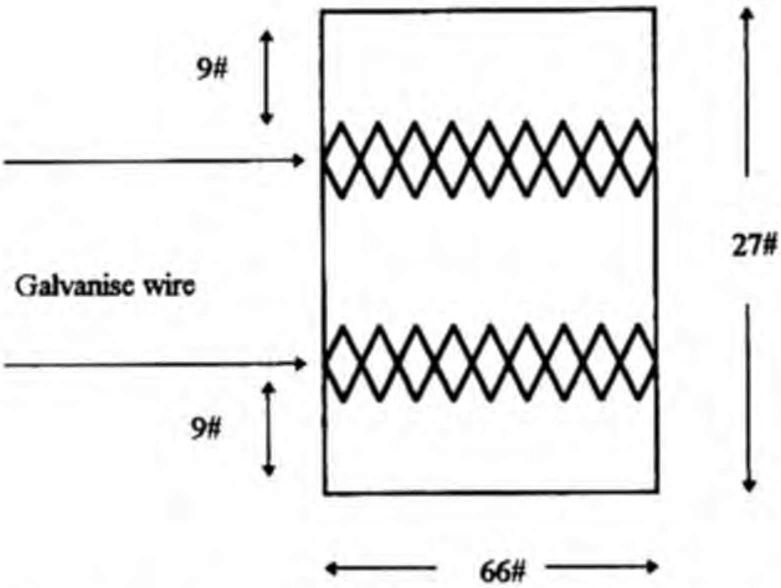
I. Floats

j. Net entrance PE 45 mm. 380 d/6 6 # x 24 #

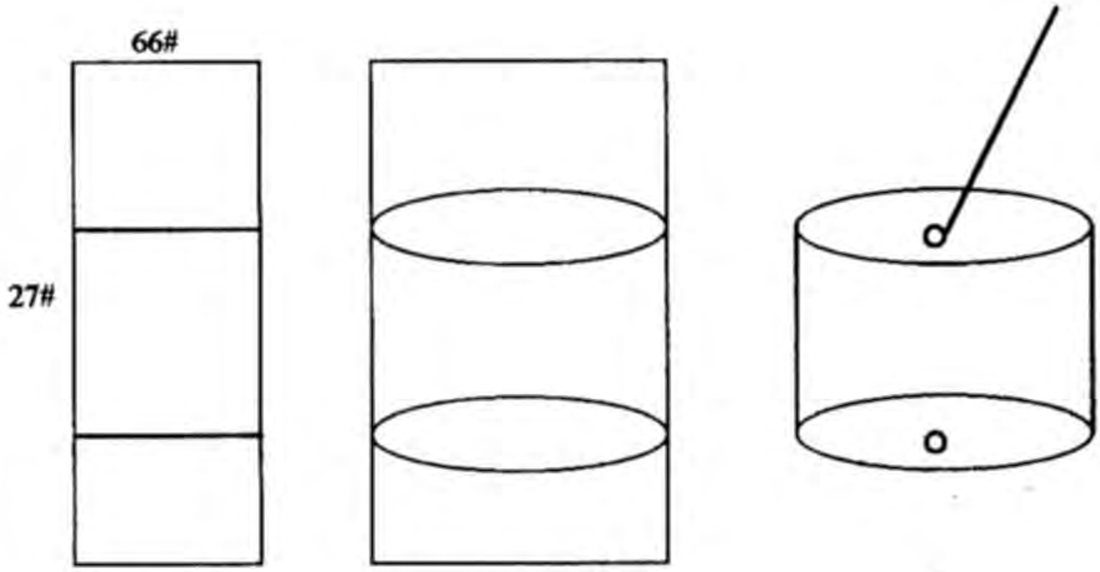
3. The making of the crab trap



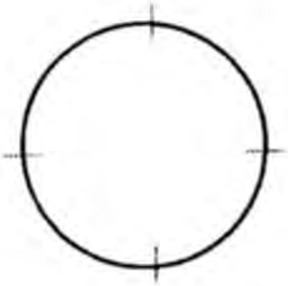
3.1 The two galvanise wires (length 165 cm) should be bent slowly and gently for a round circle (40-50 cm) by using the hammer and vise.One of it is for the upper frame and the other part is for the bottom frame. foundation).

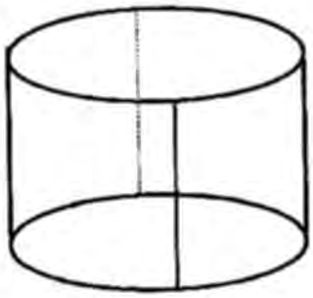


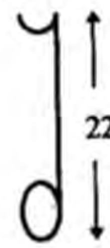
3.2 The upper frame will be inserted at the 9th meshes of the netting from the upper level and the lower frame at the 9th meshes of the netting at the lower level.



The rope will be inserted at the upper net (the first mesh) for the float and it will be the main door / entrance to collect the catch and to fix the bait. Meanwhile the lower or the bottom net will be tied permanently.







Four pieces of 22 cm length of galvanise wires will be the stands for the trap.They will be attached around the trap and the lower parts will be fixed permanently.The upper parts will be the hanger for the upper frame.

4. Boat

Since the gear is popularly operated by the smale-scale fisherman, they used smale boat powered by 4 - 5 HP out-boat engine. But some fisherman or crab-catchers are operating them by rowing boat or walking along the river bank, inside the mangrove and nipah area (during low tide).

5. Operation area.

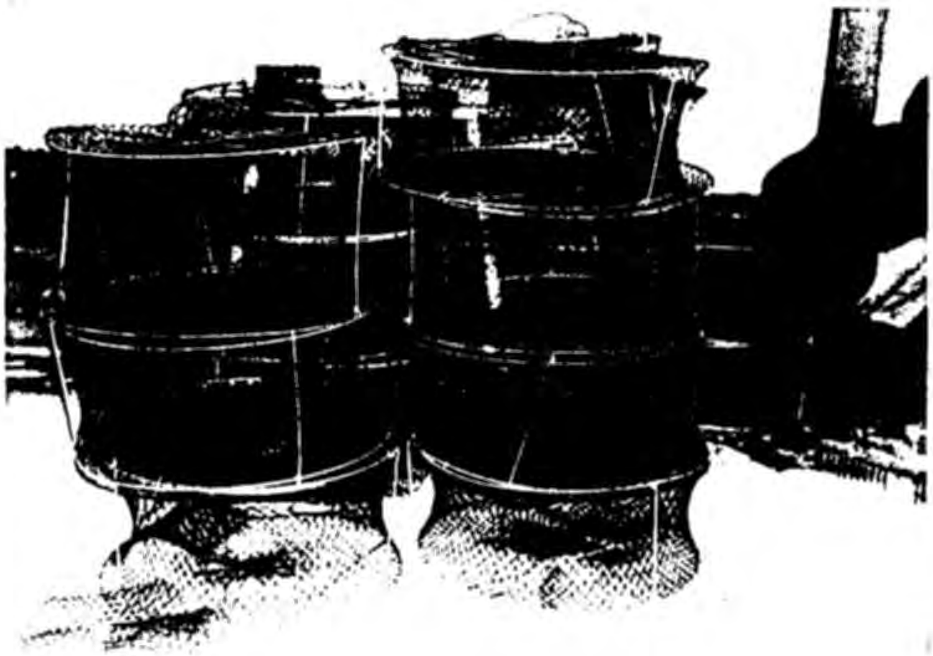
The potencial area are near the river bank , mangrove trees and nipah area.A fisherman normally operates 50 -60 units of the trap and they will leave them in the water for 1 - 2 hours before hauling.

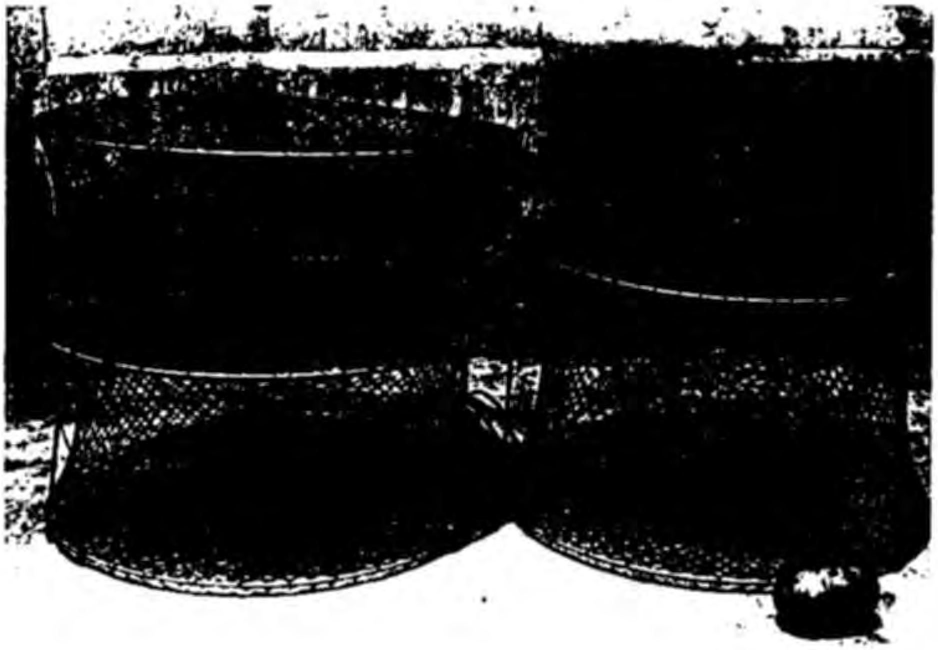
6. Target catch

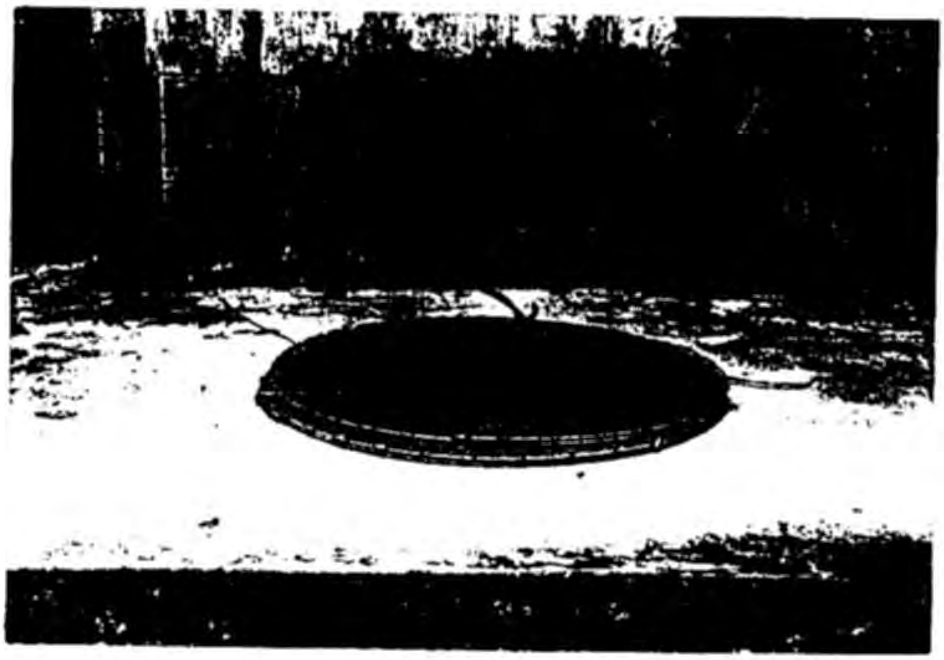
Mostly the target catch are mangrove crab and blue swimming crab. But sometimes, they can catch the fish and prawn.Catching crabs is done in the day time especially before the high tide.

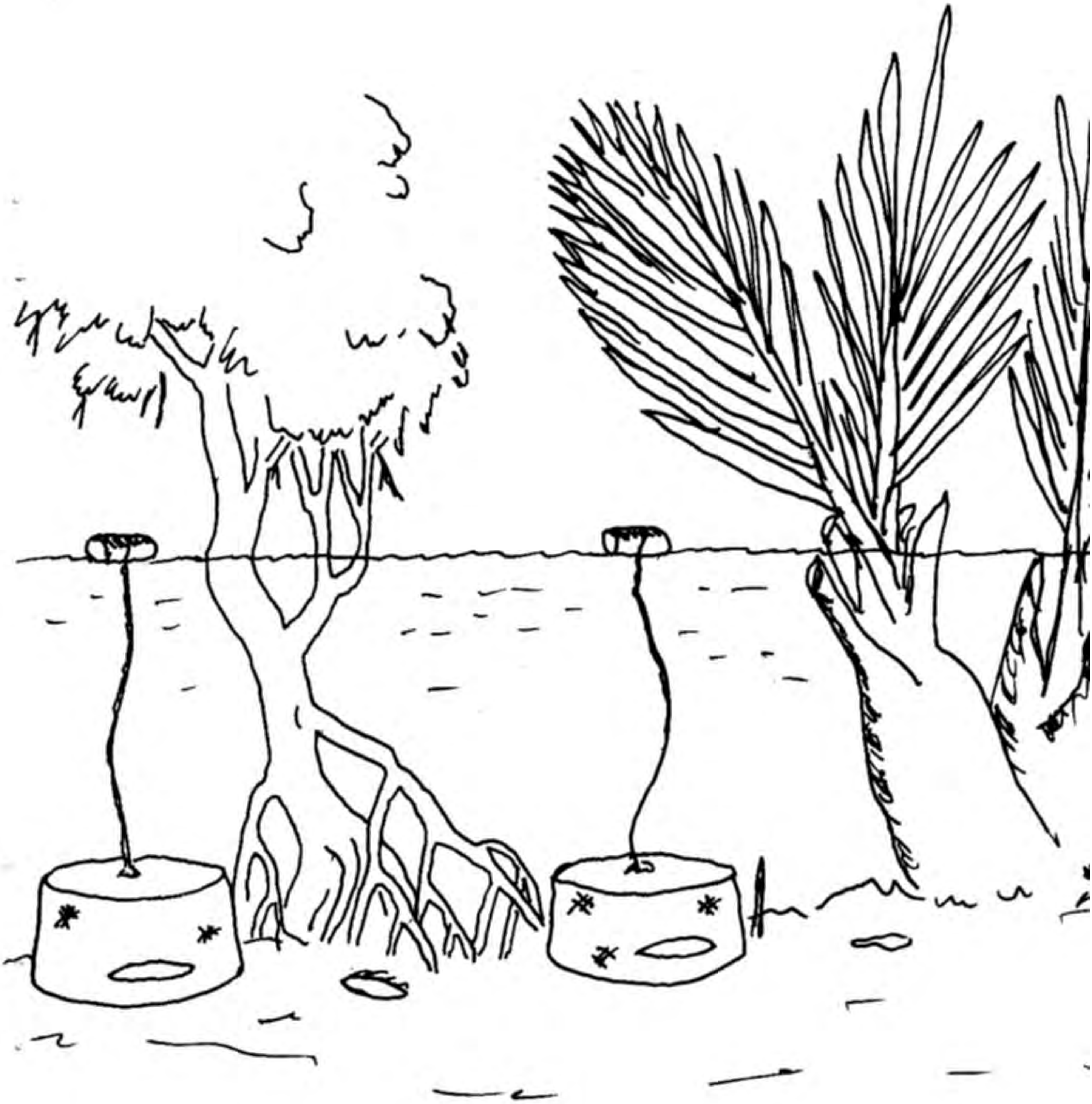
7. Conclusion

The round collapsible crab traps are handy and economical for the smale-scale fisherman.They can beneficial their income and the family.Furthermore this gear can be operated throughout the year.









Study Report
on

TRAWL FISHING IN VIET NAM

By

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The Regional Training Course on Fishing Technology
and Resource Conservation
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1.0. Introduction.

VIET NAM has 3200 km of coastline stretching from latitude 8 [illegible] N to 21 50 N and EEZ (exclusive Economic Zone) over 1 million sq. km. Annual catch are over 1 million metric Tons. Due to difference from climate and terrain of each zones, so distribution of marine species is also influenced. VIET NAM sea is divided into 3 major zones.

1.1 Gulf of Tonkin :

Limitation is from Latitude 17 00 N to 21 [illegible] N. Area [illegible] sq. km. Affected frequently by the tropical storms.

There are many larger river mouths such as : Hong river (Red r.), Ma river (Horse r.) and Ca river. And over [illegible] islands.

The plane sea bottom is formed by mud, sand and shell. Average depth 40 m, maximum depth [illegible]

Fish stock : 273.204 tonnes (including 234.[illegible] tonnes of pelagic fish and 39.000 tonnes of demersal fish). The allowable exploitation 109.282 tonnes.

Numbers of fishing boats [illegible] units ([illegible] trawlers with 200-250 HP).

The trawl fishing has not developed strongly [illegible] to the low demersal fish stock ([illegible] of total stock.

1.2 The Center Area :

Limitation is from Latitude [illegible] N to [illegible] N. Area [illegible] sq. km. This zone is also effected by annual storms.

There are not large river mouths [illegible] Gulf of Tonkin. The rough sea bed consists of coral and rocky [illegible]. Average depth [illegible] m, maximum depth [illegible] m.

Number of fishing boats [illegible] units corresponding [illegible] HP ([illegible] trawlers).

Fish stock : [illegible] tonnes [illegible] pelagic fish [illegible] tonnes [illegible] demersal fish [illegible] tonnes.

The present situation of this zone is over exploitation due to too many trawlers but too little stock of demersal fish

1.3 The Southern Waters :

Limitation is from Latitude 5 00 N to 11 00N Longitude 103 00E to 104 00 E Area 337.000 sq km

Some large river mouths such as Mekong river , Dong nai river The plane sea bed is formed by mud and sand . Average depth 40 m , maximum depth : 80 m

Fish stock . 1.728.977 tonnes (The pelagic fish : 840.000 tonnes . the demersal fish . 888.977 tonnes) The allowable exploitation 412.000 tonnes (Demersal) 386 000 tonnes (Pelagic)

Numbers of fishing boats 1.7680 units approximately 400 000 HP (including 834 units with 100 - 500 HP)

This zone is still in under exploitation situation . .

2 0 Classification of trawl net and its structure :

2.1 Classification based on operation principle :

2.1.1 <u>The Bottom beam trawl :</u> The beam trawl which uses a beam to spread the netting It is made of iron . at each end is supported by steel shoes to be able to slip on the sea bed .

2.1.2 <u>The bottom otter trawl :</u> Using a otter board at each end of sweep line to spread the netting Both sweep lines are towed by one boat

2.1.3 <u>The bottom pair trawl</u> The netting is spread by dragging of 2 boats without using boards .

2.2 Classification based on the target species :

They are divided into 2 kinds The bottom shrimp trawl net and the bottom fish trawl net

2.3 Structure of the trawl net :

The trawl net is a large bag made of netting which is dragging along the sea bed to catch some marine species living on or near the bottom .It consists of the main parts such as Upper part . is larger than the lower part because of creating an overhang of the netting - the square . The square is designed to

prevent escape of the fish upward. The upper part consists of 2 upper wings, square, baiting, upper panel of the lengthener and the upper pannel of the cod-end.
Lower part : consists of 2 lower wings, belly, lower panel of the lengthener and the cod-end.
Head rope : is made of iron which is covered by the smaller polyethylene (PE) or polyamid (PA) rope which run around the upper edge of the mouth. Along the head rope is attached with numbers of floats.
Ground rope : is also made of iron covered by PE or PA rope. Diameter of the ground rope is always bigger than the head rope's. The ground rope is attached around the lower edge of the mouth which is weighted in attaching lead or chain. Depending on the sea bed condition which it is rigged the wooden or rubber rollers to prevent damage of the net when operating (figure 1 . 2 3)

3.0 Trawler and her equipment :

The structure of trawler depends on its operation principle which can be divided into 2 major categories :

3.1 The bottom pair trawler : This kind is used widely in Viet Nam due to its high efficiency. Two boats with the low horse power can be used to tow each warp without otter board. And a larger net can be used which it is impossible for the otter trawler .And the fishing operation is more simple.
Most trawlers are made of wood with Loa : 14 - 24 m (Normally, the length of main boat is longer than the extra boat), main engine power : 30 - 350 HP (Engine power of the main boat is also more powerful than the extra boat)
Gross tonnage : 15 - 60 tons. The cruise duration from 1 day to 30 days.
Her equipment consists of A- shaped crane, capstan winch, pulley, iron roller, GPS navigator, echo sounder, radio transceiver (short distance and long distance), etc. (figure 4)

3.2 The bottom otter trawler : This kind is not very popular because it is not quietly simple as the pair trawler. To gain high efficiency, it asks for the fishermen must have good skills in making design and fishing operation .Most of the otter trawlers are distributed mainly in the Gulf of Tonkin and Southern Waters. Most of them are also made of wood

Loa : 10 - 26 m Main engine power 10 - 500 HP . Gross tonnage 5-
-80 tons The cruise duration . 1 day to 25 days Her equipment consists of boards gallows , pulley . capstan winch , boom crane echo sounder . GPS . radio transceiver . etc.. (see figure 5) .

4.0 Target species . fishing seasons and fishing grounds :

4.1 Target species : The target species caught by the bottom trawler mostly the demersal fishes and shellfish such as :threadfin bream . spotted lizard fish . silver pomfret , snapper . grouper . red bigeye . mackerel . cuttle fish squid shrimp . lobster . crap . non-penaeid prawn etc

4.2 Fishing seasons and fishing grounds :

* Gulf of Tonkin : The climate in this Gulf is not so good due to annual typhoons and rainstorms in summer and autumn And in Winter . North-East wind also makes trouble for fishing operation .

Fishing season : From April to October and November to march Numbers of fishing days per year are 220 - 240 days

Fishing ground From 21m deep to 70m deep for fish trawl And from 5 m to 21 m for the shrimp trawl.

* The Center Area : The climate is also similar to Gulf of Tonkin

Fishing season : April to October and November to march

Fishing ground Over 50 m for fish trawl and less than 50 m for the shrimp trawl

* The Southern Waters : The climate is suitable for fishing operation .

Fishing season The whole year

Fishing ground 20 m to 80 m for fish trawl and 5 m to 20 m for shrimp trawl

5.0 Fishing operation

Due to difference of structure and operation principle . so fishing operation of this gear also divided into 2 groups :

5.1 the bottom pair trawl :

* Shooting method : The main boat (I) which keeps the net and catch throw the net into the sea and tow it until it is stretched . The extra boat (II) approaches in a safe distance , the messenger line is thrown to transfer one wing of the net . The sweep line are then connected to each net wing by an iron swivel . And both boats will then move ahead together with the length of the sweep lines and the warps which depend on the depth of fishing ground and sea condition . Normally , ratio of the warp length to water depth : 6 or 8 m : 1m . Towing speed : 2 to 3.5 knots .

* Hauling method : When hauling time begins (Normally, from 2 - 3.5 hours) , both boats stop and turn award the net , and haul on their warps through a iron roller on the gallows at the bow until one end of the net wing reaches the gallows . These sweep line is disconnected and the messenger line will be thrown to the main boat to return the net wing . The cod-end is hauled on board by capstan winch passing through a pulley on the A- shaped crane and hung to escape the catch . (figure 6 .7)

5.2 Bottom otter trawl

* Shooting method : The boat moves slowly along the desired course , the cod-end and the sweep lines are cast . The end of the sweep line is tied at 2 columns astern , and the boat then run faster in order to stretch the netting as when working . After that the boat reduces its speed and the otter boards will be unhooked from the gallows and dropped into the water with a small part of warps , and wait until the board spread properly under the water surface . Release of the warps will be carried out . The length of warps also depend on the depth and sea condition of the fishing ground (Ratio of the warp length to water depth : 6 or 8 m : 1 m) . Towing speed : 2 - 3.5 knots . Towing time : 2 - 4 hours .

* Hauling method : The boat stops and warps are hauled through a pulley on the gallows , the otter boards are pull up and hung on the gallows . The sweep lines will be released and transferred to the fore deck . They are then hove on board by capstan winch passing through a pulley on the boom crane until the co-end are hung and emptied . (figure 8 .9)

6.0 Conclusion

The trawl is an important fishing gear in the commercial fisheries whose catch is approximately 40 % of the total catch . Especially , in the South Waters 60 % of the total catch is contributed by trawl .

Additionally . We should plan development of trawling for each separate zone in order to conserve marine resources to zones overexploited such as the Middle Area and Gulf of Tonkin . On the other hand , We should also increase exploitation of resources still being in underexploitation such as the Southern Waters by investing capital and technology to fishery companies , cooperatives and private individual or cooperation in fishing with foreign countries which have more modern facilities and technology

Apart from these , to conserve the marine resources for the future and avoid catching the juveniles of both target species and non-target species , it is necessary to apply new methods and technology for trawl fishing as many countries have already used devices called " Square mesh " , " Grid " or " By-catch Excluder " , " TED ", etc which is attached to the head of cod-end in order to escape the by-catch. And we should also reinforce the methods of fisheries management not only for trawl but also for the other fishing gears by restriction on gears , closed seasons , closed areas , limits on the sizes or conditions of fish , or control on the amount of fishing (limitation on the number of boats and number of fishing by each boat) , etc.

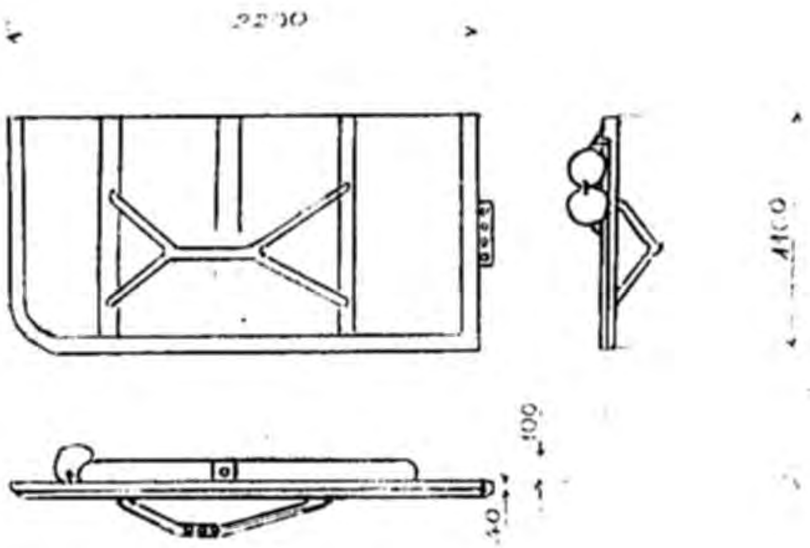


FIGURE 2 : OTTER BOARD

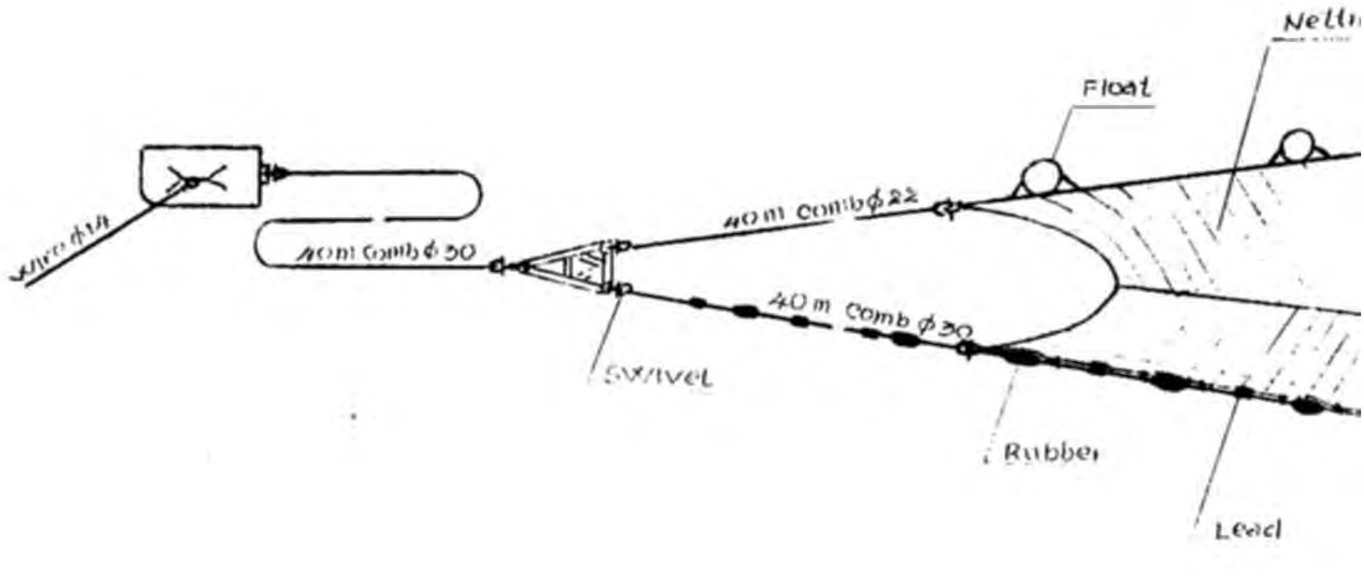
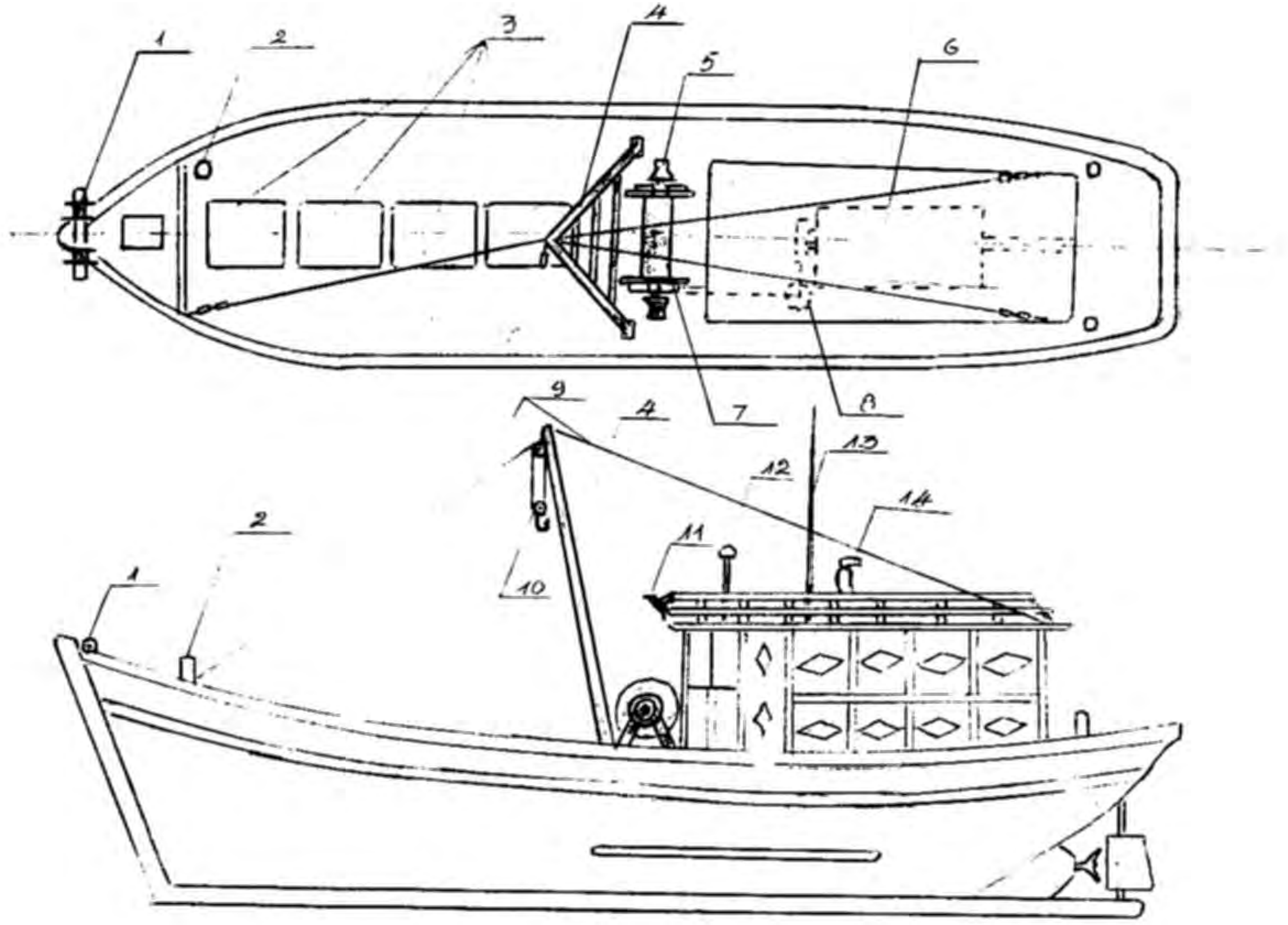


FIGURE 3 : RIGGING OF A NET WING END



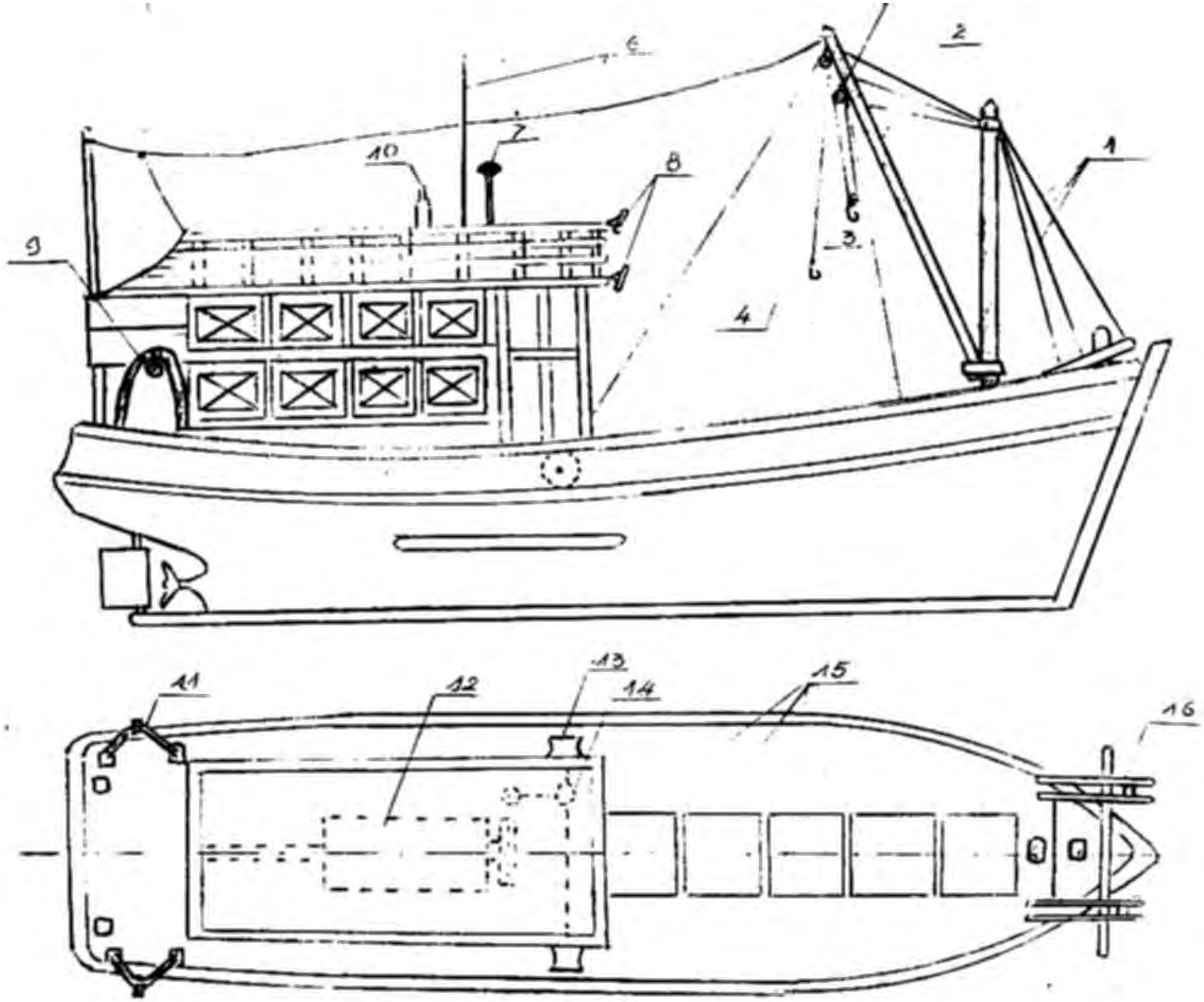
1 – warp heuling roller
2 – pulley
3 – fish hold.
4 – A - shapeel crane

5 – Capstan winch
6 – Main engine.
7 – Reel drum
8 – vehicle rear a lex

9 – Iron wire.
10 – Fish tackle
11 – GPS Antena
12 – Transceiver antenna

13 – Fishing lamp
14 – Chimney

FIGURE 4 : BOTTOM PAIR TRAWLER .



1 - Fore stay
2 - Boom crane
3 - Fish tackle
4 - Net [illegible]
5 - Pulley
6 - Antena of transceiver
7 - GPS Antena
8 - Fishing lamp
9 - Towing warp block
10 - Chimney
11 - Gallows
12 - Main engine
13 - Capstan winch
14 - Net [illegible]
15 - Fish hold
16 - [illegible]

FIGURE 5. OTTER TRAWLER

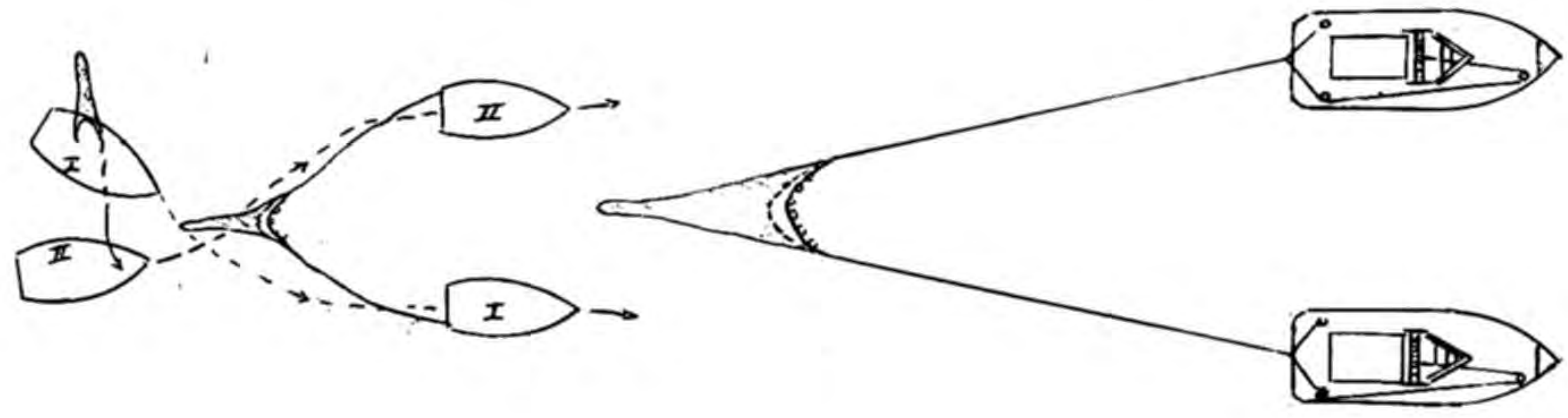


FIGURE 6 SHOOTING OPERATION OF PAIR TRAWLER

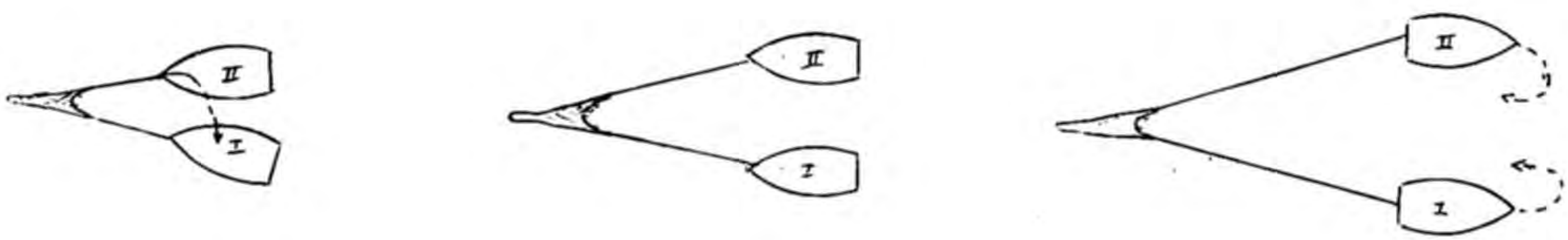


FIGURE 7 HAULING OPERATION OF PAIR TRAWLER

FIGURE 8 : SHOOTING OPERATION OF OTTER TRAWLER

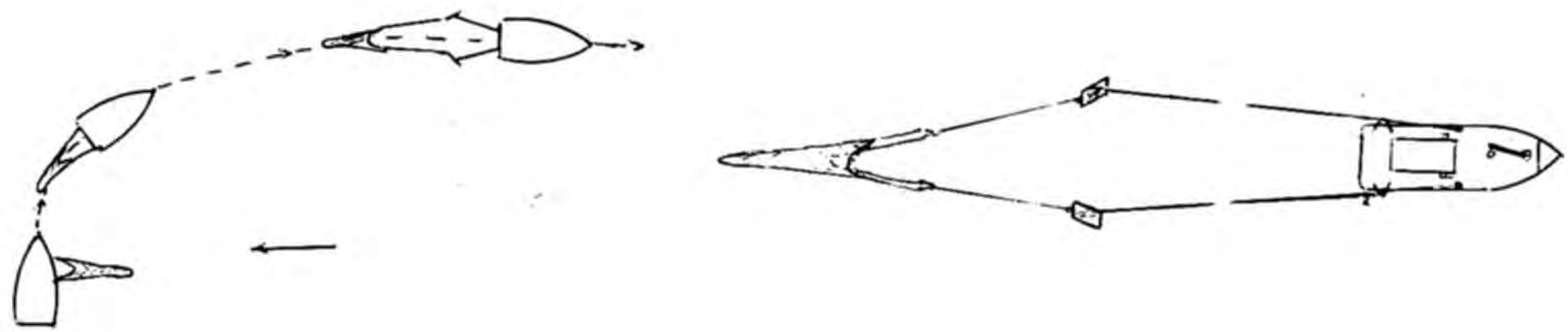
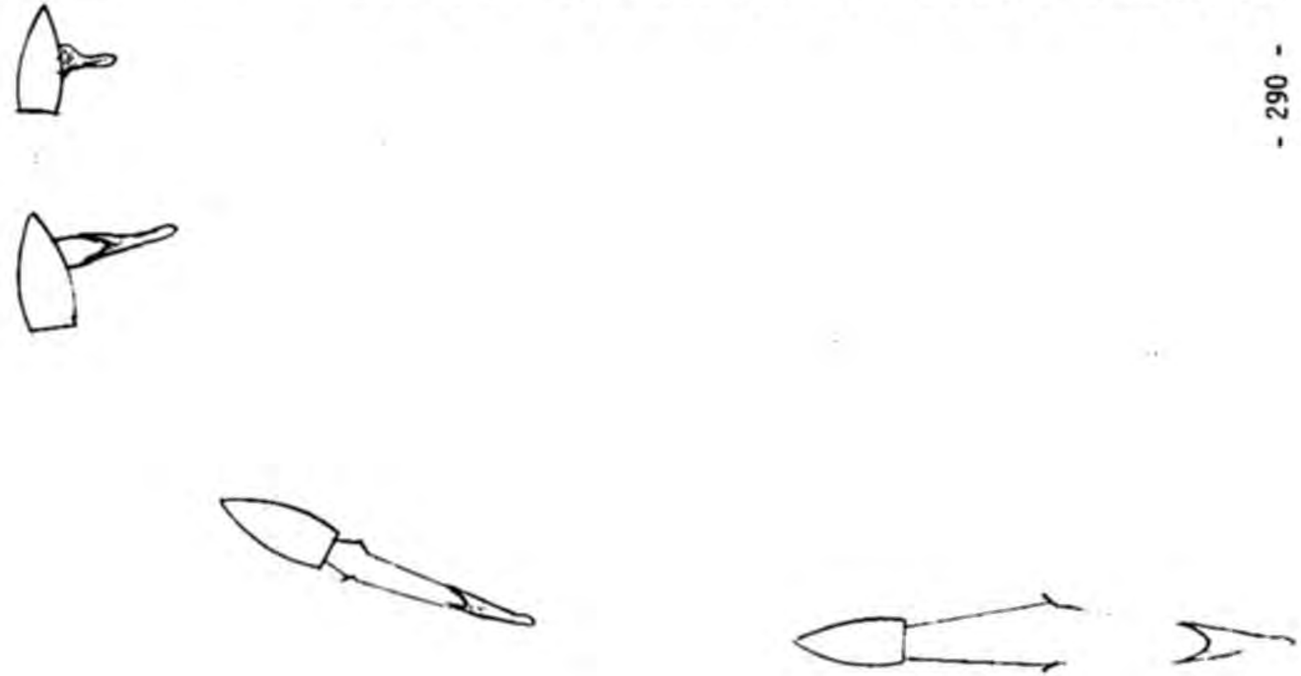


FIGURE 9 : HAULING OPERATION OF OTTER TRAWLER



STUDY REPORT

ON

LONGLINING

Abdulla Shaan
Republic of Maldives

FISHING TECHNOLOGY AND RESOURCE CONSERVATION
1997
SOUTH EAST ASIAN FISHERIES DEVELOPMENT CENTER

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In this opportunity I would like to thank SEAFDEC for giving me this opportunity to attend this Regonal Training Course in Fishing Technology And Resource Conservation.

I have gained more knowledge about fishing science and technologies and other related issues. I thank all the people of SEAFDEC for helping me in achieving this.

thank you

TABLE OF CONTENTS

1. INTRODUCTION

The Maldives Archipelago consists of low lying coral islands grouped in to 26 natural atolls in the central Indian Ocean, in an area of 90,000 sq. km. There are some 1200 islands, of which 199 are inhabited. The population is about 250,000. The islands are part of the Laccadive Chagos Ridge. Fishing industry plays a major role in the country economy.The fishing methods used are pole and line fishing, hand lining, trolling, surround netting, cast netting and bottom set gill netting ,vertical and drift long lining.

Most of the country's EEZ remained unexploited until recently when tuna longlining was introduced by giving licence to foreign vessels. There is a high scope for the improvement of this fishery.

In this study report I will emphasize mostly on the general concepts of designing and construction of longlines suitable for small boats, as in Maldives, ranging from 8-15 meters with a crew of 5-6 people. And also I will give tuna longline as an example, and other technical aspects (eg: for selectivity, etc.) related to this kind of fishing.

2. LONG LINING IN MALDIVES

Long lining is popular in Maldives. Three types of long lining are used at present. They are vertical longline , bottom set long line and drift long lining .

A) Vertical long lining

It is a widely used type of gear. It is specially made for catching gulper sharks, but other deep water sharks like bluntnose six gilled sharks , sand tiger sharks, and other deep sea fishes can also be caught.
The gear consists of a main line and multi hooked branched lines. Polypropylene is the meterial used for the main line. The length of the main line is 350-600m . The branch lines are made of steel wires and the length ranges from 0.40-0.50 m and the diameter is 1.5-2.0 mm. The branch lines are joined to the main line with a few meters of its end . A big rock or sand bag of 30-40 kg is attached at the very end of the main line with a small piece of rope , so that when the gear is hauled in the weight can be released by a sudden jerk on the main line , breaking the rope. Generally a boat of 6-8 m and occasionally a boat of 10-12m with a crew of 3-5 people is used.

B) Bottom set long lining

The gear used is similar to drift long line except no floatline is used. Instead of a float line, two floats are attached at the two ends of the main line with an anchor. This type of long lining is mainly used inside the atolls to catch sharks.

C) Drift long lining

The gear consists of four major parts: main line, branchline and the float line. The branchline is formed into 3 parts, namely the branchline proper , sekiyama and leader wire with hook. A basket or unit of longline consists of a pre-connected mainline, five pieces of branch line , a floatline and a float. Measurements of all parts are given in figure (01).

The mainline normally has a length of 250m. The length of upper branch line varies between 12-14m. The material and the diameter of the upper portion of the branch line are the same as that for the main line. A swivel weighing 45g is used . The length of the sekiyama varies between 6-10m. The sekiyama is constructed with steel wires of gauge no 27 (dia .0.42mm) and 'Z' direction twisted wire is used.

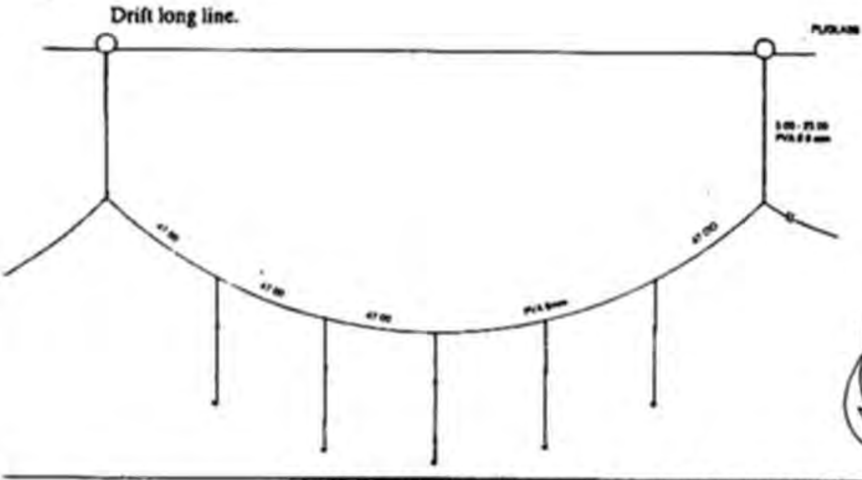
The length of the leader wire varies between 1.5-2.5m . The material and construction of the leader wire is the same as that of the steel wire of sekiyama.

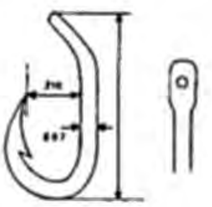
The material and specifications of the floatline are the same as that of the main line. Eye splices about 20 cm long are formed at both ends of the float line.

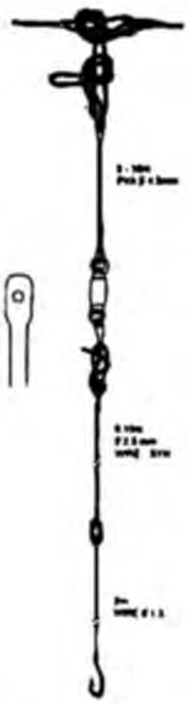
Spherical shaped Floats made of glass or plastic materials are used. The size of the float is around 300 cm in diameter with a shell thickness of 3-4 mm. Any available species , mostly reef fish is used as bait. Japanese square type tuna hooks are used in long lining.

The line shooting is carried out at the aft of the vessel. The vessel is about 10-12m in length and the line is usually set 15-20 miles offshore. Individual units or baskets of longline are connected to one another while the vessel progresses forward casting the lines. The depth of the main line is adjusted by increasing or decreasing the length of the float line. The fish which are caught are the skip jack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*) , Big eye(*Thunnus obesus*), Oceanic whitetip (*Carcharhinus longimanus*), Tiger shark(*Galeocerdo cuvier*), Silky shark (*Carcharhinus falciformis*), Thresher shark(*Alopias vulpinus*), and sometimes bill fishes like marlins and sailfish can also be caught.

Figure (01)







3. LONGLINING IN GENERAL

A long line consists of a main line to which at various places snoods equipped with baited hooks are attached, and left in the water for a few hours. Depending on the species of fish to be caught , the long line can be set at different depths and can be classified as :

- Drift longline
- Bottom longline or
- Vertical long line

The length can vary from a few meters to thousands of meters and the number of hooks can reach to thousands.

The concept of longline is that pieces of bait is attached on a series of hooks which attracts fish , which then get caught by eating the bait.

The area we place the long line is very important. One of the reasons is that fish behavior is very much related to the kind of habitat where it lives, migrating patterns etc.

Today good navigation systems with GPS and other equipments are available. And also echo sounders and sonars are used to find favourable sea bottoms and fish.

In general for pelagic fishes its best known that along the edges of the continental shelf is best for fishing.

The yield from long lines is extremely variable and depends on many factors.Some are :

- The season (migrating patterns etc.)
- Time of the day fishing is carried out
- The amount of time the long lines are left in the water

The amount of time longlines are left in the water is very important. If left for too long the amount of catch may decline. This is due to destruction of bait by scavengers and loss of attractiveness (these may favor in catching undesired species).

A good bait always should stay on the hook for the entire time the long line is out and still attract fish.

Most of the fish caught by a long line is hauled in alive and if handled properly we can bring a superior quality of product to the market, much better to that obtained by other fishing methods.

4. MATERIALS NEEDED TO MAKE A LONG LINE

The materials needed to make a longline depends on the type of fish we want to catch. A longline which is used to catch bottom fish such as groupers , will not have the same materials as one for pelagic fish such as tuna.

But the basic elements are the same for all longlines : mainline, snoods, hooks, buoys and buoy ropes.

One of the most important things to keep in mind when assembling a longline is that care must be taken in attaching the elements together, especially with the knots used on the hooks, swivels, clips and how the snoods are attached to the main line.

4.1 MAINLINE

The choice of material for the mainline will depend on the type of fish to be caught, the type of fishing to be done (drifting or bottomset) and the means of handling the longlines(mechanical or manual).

The main line can be either monofilament or twisted or braided line made-up of polyamide, polyethylene or polyester.

The material for the mainline must be chosen while keeping these in mind :

* The material has to be kept onboard the vessel (i.e. A long distance of line should be kept in a small area as possible).
* A property the material should have is that it should unwind easily on its way to the water.
* The size of the fish expected
* The boat which is going tobe used
* The strength of the line (Also the strength of a line depends on whether we use knots during assembling the line and the breaking strength in water. If knotted monofilament line is used the breaking strength of the line is 20% less).

A poor choice in the material of the mainline can result in disastrous accidents.The advantages of using monofilament lines is due to its:

* Transparency
* Thinness when compared with braided or twisted cords (care must be taken when laying out and hauling in)
* Does not absorb the smell of the bait, thus making it more efficient in fishing.
* Average durability
* Stretch a little bit before breaking

Nowadays there are nylon monofilament lines (which is quiet cheap) with bigger breaking strengths (Flouro carbon). The mainline loses its strength after used for a long time and needs to be replaced. Thus replacing the main lines is the biggest expense in long lining.

4.2 SNOODS

The length of each snood must be atleast less than half the distance on the mainline between two consecutive snoods (to prevent from tangling). The breaking strength of the snoods must be less than that of the main line (as a precaution) and mustbe strong enough to take the fish targeted.

For pelagic longlines, the snood is often attached on to a twisted or braided secondary line of diameter greater than that of the snood.The snood is made-up of monofilament or galvanized wire depending on what species is targeted.

The correct length of snoods is hard to determine. It depends on :

* The kind of fish targeted
* The system used in handling the line.
* The quality of fish we want to catch (to catch fish which is strong and alive , fairly long snoods is required).

Also the ease in pulling in the catch also must be considered when choosing the length of the snoods.

Also the first snood mustn't be set too close to the buoy rope (to prevent entangling).

There are many ways of attaching the snoods to the main line, such as :

* Splicing the snood on the main line.
* Direct tying of the snood to the mainline.
* Tying the snood to a rope loop which is pulled through the fibre of the mainline and secured in place.
* Tying to a blocked or fixed swivel threaded on to the main line.
* Attaching hangers directly inbetween two swivels or at intervals along the mainline

4.3 HOOKS

The most important things to consider when selecting hooks are that:

* The type of fish targeted
* Behaviour of fish targeted

Other important things to keep in mind when selecting hooks :

* Fish should not be able to unhook itself but should still remain alive
* The diameter of the hook
* The kind of material the hook is made up of
* Its breaking strength (related to diameter and material)
* Type of fishing ground
* Size of fish
* Long hooks are easy to handle and to bait but are not necessarily the most effective

* Short or wide gap hooks are the hardest touse but gives a higher yield for some species and generally maintains the fish alive for a longer period

There are many kinds of hooks. Some are made of brass, steel, galvanized steel, or stainless steel, and some are tin-plated to prevent corrosion and also gives a glittering shine to the hook when its in water.

They are straight or curved hooks, hooks with wide eyes or rings and hooks with flatted shanks or with swivels.

The profitability of a long line depends on the number of hooks it carries, the type of bait, and how the bait is hooked. Cuttle fish , squid, horse mackerel and other pelagic small fish is good for bait fish. How attractive the bait looks in the water is essential.

4.4 FLOATS

The floats enable the boat to locate the line and also acts as a signal to other fishing boats and vessels and acts as a bouyancy to the lines. Either a flag ,a radar reflector or alight can be used with the floats which are attached to the ends of the longline.

One or two auxiliary floats can be moored to the main float to show the direction of the current and to make it easier to haul it with a gaff. Furthermore on lengthy mid water longlines intermediate floats can be attached. Buoys are made-up of glass, wood, cork, polystyrene, etc.

4.5 FLOAT LINES

Float lines link the buoys with the ends of the longline. The material used is stronger than that of the main line. The length varies depending on the type of long line and kind of fish targeted.If in bottom longline the length is extended to 40% of the existing mainline. It is joined with the main line by the means of a snap or knots.

4.6 WEIGHTS

Weights are used in bottom longlines to keep the line from shifting away. But in tuna monofilament longline weights are used to keep the main line and snoods at the desired depth.This is very important because if there is a strong current the line will try to stretch by itself, if no weights are used. It can be adjusted according to the fishing conditions.

4.7 SWIVELS

Swivels increases the effectiveness of the longline. It helps the snoods not to get entangled.They are normally placed at the end of the snoods and on the mainlines , but they may also be combined with the hook or used between the snoods .

4.8 HANGERS

Hangers acts as an aid in joining the snoods with the mainline.Hangers between the mainline and snood makes it easier to use and to store the long line.

5. FISHING OPERATION

The fishing operation has two steps. That is putting the line in the water and after a reasonable amount of time to haul the gear up. In any kind of fishing operation it is important to organize the work on board. In long lining special care should be given when handling the gear during shooting time and hauling time.

On the way to the fishing ground the crew will arrange the baskets and get ready for fishing operation. Baiting the hooks is one of the most tiring and difficult part of the operation. Different techniques are used in baiting the hooks. Some bigger vessels use automatic baiting systems.

A line winch , a line guide roller and a line chute is used in the operation.When arrived at the fishing ground the line is put into the water from the stern of the vessel. The line is kept on the line chute for easy laying out. When laying out the line the current, wind and the speed of the vessel is important. After the last buoy is put in to the water the boat will drift with the line during the time the line is kept in the water. After a reasonable amount of time (depends on the fish targeted) the line is hauled in with the help of a line hauler which is installed at the starboard bow or at the stern (this depends on the kind of boat used). Again the direction of the current and the wind has to be checked first.

Where ever possible the hauling is done against the wind and current and the efficiency of hauling depends on how well the captain handles the boat and also the crew involved in hauling the gear. It is easy to lose fish from the line when hauling if not careful.

6. LONG LINE AS A SELECTIVE GEAR

The long line can catch all types of fish, from the smallest to the largest. Selectivity by species is possible by using longlines. Fish is attracted to a longline by using bait. However to catch a targeted species of fish or size, the ecological, technical and biological aspects has tobe considered. They are :

* The fishing ground itself
* The season
* The condition of the fishing ground (eg: current)
* The construction of the line
* The materials used (eg: visible or invisible)
* The type of hook
* Depth fished (bottom or midwater)
* Nature of bait has tobe carefully chosen (salted frozen or fresh)
* The behaviour of fish
* Other factors depending on the type of fish targeted

How selective a longline is only determined by comparing the catch with the gear used.to catch a certain species its' behaviour is very important.

7. FISH BEHAVIOUR

Reaction of fish to environmental stimuli and their application

Environmental stimuli	Fish reactions	Remarks	Use,gear
Light	Feeding reaction, shoaling	Turn feed in clear water	Aggregates in clear water
Sound	Mostly avoidance(ship and gear)	Frequency 50-500Hz/20 dB	Fish finding etc.
Currents	Orientation	For migration	Fishing tactics in set gears
Turbulence	Avoidance,diving	Affects depth of schools	Gear
Temperature, boundaries	Affects activity and food	Aggregation at current boundaries	Finding fish aggregations
Food	Search, visual and olfactory	Migration speed slow with abundant food	Fishing tactics and adaptation
Response to bait	Olfactory stimuli	Smell distribution affected by currents, palatibility	Luring to bait.Longline
Associated to grounds	Spawning, feeding	Association different with current, food	Major preferred fishing grounds

Fish behaviour, stimuli, reactions and their applications

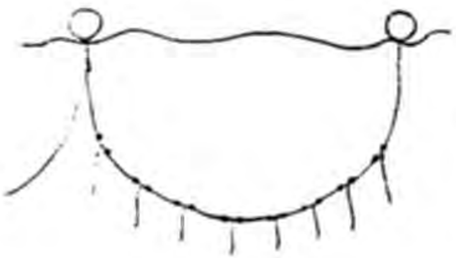
Behaviour	Stimuli	Reactions(common)	Use in fishery
Attraction	Light	Feeding	Aggregation for capture
	Sound	Fright	
	Chemical	Feeding	Luring to bait
	Food	Feeding frenzy	
	Presence of objects	Protection of predators	Aggregation(FADs)
Avoidance	Obstacles	Change direction,Avoidance	Leading to traps
	Sound	Diving speed and direction	Noise reduction of ships and gear
	Turbulence	Change	
	Turbidity	Diving	Depth of gear
	Predators	Moving out	Fishing strategy
Fright	Sound	Avoidance, Increase speed	Driving into gear
	Moving obstacles	Changing direction	Avoidance of escape
			Reduction of gear turbulence
			Visibility
	Predators	Fright	
Feeding	Food	Slowing speed	Baited hooks and traps
	Hunger	Feeding(frenzy)	Chumming of bait
	Migration		

8. CONCLUSION

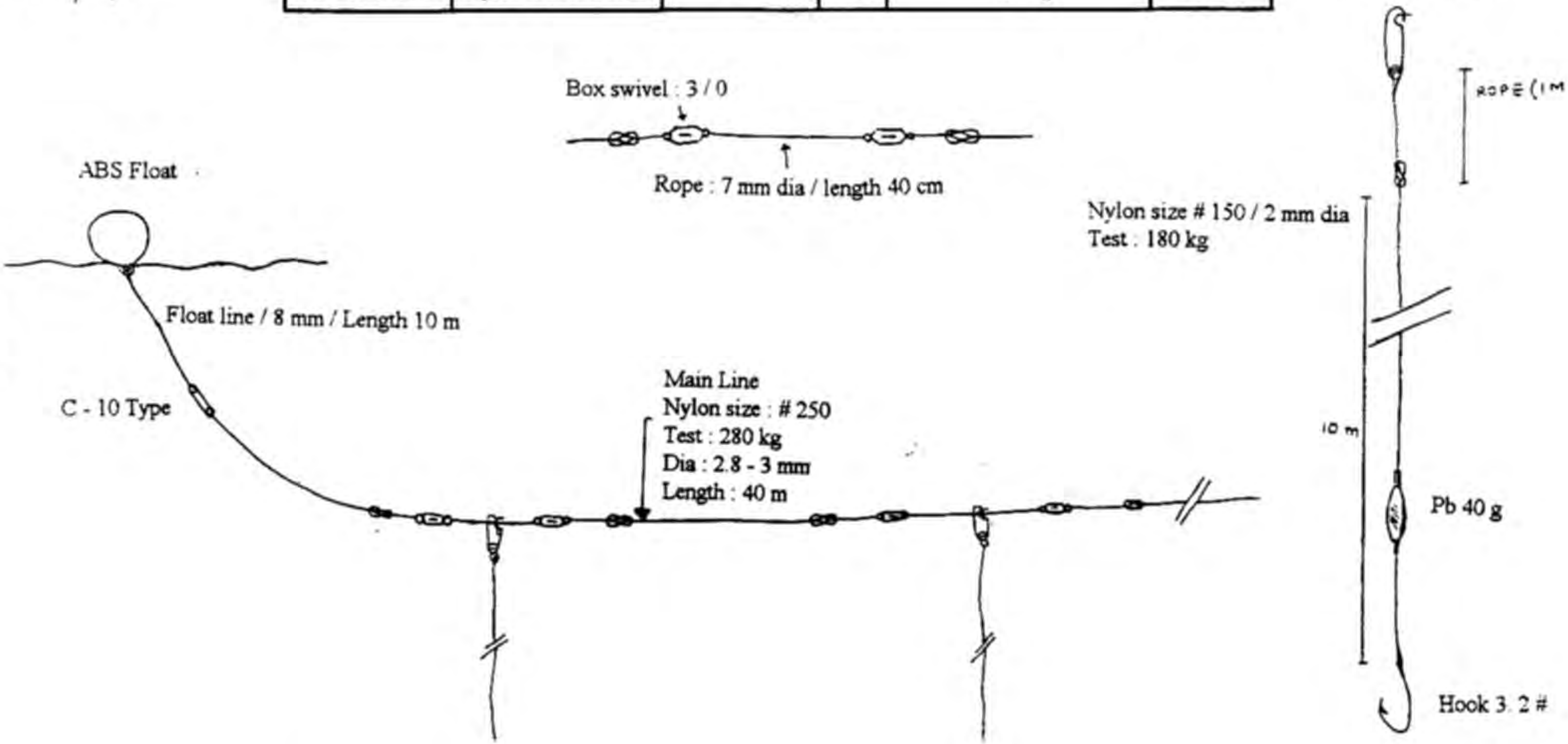
Most of the fishing gears being used today canbe said tobe non-selective thus increasing the amount of by-catch and killing non-targeted organisms. By careful selection of gears and techniques we can reduce it. The earths fish stocks are now fully exploited or over exploited. The harvests from most oceanic fishing regions are probably near (or exceed) the regions' maximum sustainable yields. The effectiveness of fishery management systems depends on National and International co-operation for the sustainability of our marine resources for future generations.

Responsible fishing practices needs tobe applied world wide inorder to achieve this.

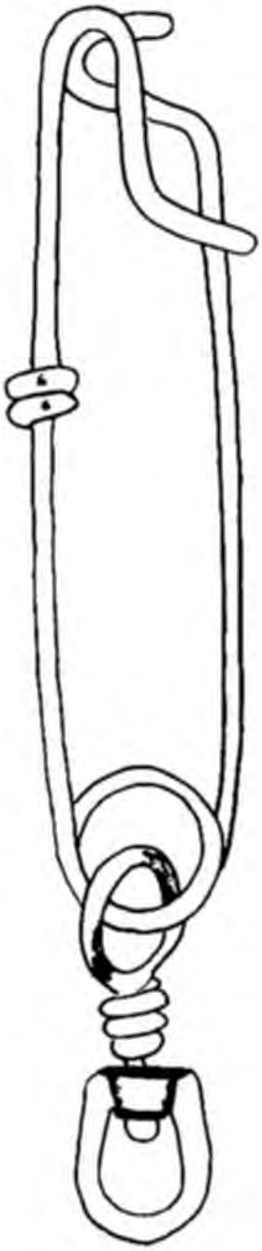
DESIGN OF A TUNA LONGLINE FOR SMALL BOATS



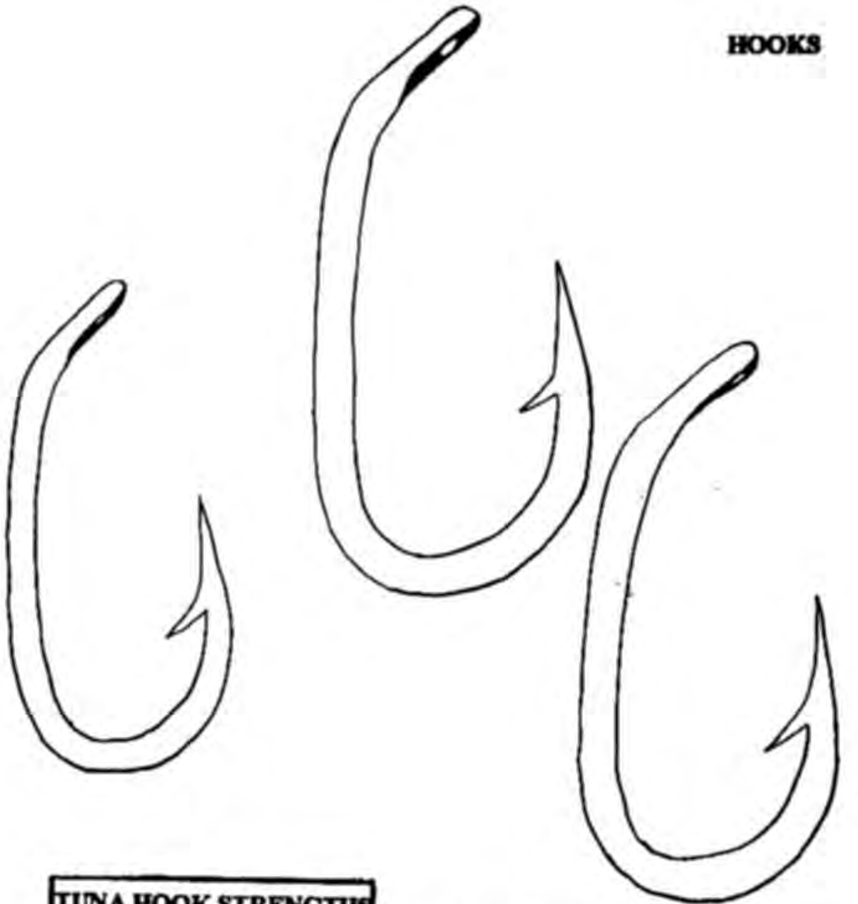
SPECIFICATIONS OF A NYLON MONOFILAMENT TUNA LONGLINE FOR ONE UNIT					
LENGTH	MATERIAL	NO. OF PIECE	SIZE	BREAKING STRENGTH	DIA
MAINLINE	Nylon Monofilament	11	# 250	280 kg	2.8-3.0 mm
FLOATS	Polystyrene	2	-	20 kg	300 mm
FLOATLINE	Nylon Monofilament	2	# 250	280 kg	2.8-3.0 mm
BRANCH LINE	Nylon Monofilament	8	# 150	180 kg	2.0 mm



HANGERS



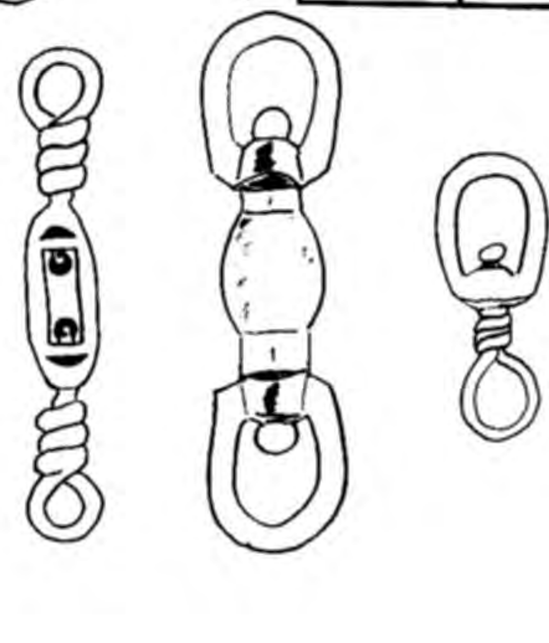
HOOKS



TUNA HOOK STRENGTHS	
Size	Test
3	205 kg
3.2	228 kg
3.4	248 kg
3.6	320 kg
3.8	320 kg
4	421 kg

HOOK SIZES FOR SPECIES	
3	Yellowfin
3.2	Yellowfin + Albacore
3.4	Yellowfin + Bigeye
3.6	Yelloyfin + Bigeye + Bluefin
3.8	Bluefin
4	Boston tuna + Marlin

SWIVELS



STUDY REPORT

ON

SELECTIVITY OF COMMERCIAL FISHING GEARS

BY

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FOR

THE REGIONAL TRAINING COURSE IN FISHING TECHNOLOGY AND RESOURSE CONSERVATION
(16 JUNE - 15 DECEMBER 1997)

TRAINING DEPARTMENT
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SELECTIVITY OF COMMERCIAL FISHING GEARS

Introduction:

Harvesting a previously unexploited specie is similar to introducing a new predator to that specie's habitat. It removes largest individuals from the harvested population and affect population size, age and other species that interact with the harvested species. The average size and age of the adult individuals in an exploited specie reduces than that in an unexploited population. These downward shifts are due to the fact that a fishery usually removes the larger(old) fishes and leaves the smaller ones. The exploitation of fishery resources are not harmful to the species as long as enough adults are left for reproduction. Under ruinuos fishing pressure, the average age of harvested fishes drops below the age at which they become sexually mature. At this stage fishes are caught before they have a chance to reproduce even once.

Another aspect of overfishing is that when fishes are removed from a marine community, both the predators and the prey of the harvested specie can be affected. The prey may experience reduced predation and may become more numerous. The predators that eat the harvested fish find their food supply reduced and may decrease in numbers.

With the development of fishing gear, the application of various electronic instruments on board the vessels and implanted on the fishing gear and accessories has greatly revolutionized the operational techniques. In total, the fishing efficiency of the fishing gears have improved tremendously, resulting in improved harvesting of the fish resources. The present situstion is that many fish stocks are being over exploited. Discards from the world fisheries are estimated to be 25-30 million tons being approximatly 30 % of the total marine harvest. There are in fact few fish resources which are not fully utilized and any increase in yield therefore has to come from a more responsible exploitation of the resources. Future development of fishing gear should therefore be focused on improvement of the selectivity properties and not so much on improving the efficiency as has been the case in the past.

According to the United Nations Convention on the law of the Sea(1982) which enterd into force in November 1994, provides the international legal framework for the adoption of national regulatory measures for fisheries management and conservation. For example, in the exclusive economic zone (EEZ) coastal states are required," taking into account the best scientific evidence available to it, (to) ensure through proper conservation and management measures that the maintenence of the living resources in the EEZ is not endagered by over-exploitation (Art.61(2)). Article 62, makes it clear that the regulation of gear selectivity is one of the tools States can use to meet their overaching responsibilities.This article establishes the obligation of nationals of other states to comply whith the coastal state's laws and regulations concerning management and conservation. Such laws and regulations may regulate "seasons and areas of fishing,the types, sizes and amount of gear, and the types, sizes and number of fishing vessels that may be used,"Article 62(4)(C) .

According to Agenda 21, nations have committed themselves to take steps necessary for the conservation and sustainable use of marine living resources under national jurisdiction including the development and use of selective fishing gears and practices that minimizes wastes in the catch of target species and minimize by-catch of non-target species.

The 1995 UN Aggrement relating to the Coservation and Management of Sraddling Fish stock and Highly migratory Fish stocks Coastal States and States fishing on the high seas, to (f) "minimize population, wastes, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species and impacts on associated or dependent species, in particular endangered species, through measures including , to the extent practicable, the development and use of selective fishing gear and techniques, (Art.5(f)General Principles).

Besides these, there are other international legal instruments like Code of conduct for Responsible Fishing, which require the states that fishing gear, meathods and practices are sufficiently selective so as to minimize wastes, discards, catch of non-target species and impacts on associated or dependent species, (Art.8.5.1 Fishing operations) and says that States and relevent institutions should collaborate in developing standard methodologies for research into fishing gear selectivity, fishing methods and strategies.This study report provides an introduction of the methods that could be applied to assess the selectivity of commercial fishing gears like trawl and gillnet.

Fish Selection and Selectivity of Fishing Gears:

The selection of fish by fishing gear can be considered to be the process which causes the catch of the gear to have a different composition to that of the fish population in the geographical area in which the gear is being used. Another view is the catchability of any one or more species is the probability of an individual being caught by the fishing gear. It is contingent upon accessibility, vulnerability and efficiency.

The accessibility of the species will depend on its life cycle and on its relation to the fishing ground, i.e. migration, recruitment and moulting or on behaviour and activity, during certain periods, the animal is out of the range of action of the gear.

Vulnerability, inversely is related to the ability of the organisms to escape the fishing gear once they have come into contact with it.The more effective the gear , the higher the vulnerability of the target specie.
Efficiency is related to fishing tactics. For the same fishing effort, results may vary depending on the weather condition and fishing zone.
Selectivity of fishing gear is of two types: **Interspecific** and **Intraspecific**. The ability of the gear to take one specie rather than other. This is inter-specific or multi-specific selectivity, and for a single specie, to retain only the individuals that have reached a certain size, this is intra-specific or size selctivity.

Trawl selectivity:

Seletion is simple in the bag type of gears, like trawl. For this type of gears it is usually assumed that the size composition of the fish is the same as that in the vicinity of the gear. The selectivity of this gear therefore is a question of escape that occures through the codend. Selectivity can therfore be determind directly if the number of each size of fish entering the net can be estimated either by attaching a smaller-meshed cover over the codend or other parts, or from the size composition of the catches of nets of much smaller meshes fished at the same time and place. Whichever method is used, the results can be expressed as the proportion of fish at each length entering the net which are retained in the codend.Some researchers have studied trawl selectivity based on factors other than size i.e. fish species, net materials, gear contruction, codend hydrodynamics and fish behavior.
The methods for measuring trawl selectivity fall into two categories. The first is the coverd codend method and the seconed category of methods can be reffered to as "paired-gear" methods.

Coverd Codend:

In this method codend is fitted by a small mesh cover arround the test codend and a direct measurement of the fish escaping through the codend meshes is obtained as cover collects the fish not retained by the test codend. Since covers may physically mask the codend mashes and prevent fish escape to some extent, Davies(1984) suggested the use of cane hoops to reduce the risk of masking. These hoops aim to prevent any contact between cover and codend, especialy at the point where the catch expands to form a bulge.

Advantages: The main advantages of this method are that each haul produces a selection curve and the same method can be used on a wide variety of gears allowing the codend selectivity of different gear types to be compared.

Disadvantages: The net does not fish exactly as in commercial fishing as the cover may affect fish behaviour or gear performance, because water flow through the codend reduces, or the extra drag of the cover may distort the shape of the net. The fish selection may therefore be different from commercial fishing.

Alternative Haul Method :

In this method hauls are made alternately with the gear whose selectivity is to be measured and then with the same gear with small mesh codend. The latter obtains an estimate of the population entering the test codend. If, selectivity for whole gear is to be measured then the seconed set of gear would be made in small mesh throughout. It is essential that the pairs of hauls should be similar in every respect except for the mesh size in the part of the gear whose selectivity is being measured.

Advantages: This method is used to avoid any bias caused by a cover as it fishes, as in normal commercial fishing.

Disadvantages: The major drawback is the need for a longer number of hauls because every haul takes place under different conditions and at different time, which will increase the cost of the experiment. At least two hauls are nessary to calculate a selectivity curve.

Parallel Haul Method:

The parallel haul method involves two vessels fishing on the same ground at the same time. The experimental gear whose selectivity is to be measured is towed by one vessel and a gear of identical design but with a small mesh codend is towed by the other.

Advantages: The test codend is fished as in normal commercial fishing. The two codends are fished at the same time, on adjacent seabed areas which are assumed to have similar population of fish.

Disadvantages: It requires two vessels which doubles the cost of experiment. Also the two nets will not in general encounter the same population. Lager variance can alters the results.

Twin Trawl Method:

One trawler tows two similar trawls simultaneously side by side, using special rigging. The test codend is attached to one end of the twin trawls. A small mesh codend is attached to the other trawl to obtain an estimate of the total fish population entering the test cod end.

Advantages: The method is recommended to estimate whole trawl selectivity, and to conduct catch comparisions. It is free from any bias caused by the use of a cover.

Disadvantages: Although the two trawls are working close to each other in the same conditions there is no certaininty that the same population of fish will enter each trawl. Therefore, larger number of hauls are required to achieve the precision of estimation. The behaviour of fish ahead of the trawl may be affected by the change in wire rigging between the trawl and the vessel.

Trouser Trawl Method:

The trouser trawl method is a variation of the twin trawl method whereby a standard trawl is divided down the middle by vertical panel (are attached to the aft end, one on each side of the the panel). Both trawls are towed from one vessel , the test codend is attached to one side while the control codend is attached to the other side. The design is based on the premise that an equal number of fish will enter each side of the trawl.

Advantages: No special rigging is required as this trawl can be handled in a similar manner to a standard trawl. No covers are used to impede escape of fish from the codend. This method can also be used to value direct catch comparisions between codends.

Disadvantages: Strong currents, inaccurate wire lengths or other effects can cause bias towards one side of the net. There is a greater risk of unequal catches in the two codends because of the short dividing panel ahead of the codends and hence a greater variance in calculated selectivity parameters.

Methods for special selective devices:

Special devices such as square mesh windows and different designs of grids, BRDs and TEDs are used to release undersized fish and unwanted by-catch. These devices can be inserted in the codend or in the aft part of the extension piece. These devices are designed to take advantage of the general upward escape behaviour of fish and are, therefore, positioned in the upper half of the codend or extension piece. Grids, BRDs and TEDs have size selectivity by bar-spacing. It's efficiency depends on bar-spacing and the size structure of each species.

Grid selectivity is defined as the probabilty of fish does not pass through a grid given that it has encountered the grid.

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Grid selectivity is defined as the probabilty of fish does not pass through a grid given that it has encountered the grid.

It is important to decide at the outset what selectivity is to be measured:

1.The overall selectivity of the device and codend together. OR

2.The selectivity of the device itself and of the codend selectivityely.

1. Overall selectivity:

It can be measured using the twin or trouser trawls, alternate or parallel haul methods. Depending on the position of the device a single cover and the whole area is used. Some modifications may be needed like loop to reduce the influence of the cover on fish escape through the device.

2. Selectivity of the device:

If the specie, whose selection is to be measured, escape only through the device, because, the codend mesh size is relatively small, then it will be necessary to use a cover, only over the device itself. In this case, the selectivity of the device and overall selectivity of the codend and the device together are the same.

If the species, whose selectivity is to be measured escape through both the device and the codend meshes, it may be required to assess the selectivity of the device and the codend separately. To do this more complex covers could be designed with internal divisions to separate the fish escaping through the device and from the codend.

General considerations:

1. The population of target species in the fishing grounds should have sufficient numbers in the selection range of the gears being tested.

2. The behaviour of the target species should be known and taken into account in the experimental design.

3. A commercial vessel should be preferred if the experiment aims primarily to measure the selectivity of a commercial fishing gear.

4. The selectivity of the gears under test should not be affected except by the variables for which the experiment is designed.

5. If the fishing powers of the gears are found to be unequal due to the differences in mesh sizes of the test gear and the control gear then it is necessary to design the experiment carefully to account for this fact.

Gillnet Selectivity:

The importance of gill net to world fishing has been recognised since long years ago, because it is one of the simplest and cheapest kind of fishing gear. It is a passive fishing gear used in inland, coastal and offshore waters. Gill nets are calssified according to method and manner of setting into three types, surface, midwater and bottom gill net.
During the years in which drift net fishing was in full swing, a boat would set 50-60 km of drift net each evening in the South Pacific region alone. During each night of fishing, these boats set enough net in the water to circle the earth.
In recent years, drift gill nets have attracted international attention not only for their negative effects on fisheries but because of the damage they can cause generally to the marine environment.
Like other gears drift gill net also takes an incidental catch (by-catch) of non-target species. This is one of the most significant way in which large scale fishing disturbs marine ecosystems. If these nets could be made selective to catch only particular fish and particular size, then this improved

gear can help conservation of existing fishery resources and the preservation of the natural environment.

Methods to measure selectivity of gill net:

To analyse the selectivity of gillnets of different construction such as with different netting depths and hanging ratio and mesh sizes are used. The net whose selectivity is to be measured is set in the sea at night and hauld the following morning. During hauling fish is removed taking note of the species, direction of approach, the fish length, fish weight and its girth. Other observations should also be done like vertical distribution of the fish caught in the nets and the method of catching (enmeshed by head, operculum, mouth entangled, maximum girth etc.). It can be done by just looking at the mark on the body of the fish caught.

Series of experiments could be conducted and data can be collected for selectivity calculations. Selectivity calculations are done for each classification of fish body part i.e head, operculum, girth or mouth. The total of each classification is divided by the total number of fish exposed to the net.

The formula for selectivity of gill net for a given mesh size is as follows: $S_J = C_{Jk} / P_J$

where C = cumulative catch,

P = total population of fish the net was exposed to,

j = size class,

k = classification by fish body part.

The Figure 1 shows the population of fish caught according to the classification.

The catch on the girth tends to peak at the smallest size class and decreases as the size of the fish gets bigger. The catch on the operculum shows an increasing trend as the size of fish increases and tapers off it decreases.

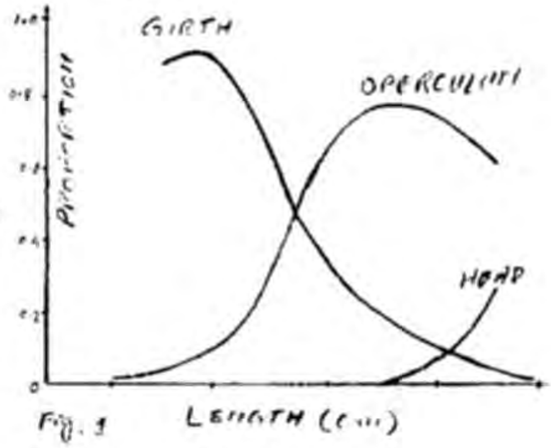

Fig. 1

Selectivity of nets based on the body classification:

The selectivity curve of a gill net having a given mesh size is simply the sum of the component curves of the fish caught at different portions of the body. Hence the total selectivity curve S_{JT} becomes:

$$S_{JT} = S_{JO} + S_{JG} + S_{JH} + S_{JM}$$

O - operculum

G - girth

H - head

M- mouth

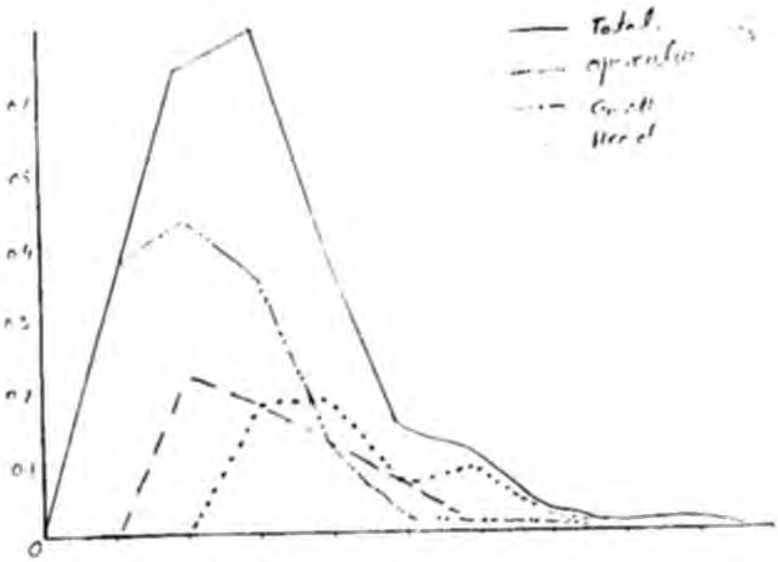

Figure Based on experiments by Lord P. Losanes in his study on catching efficiency and selectivity of gillnet and entangling nets (1981).

Factors affecting selectivity of Gill net:

1. Size and shape of the mesh, twine elasticity. (The rate of escape gradually increases with size)
2. Current speed and direction.
3. Visibility of the netting under water.
4. The behaviour of the fish when it encounters the net.

Conclusion:

In some countries trawling is banned altogether, while in others, it is banned in coastal waters and in estuaries in order to protect fish and shrimp nurseries. To ban a particular fishing gear because it is believed to be too efficient, environmentally unfriendly or unselective
without carrying out studies to quantify these effects, and to quantify the effects of the alternative fishing gears to be used, is not sound, but wrong because it can disenfrenchise a paraticular group of fishermen. So, it is need of the time to conduct studies on selectiveness of the different fishing gears and their effects on the environment before taking any management action.
It is suggested that, a type of net should be choosen which is more successful in catching the target specie than the others from among the different species, in the fishing ground. And also accidental capture of endangerd species could also be minimized by selecting the type of net which is least effective in catching these species.

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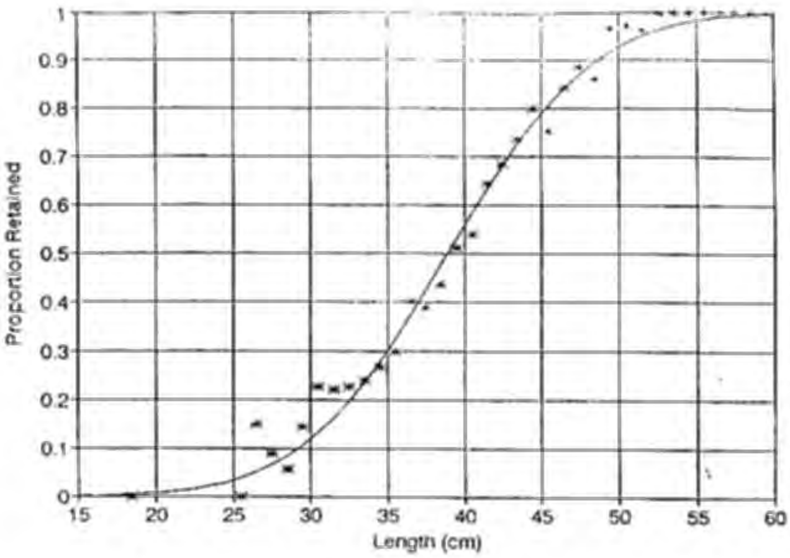

Figure. 2 Example of a codend mesh selection curve.

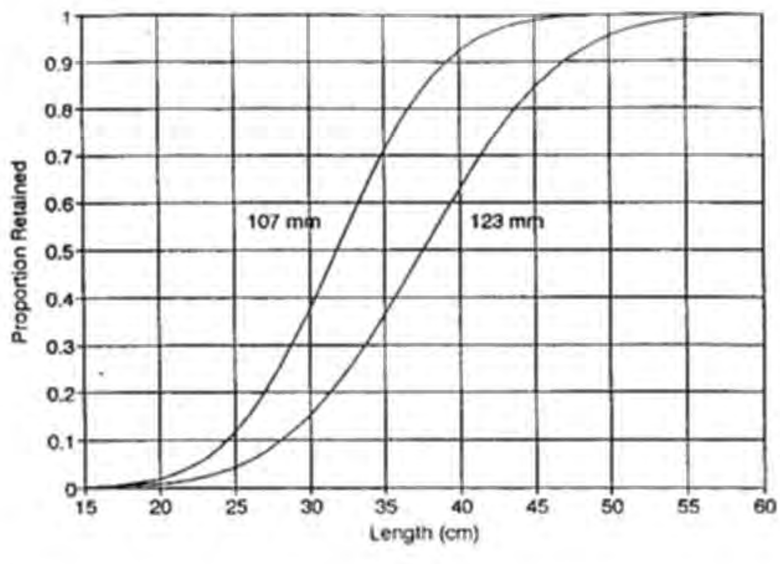

Figure. 3 Example of change in codend mesh selection curve on increasing codend mesh size.

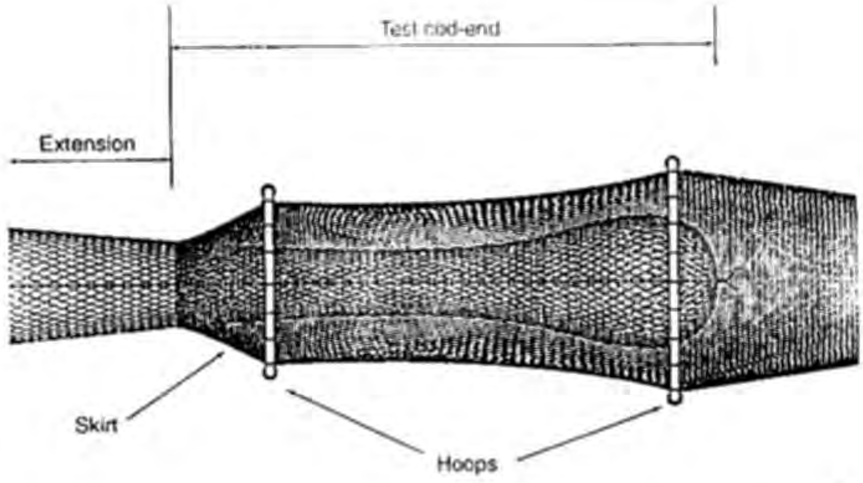

Figure 4 Schematic diagram of covered cod-end.

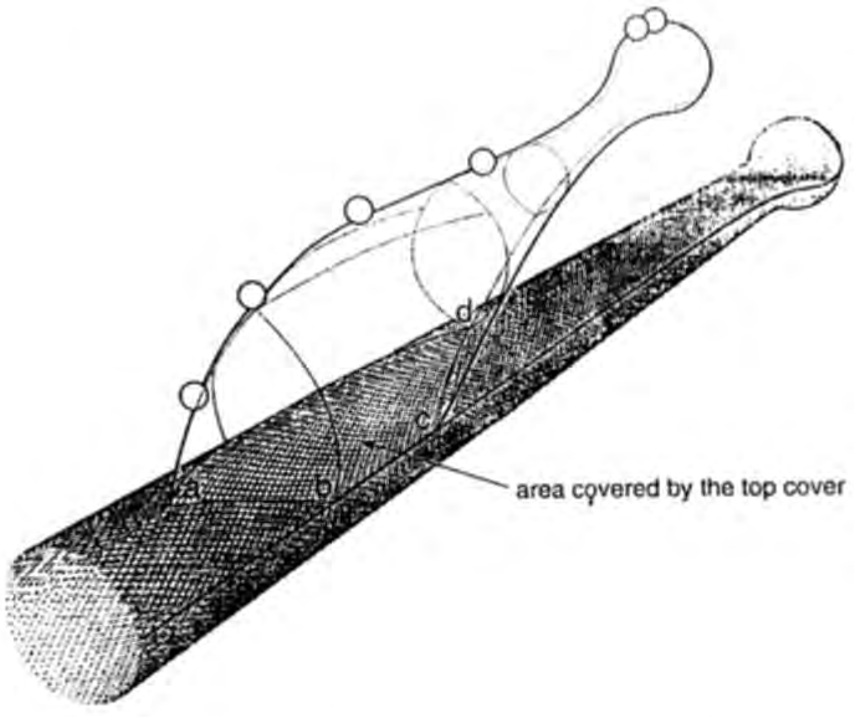

Figure . 9 Schematic diagram of top cover over a window

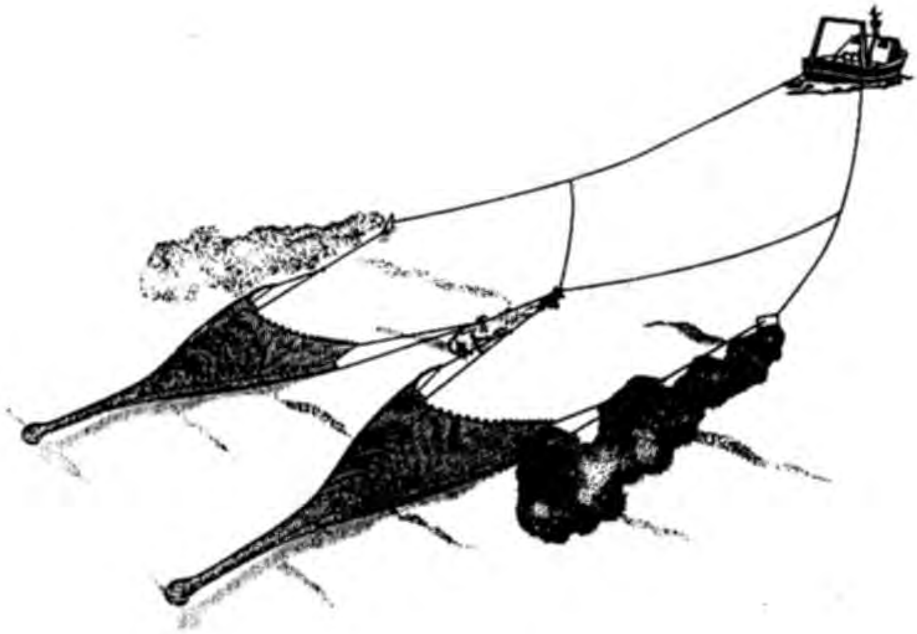

Figure . 5 Schematic diagram of twin trawl

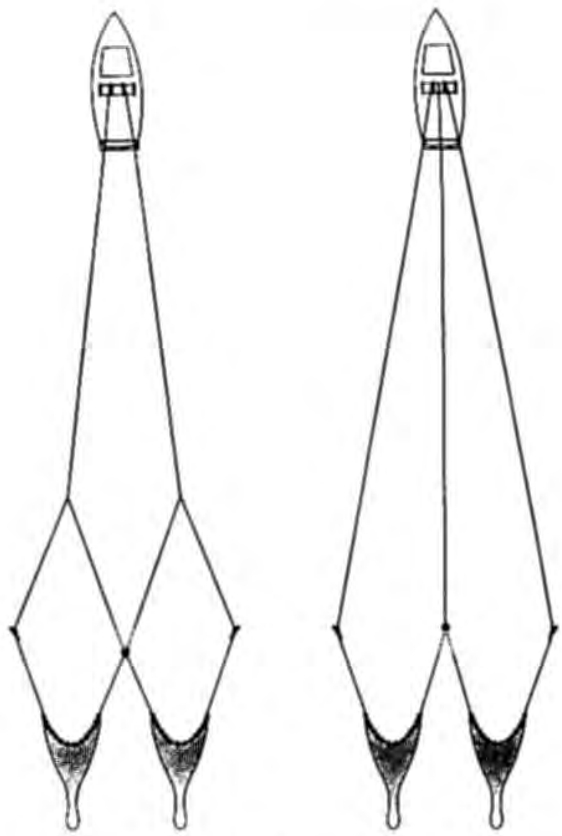

Figure. 6 Two and three warp rigs for twin trawl

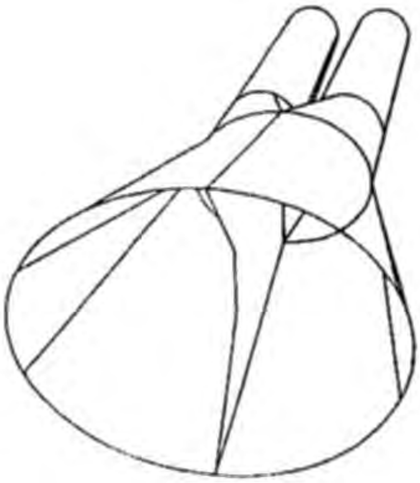

Figure . 7 Schematic diagram of trouser trawl - a single net with a vertical dividing panel and two cod-ends

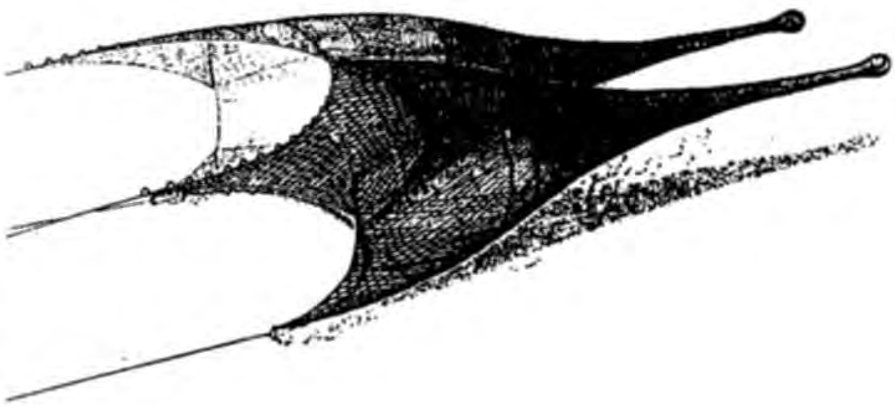

Figure . 8 Schematic diagram of divided or siamese trawl - two nets hung on a single headline and groundrope

The Regional Training course in fishing Technology and Resource Conservation - 1997

South East Asian Fisheries Development Center
Thailand

Study Report

GILL NETS IN SRI LANKA

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Introduction

Gill nets can be described as open meshed curtain of twine which hang vertically in the water across the path of moving fish .

Fish are caught in gill nets in one of three ways :

1.Gilling	-as the name implies the fish are gilled when they try to swim through the net
2.Wedging	-the fish is held tightly around the body by the mesh
3.Entangling	-the fish is entangled by its teeth ,maxillaries or other projections

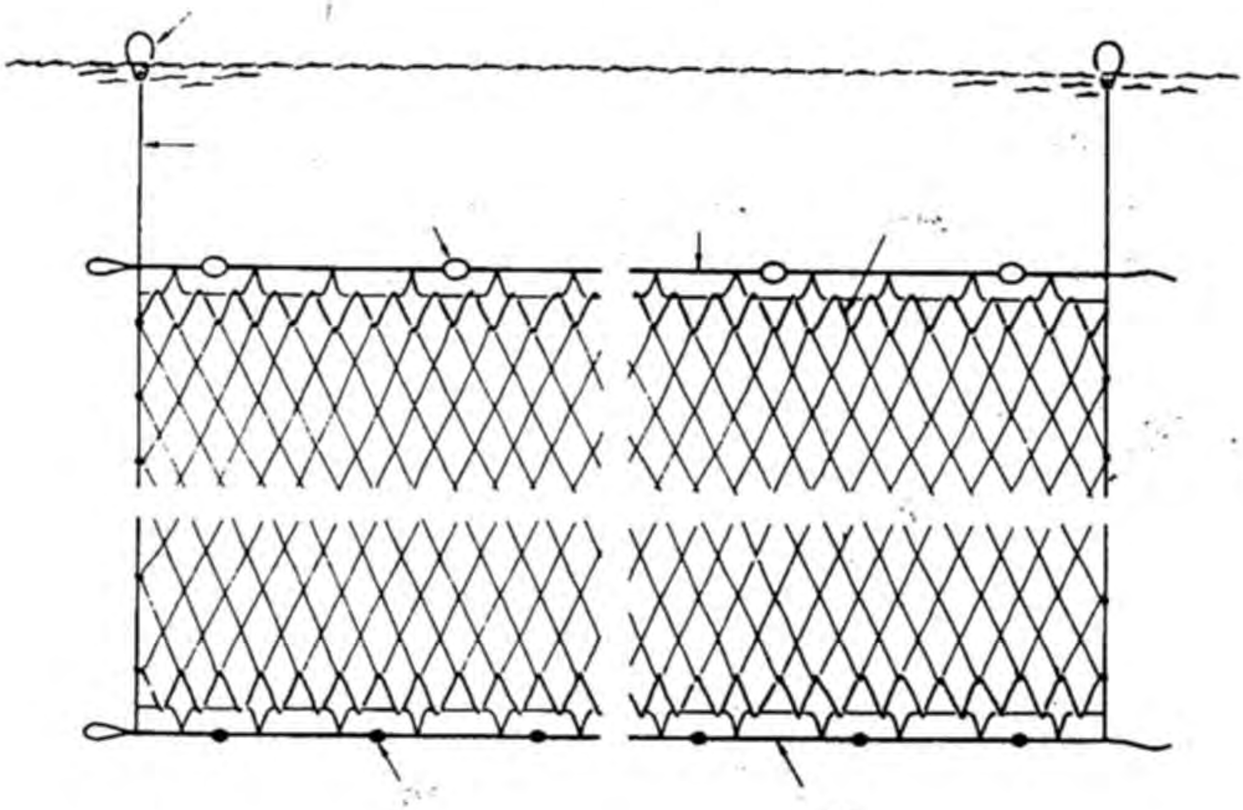
Gill nets are constructed by attaching ropes to both the upperside and the lowerside of a long narrow band of netting and by attaching floats and sinkers ,to keep the net vertical and stretched in the water by the buoyant force of the float and sinking force of the sinkers. Floats can be attached directly to the head rope or to a separate float line which is attached to the head rope . Sinkers can be attached to the webbing directly or through separate sinker line or directly to the bottom rope.

Gill nets can classified into three types according to the water depth in which they are laid.

1. Surface gill net	- laid in the surface layer of the sea
2. Mid-water gill nets	- laid in the mid-water layer
3. Bottom gill net	- laid on the bottom of the sea

Gill nets can be classified into two types according to the operation method.

1. Drift gill nets	- floated in the sea and drifting along due to wind or tidal current.
2. Fixed gill nets	- fixed in the sea with anchor or like.



Elements of a gill net

1 . Buoy
2 . Buoy line
3 . Float
4 . Float line
5 . Sinker
6 . Sinker line

Among the commercial fishermen in Sri Lanka , gill net fishery is the most popular, because of their effectiveness and the similarity of their operation. Gill net fishery developed rapidly after the introduction of the synthetic net , mortorization of craft and the introduction of new mechanized craft since late 1950's.

Gill net is the most important fishery which is mainly responsible for the capture of large and small fish from the coastal as well as from the offshore areas. Within the coastal zone or within the shelf limit there are sub fisheries identified on the basis of the targeted fish and their inhabiting area.

There are many kinds of gill nets with different mesh sizes and varying ply , targeted for specific species or groups of species . They may be large mesh gill nets for large fish and or small mesh gill net for small fish varieties.

Nowadays almost all gill nets are made out of nylon (Polyamaide).

Different gill net types used in Sri Lanka.

1. Large pelagic fisheries - drift gill net
    1. Large mesh - off shore
    2. Large mesh - coastal
2. Small pelagic fisheries - coastal drift gill net
    1. Gill net fishery for Anchovy
    2. Gill net fishery for Sardines
    3. Gill net fishery for Trenched Sardine
    4. Gill net fishery for flyingfish
    5. Gill net fishery for Indian mackerel
    6. Gill net fishery for Frigate tuna
3. Demersal fisheries
    1. Bottom set net
    2. Trammel net (Disco net)

Specifications of gill nets used in Sri Lanka.

name of net / target fish	mesh size mm.	ply	head rope dia. mm.	bottom rope dia. mm.	depth by meshes	length by meshes
1. Off shore and coastal large mesh drift gill net Skipjack tuna, Yellowfin tuna, Kawakawa, Silky shark, Marlin, Sail fish, Indo Pacific mackerel.	125 - 180	21, 24, 27	10 - 12	--	80 - 120	1000
2. Anchovy gill net Indian anchovy, Long jaw anchovy Short jaw anchovy	10 - 18	2	2 -3	2 - 3	500 -600	3000
3. Sardine gill net Sardine, White sardine	22 -30	2	4	4	225	1500
4. Trenched sardine gill net T. sardine, d barracuda Banded sardine	28 -38	2	4	4	225	1500
5. Flying fish gill net Bony f.f., Suttons f.f., Yellowfin f.f	35 -45	2	4	-	60 -80	1500
6. Mackerel gill net Indian mackerel, Scad, Trevaly	46 -60	2 -4	2 - 3	1.5 - 2	80 - 125	1500
7. Frigate tuna gill net Frigate tuna, Bullet tuna, Spanish mackerel, B.baracuda	75 - 100	4 - 9	4 - 5	-	150	1500
8. Bottom set nets a						
1.Thorny ray, Fantail ray, Reef cod, Cowtail ray	360 - 460	27 -36	8	3	17 - 18	500
2.Snapper, Grouper	60 - 90	2 - 4	3 - 5	3	125 - 150	2500

3.Scad. Trevally	50	2	6	2	200	1500
4.Shark, Queen fish, Skate	120 - 180	21 - 27	10 - 12	-	40 - 60	1500
9. Trammel net (Disco net)						
1.Indian white shrimp,	40-50/200-250	2 / 6	3 - 4	3 - 4	40-50/7-8	1500/150-160
Green tiger shrimp						
2. Lobster	50-70/380-410	4/6-9	7 - 8	3 - 4	40/7-8	1500/150-160

Operation method

1 . Large mesh drift gill net (off shore)

This gear is widely used in almost all the off shore region in the country , by using fishing vessels ranging from 9-10 m. multy day boats.

Shooting of the net is usually done in the evening just before sunset The net is allowed to drift about 4-5 hours in the monsoon season and about 6-8 hours in the off season and houled in to the boat by hand.

Large mesh drift gill net (coastal)

This gear is mainly operated by the 3 1/2 ton boats in all coastal areas and a few G.R.P boats with out board engines . Operating mathod is same as the that in case of off shore drift gill net.

2 . Anchovy gill net

This gear is very popular among the fishermen operating small canoe and small G.R.P. boats. Those are operated in the south , south west and western parts during December to April while in the eastern part during May to November . The shooting of the net is done early in the morning at about 5.a.m and hould up after 1 or 2 hours.

3 . Sardine gill net

This gear operated by the Theppan and small G.R.P.boats. Fishing season and the operation method is is the same as that of the anchovy gill net.

4 . Trenched sardine gill net

This gear is also operated generally in the same way as the Sardine and Anchovy gill net.

5 . Flying fish gill net

This gear is quite popular in the western and north western region of the country. Operation season is from December to April and is done within 10-12 miles from the shore by using small G.R.P.boats with out board motors. The shooting of the net is started at about 4 a.m. and allowed to drift for about 3-4 hours. The boat is operated around the net to frighten the fish and drive them to the net to be gilled. Then after that the net is houled up to the boat.

6 . Mackeral gill net

This gear is operated in most parts around the country, except in the south east region. Fishing is carried out within 2-3 miles from the shore by using small G.R.P. boats and the traditional crafts. The net is set at about around 3 a.m and houlded after 3-4 hours.

7 . Frigate tuna gill net

This gear is very popular in south, south west, west and northwest regions in the country. This net operated within 10-12 miles from shore using traditional craft and small G.R.P.boats. Shooting starts at around 5 p.m. and houlded after 2-3 hours and normally they do second shooting also before the sun rise.

8 . Bottom set net

1. For Skates - This gear is one of the oldest gear in the country. It is operated during all seasons and most of the coastal regions of the country by using traditional crafts and small G.R.P.boats. Fishing is carried out within 10 miles from the shore. The gear is set at a

suitable location and allowed to be there for two weeks. The net set in the sea by using anchor weight about 8-10 k.g. .And a marker is fixed to identify the location. Every morning from 8-11 fishermen go to collect the catch and at that time they also repair and replace the damage nets.

2. For Scads - This gear is traditionally operated in the southern region of the country. The fishing season starts from May to September during the south west monsoon period. Large traditional crafts engaged in this operations. This gear is operated within 2 miles from the shore and depth of 6-8 m. . Fishermen set the net early in the morning at around 5 a.m. and houl after 1-2 hours.

3 For Shark - This gear is operated in western region throughout the year while in eastern part , from November to April by using traditional craft and motorized boats. The net is set for 2-3 weeks and fish is collected in the morning hours.

9 . Trammel net (Disco net)

1. For Shrimp - This gear is very popular among the fishermen targeting the shrimp, because of its high efficiency. This gear is operated during day time as well as the night time. The fishing season is November to March. The operations are carried out within 3-4 miles from the shore. The net is set across the tidal current and anchored by two stones weighting about 3-4 k.g. ,and houlded within 15-30 minutes. About 8-10 operations are carried out per day.

2. For Lobster - This gear is operated within 2-3 miles from the shore and in depths of about 20 m. . It is very popular in western and north western region of the country. Fishermen operated this gear two times a day. In the morning they shoot the net around 5 a.m. and hould the net after 1-2 hours. In the evening they shoot around 5 p.m. and hould after two hours.

Contribution of the gill fishery to the fish production

The gill net fishery is conducted throughout the year , but the peak catches are landed during the monsoon periods. Gill nets are widely used in almost all the off shore regions in the country and contributes over 70% for the total off shore fish production.

Coastal tuna production has averaged over 35000 tons in recent years, with over 16000 tons of skipjack and 9000 tons of yellowfin . It is estimated that nearly 80% of skipjack and 90% of yellowfin in the coastal catch are landed by the gill net fishery.

Important factors in a gill net,

1. Size of the net. -

The most important factor relevant to gill net is the size of the mesh. The proper size of the mesh to the body length of fish is strictly related to the efficiency of the gear.

2. Hang in ratio. -

The correct hangin of the webbing to the framing or supporting lines is an important factor in gill net. The shape of the mesh is decided by the value of hangin ratio.

3. Colour of the nèt .

The behavior of the fish in relation to the visibility of the net , plays a very important part . the high capture of fish in gill net , depends on the low visibility of the net in water. The colour of the gill net must be chosen according to the fishing ground and operating depth.

To develop the gillnet fishery in Sri Lanka following actions are proposed to be considered .

Sri Lankan fishermen still use their own traditional methods in gillnet fishery. So this is the time to introduce the modern technology to them.Such as net construction methods operation methods deck machinery and hydroacoustic equipments. When they make a gillnet they should know their fundamentals and importance of the major factors in gillnets.They should know the suitable mesh size according to the targeted fish inhabiting in a particular fishing ground. They should also know the appropriate hangin ratio . And They should also take in consideration the colour of the net according to the fishing ground and the operation depth before they buy or dye the net.

"Saran" canbe introduced in nets which do not have a ground rope. This will Improve the catch efficiency. It helps to keep the net properly stretched vertically and keep the shape of the net properly all over the net more than sinkers which are attached to the webbing directly. The proper shape of the net when in the water is important to entangle the fish.

And it is necessary to improve the fishing boats also with proper deck machinery , navigational and hydroacoustic equipments. Specially the net hauler is very important for gillnet operations, since manual hauling is very labour intensive and time consuming.

I feel creating awareness to the fishermen about responsible fishing practices and their advantages is also important to the development of fishery. The fishermen should take necessary actions about it to balance the development and conservation of the resources. For example they should take care to avoid ghost fishing which can be caused by the damaged gillnets.

Following fishing gears are recommended to be popularised among the Sri Lankan fishermen.

1. Drift gillnet used in Phillippines for tunas and mackerels.(Fig.2)
2. Drift gillnet used in Malaysia for Spanish mackerel (Fig. 3)
3. Set net used in Philippines for anchovy (Fig. 4)
4. Bottom set net used in Thailand for spiny lobster (Fig. 5)
5. Trammel net used in Philippines (Fig. 6)

Conclusion

One of the main goals in Sri Lankan fishery is to reach the optimum fish production using modern technology along with various conservation measures. Gillnet fishery is very effective and also a selective fishing gear. The improvement of gillnet fishery is extremely important to achievethe target and also consequential to a responsible fishery development in Sri Lanka.

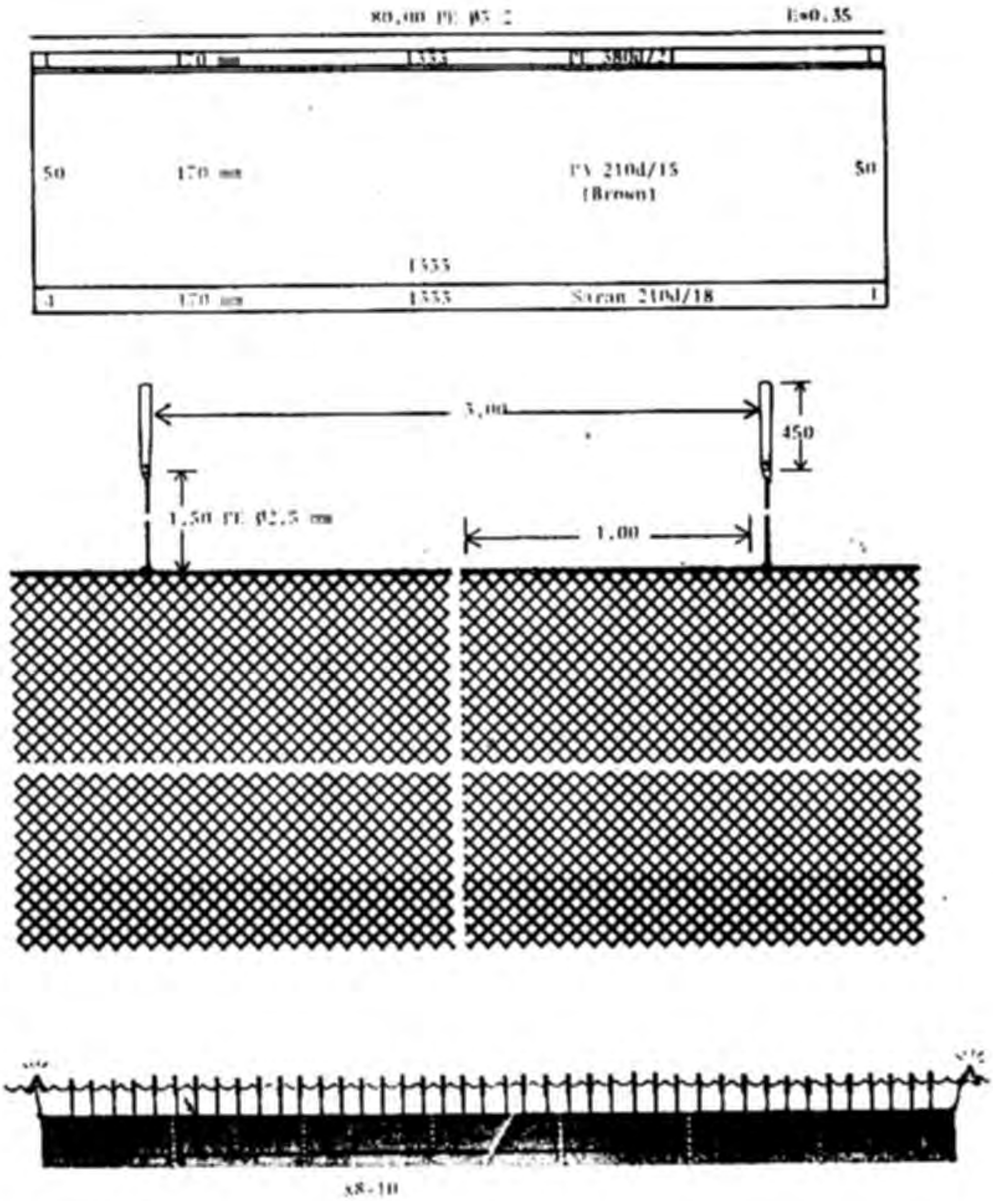
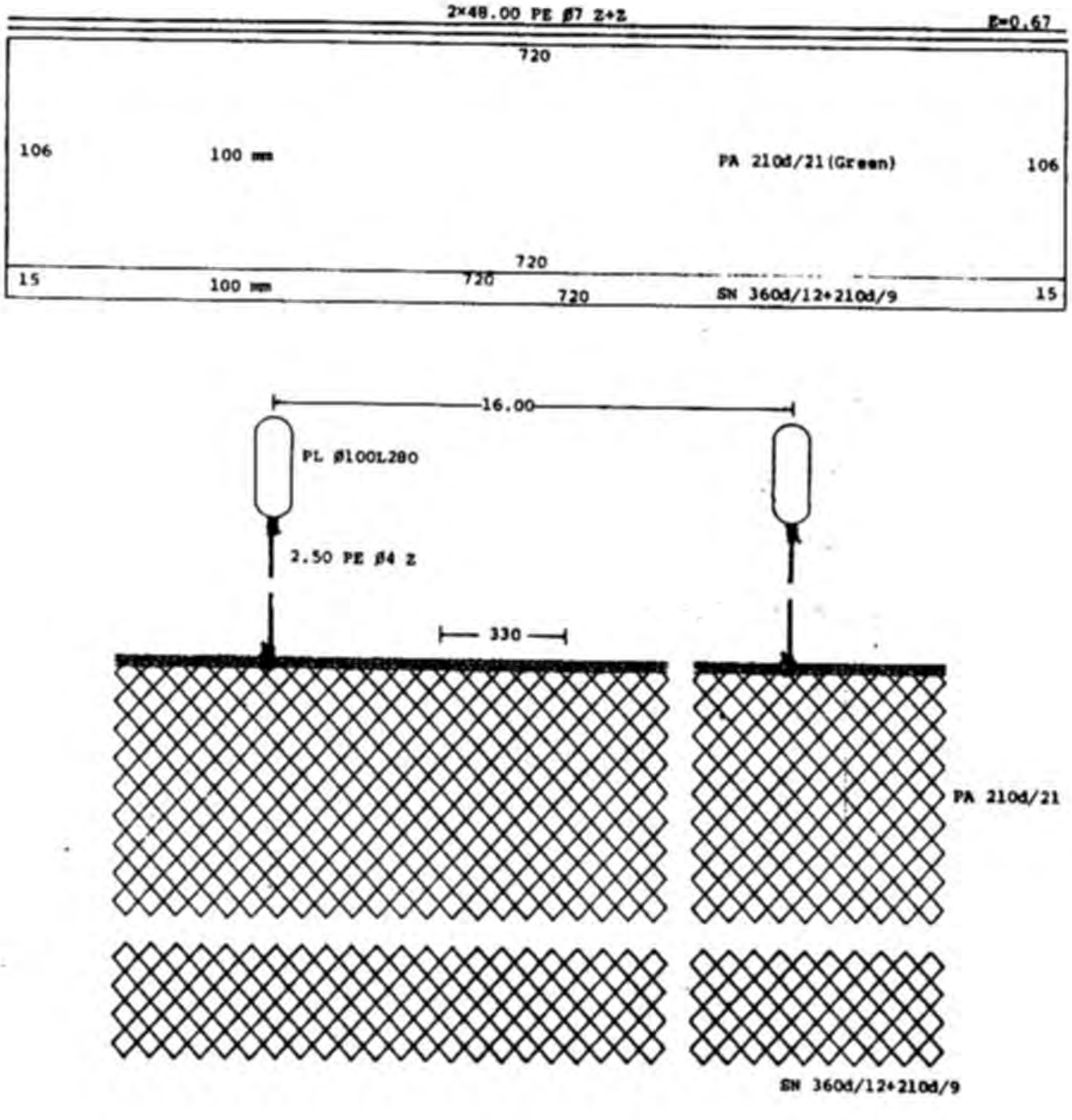


Fig. 2



2×48.00 PE Ø7 Z+Z
E=0.67
720
106
100 mm
PA 210d/21(Green)
106
720
15
100 mm
720
720
SN 360d/12+210d/9
15
16.00
PL Ø100L280
2.50 PE Ø4 Z
330
PA 210d/21
SN 360d/12+210d/9

Fig. 3

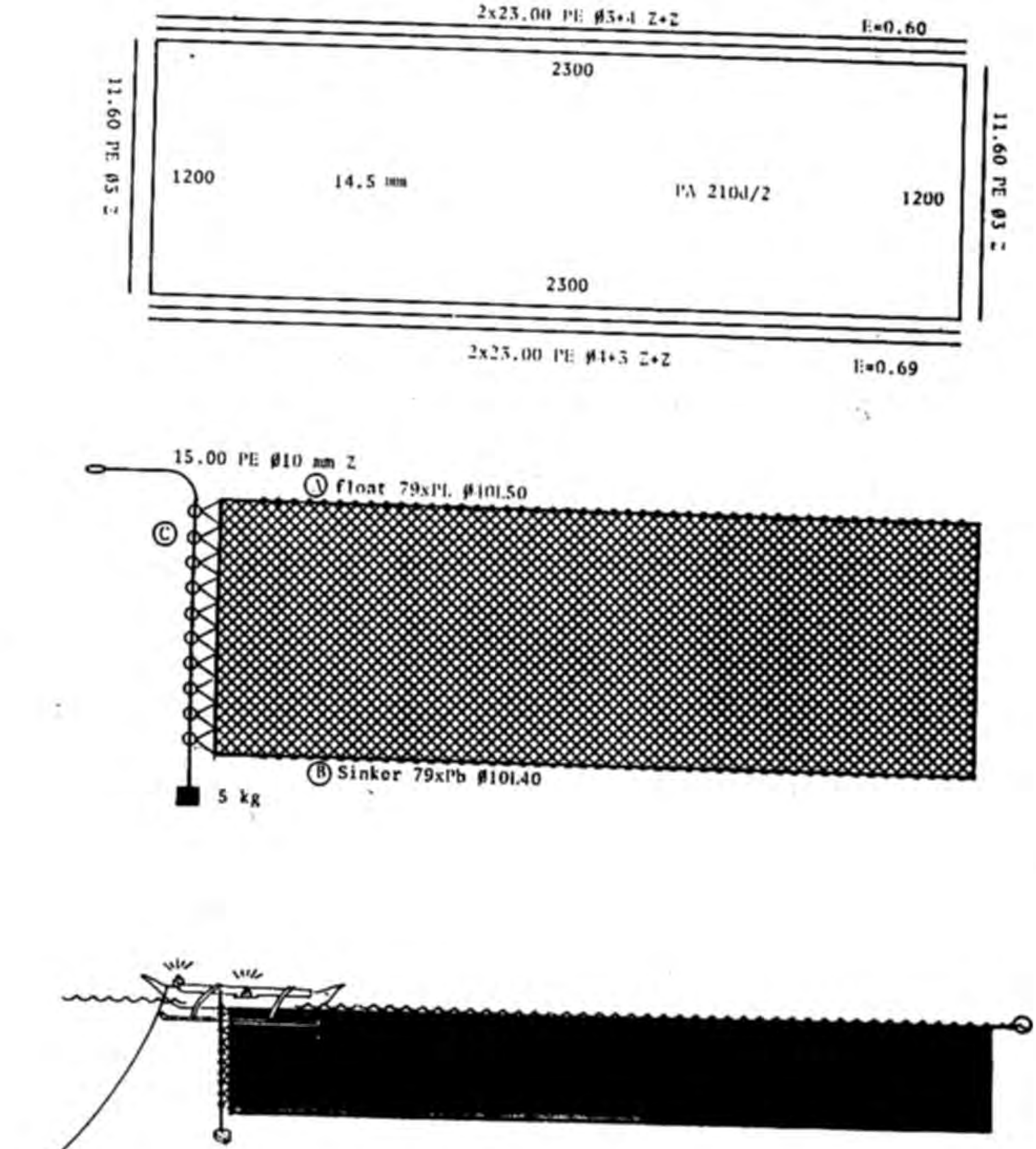

2x23.00 PE Ø3+4 Z+Z
E=0.60
2300
11.60 PE Ø3 Z
1200
14.5 mm
PA 210d/2
1200
11.60 PE Ø3 Z
2300
2x23.00 PE Ø4+3 Z+Z
E=0.69
15.00 PE Ø10 mm Z
A float 79xPL Ø101.50
C
B Sinker 79xPb Ø101.40
5 kg

Fig. 4

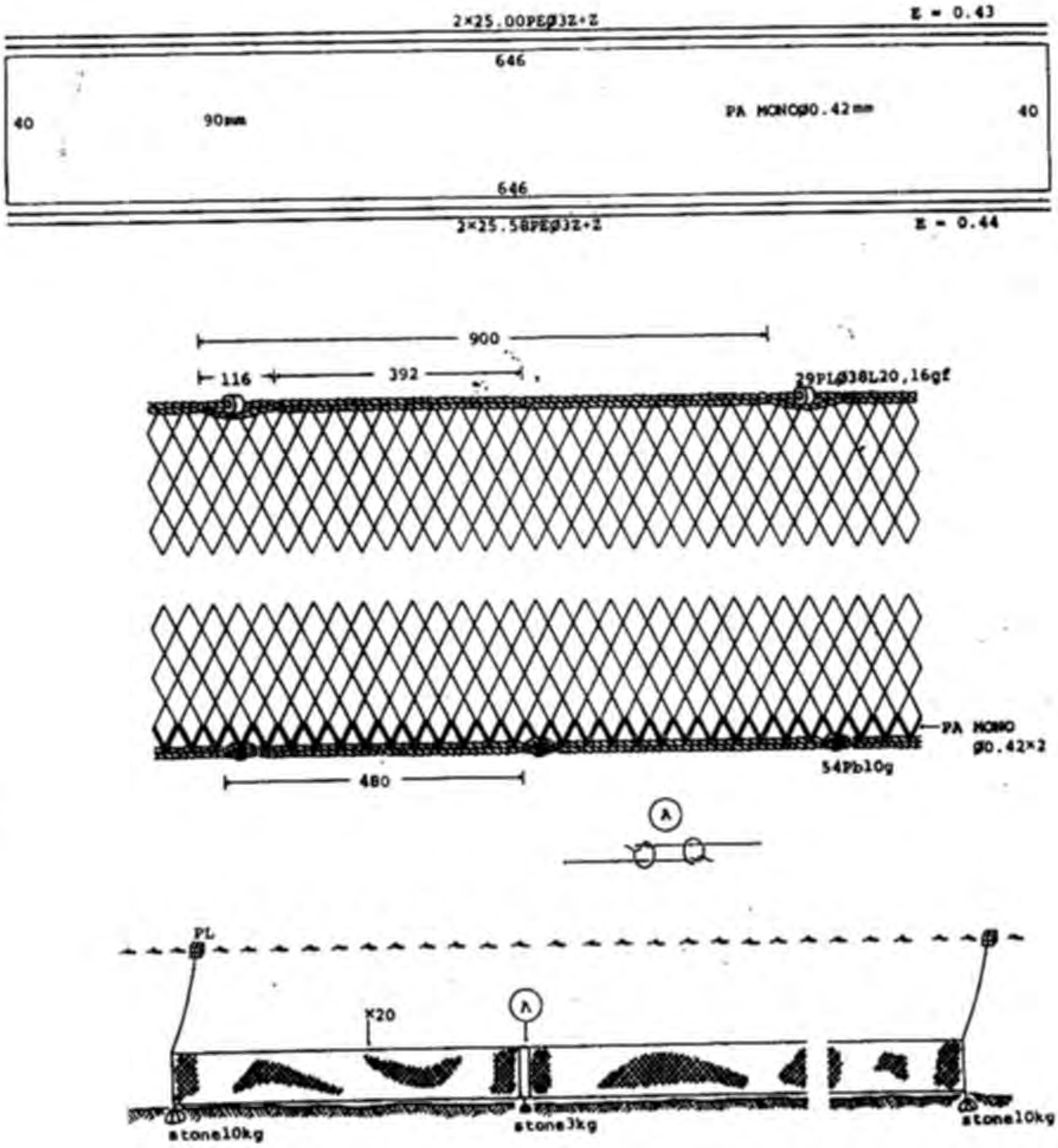
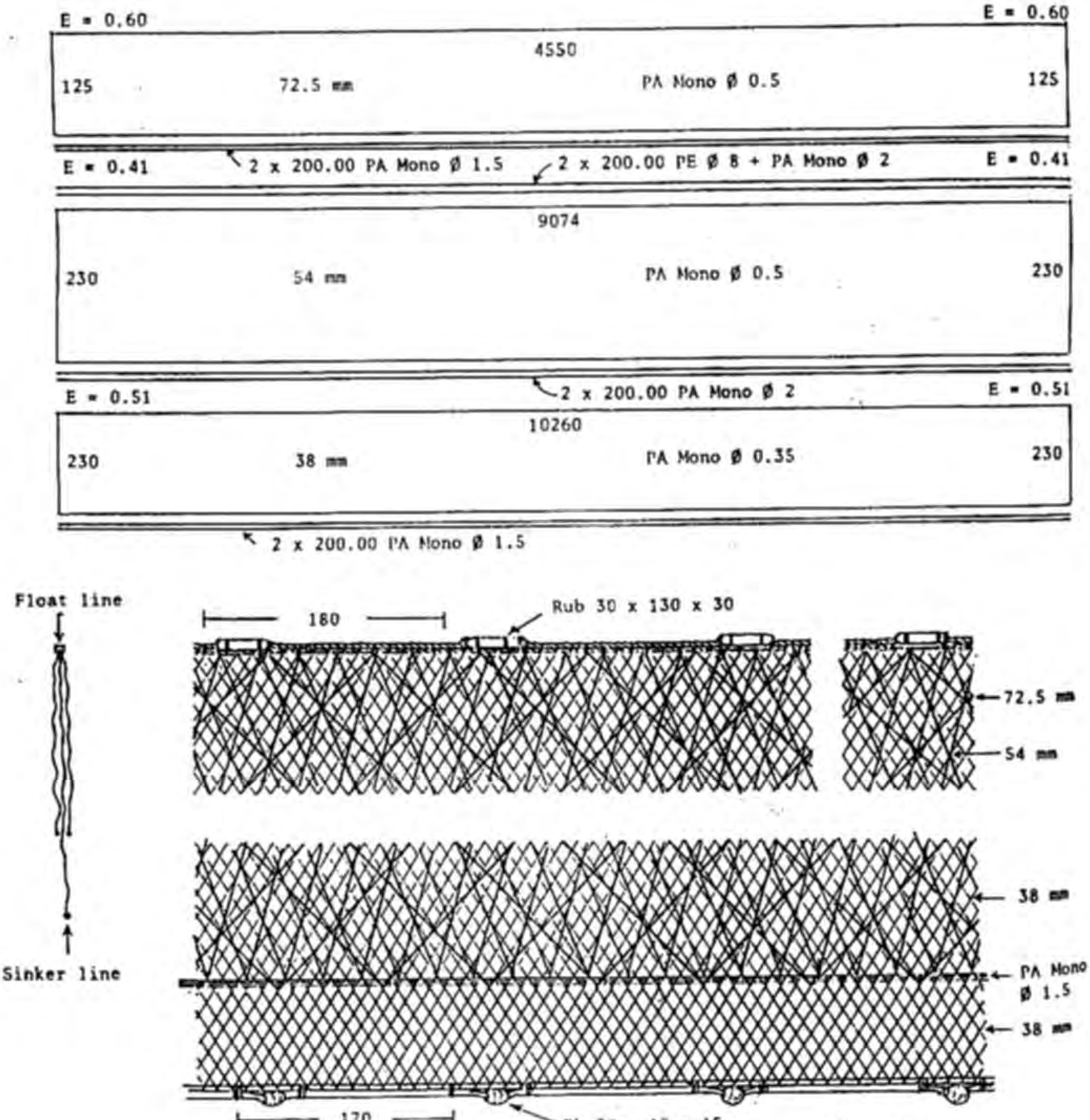

2×25.00PEØ3Z+Z
E = 0.43
646
40
90mm
PA MONOØ0.42mm
40
646
2×25.58PEØ3Z+Z
E = 0.44
900
116
392
29PLØ38L20,16gf
PA MONO
Ø0.42×2
54Pb10g
480
A
PL
×20
A
stone10kg
stone3kg
stone10kg

Fig. 5



E = 0.60
E = 0.60
4550
125
72.5 mm
PA Mono Ø 0.5
125
E = 0.41
2 x 200.00 PA Mono Ø 1.5
2 x 200.00 PE Ø 8 + PA Mono Ø 2
E = 0.41
9074
230
54 mm
PA Mono Ø 0.5
230
E = 0.51
2 x 200.00 PA Mono Ø 2
E = 0.51
10260
230
38 mm
PA Mono Ø 0.35
230
2 x 200.00 PA Mono Ø 1.5
Float line
Sinker line
180
Rub 30 x 130 x 30
72.5 mm
54 mm
38 mm
PA Mono
Ø 1.5
38 mm
170
Pb 20g, 13 x 15

Fig. 6

STUDY REPORT ON

TRAMMEL NET FISHERY : BANGLADESH PERSPECTIVE

By

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Department of Fisheries, Cox'sBazar, Bangladesh.

For

The Regional Training Course in
Fishing Technology and Resources Conservation

16 June -15 December,1997

Training Department
Southeast Asian Fisheries Development Center
Samutprakan,
THAILAND.

STUDY REPORT

Trammel net Fishery : Bangladesh Perspective

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Marine Fisheries Survey Management Unit,
Cox'sBazar, Bangladesh.

1. Introduction :

Bangladesh is bordering by India in the west, north and northeast; by Myanmer in the southeast and in the south by the Bay of Bengal. It is a densely populated and agriculturebased developing country with a large number of rivers, tributaries, canals, floodplains, ponds and mangrove areas. Her EEZ covers 200 nautical miles from the baseline in the sallow continental shelf of the Bay of Bengal. Fishery is the major sector after Agriculture. Capture fisheries from the estuarine and marine waters cover about 30% of the total fish production. Multigear and multispecies fisheries exist here. Most fishing methods in marine waters are artisanal in nature. Only about 5% marine production comes from industrial trawlnet fisheries. Among the artisanal fisheries major gears are set bagnet, bottom longline, beach seine and gillnet (drift/bottomset).There lies interactions in different fisheries- in between artisanal fisheries ,as well as, with artisanal fisheries and industrial fisheries.

The trammel nets were introduced about 15 years back by the fishermen of Teknaf, the northeast part of the country. They collected this gear from Myanmer. Due to its effectiveness and profitability, this gear became popular and spreadout upto some extends. Some studies on census, fishing, species composition, catch, effort, production and cost-earnings analysis were done by Islam *et al.* (1987,1988), Khan and Rahman (1990), Islam(1991), Islam and Khan (1993). It is revealed that this gear is selective in nature and seems not to be harmful to the resources. Some authors suggested to expand this gear horizontally, as well as, vertically. Much informations about the technological viewpoints of this gear are not available in Bangladesh. So, the present assignment is undertaken.

2. Trammel net fishery : Bangladesh situation

2.1. Gear: The special feature of this gillnet is that it has three panels attached to the same head and ground ropes(Fig.1). The two outer panels have large meshes(150-265mm) while the inner or middle panel has small meshes(40-45mm). The height of the outer panels is 1.8m, while the inner panel has a height of 2.25m and , therefore it stands in a loose hanging motion during operation. When a fish pushes through the inner smallmeshed panel, it is easily entangled in a bag forming with the help of the outer panels.

The outer panels are made with PA twine of size 210 d6 while the inner panel is of twine of size 210 d2. The groundrope of the net contains lead sinkers of 5mm diameter, placed at an average interval of 20cm. The floats on the headrope are of 27mm diameter and are placed at an average interval of 65 cm.

A complete trammel net set generally consists of 16 to 25 pieces. The majority of the sets have 18-20 pieces. The length of each piece of net is around 28m and each net costs about Tk. 1500/-(1 US$ =Tk.45/-). Locally made nets cost less. The average life of a trammel net is 4-5 years, with periodic mending or partial replacement of panels.

2.2. Craft : The trammel net fishermen generally use 8-10m long open wooden craft of 'dinghy' type, powered by oars and sail. One set of trammel net is usually operated from each boat. A crew of five or six fishermen row the boat. The price of boats vary between Tk. 7,000/- and Tk.11,000/- and their average life is 8-10 years. These boats also need periodic repairing.

2.3. Fishing area and operation : In Bangladesh, the trammel nets are operated in the shallow coastal areas at depths of 8-20m and about 3-20 km from the fishing base. The area of operation depends on seasonal conditions. From the last census, it was learned that about 400 trammel net sets were operating from 28 fishing centers between Teknaf and Moheshkhai island. The fishermen sail out in the morning and often return in the afternoon. Some fishermen conduct night fishing and return the next morning. This is a oneday fishing and fishermen do not carry ice for preservation of fish.

2.4. Fishing efforts: All 400 sets are not operated everyday. The fishing pattern depends on tides, climatic conditions and seasons. The minimum number of boats operate trammel nets during the rainy season (June-August) and maximum number in winter (December-January) when the sea remains calm. When the sea is rough , the fishermen can not set the net. Also sometimes when catchrate is low they do not go for fishing. The soaking time varies from 3-5 hours a day. According to last study ,the fishermen operated trammel net for about 140 days a year and the total fishing efforts was estimated as around 34,300 boat-days/year.

2.5. Species composition: During the investigation, it was found that seven species of penaeid shrimp, one species of spiny lobster and 29 species / groups of finfish were found in the trammel net catches. Shrimps and finfish comprised 2.4% and 97.5% respectively in the annual catch composition. Among the shrimp, tiger shrimp(*Penaeus monodon*) and white shrimp (*P. indicus*) are major species. Croakers, catfish, bombayduck, sardine and anchovy are major finfish caught.(Fig. 2). Threadfin, mackerel and jack/travally also occurred sporadically.

2.6. Catch rate: Catch rates vary with seasons. During the study period, minimum catch of 19.2 kg./day/boat was found in November and a maximum 90.2 kg./day/boat of fish was caught in December. The annual average catch was 51 kg.

2.7. Production : The annual production from the trammel net fishery was estimated at 1754 t for 34,288 boat-days during the study period, out of which about 41 t was the shrimp.

2.8. Size composition : Most shrimp and finfish were caught at sizes that were about 40 percent and more of their maximum lengths recorded in this region. Most of the shrimp caught in this fishery were in their preadult and adult stages (Fig. 3).

2.9. Population biology of the species exploited by Trammel net : Three species were considered for biological analysis to assess the dynamics of the population , for which length frequency data were available. The growth parameters ,i.e., the asymptotic length L, the growth coefficient K, natural mortality M, fishing mortality F, length at first capture Lc, exploitation rate E of the species have been furnished in table 1. The values of the natural mortality (M), fishing mortality(F),the total mortality (Z) respectively were found as 1.4, 2.8 and 4.2 for *P. monodon* ,1.41, 1.16 and 2.57 for *M. monoceros* and 1.0, 0.33 and 1.33 for *L. savala*. On the basis of the total mortality and the corresponding fishing mortality of each species the exploitation (E) pattern were estimated as 0.66, 0.55 and 0.25 respectively for *P. monodon, M. monoceros* and *L. savala*.

From the table 1, it is evident that the rate of fishing mortality of the species are not higher in comparison to the respective rate of natural mortality . From the result of the exploitation rate (E) ,it can be seen that none of the species were being overfished by the trammel net.

2.10. Cost and earnings :

Share system : Most owners of the trammel nets and boats are of the fish landing localities. They are locally known as 'bahardars'. The fishermen are paid on a share basis ,after deducting incidental expenses, which are generally small amount. If the owner is also a member of the crew, he gets a extra crew share. There is also a few cases, where the fishermen jointly own a set or sets of gear and one or more supporting crafts.

When the net revenue from the landed catch exceeds Tk. 500/-, 50% of it goes to owner of the gear and craft and the remainder is divided equally among the fishermen. If the gross income is between Tk. 200/- and Tk. 500/-, then a fixed amount of Tk. 200/- is shared among the fishermen, and the rest of the money goes to the owner. This is a traditional sharing system.

Marketing: Catch is sold on a wholesale or retail basis to the middlemen at the landing center. Middlemen sell the fish at local markets. Exportable shrimps are sometimes sold at a reasonable price to representative of a freezing plant from whom the fishermen borrow money for capital and operational costs. Croakers also have special demand from factories drying them for export.

Cost and earnings analysis : In most months ,the bahardars earn a good income from the fishery, with maximum earnings in December and minimum in March. The gross income of a boat per day during the study varied from Tk. 128/- to Tk. 3896/-, with the average gross revenue per boat per day being Tk. 1036/-. The deductive expenses being very small, the net revenue would be almost equal to the gross revenue.

The average annual gross earning per boat was Tk. 143,664/- in seven fishing months and the annual income of the owner ,after deducting the fixed costs(including depreciation, repair and maintenance cost of craft and gear-about Tk. 9000/-) was Tk. 59,437/-. The operational costs are generally incidentals such as tobacco and minor food items. During the period of study, the trammel net fishery was profitable in all months except in March, when there was a loss due to a decline in catch rate of the more valuable species (Fig. 4).

3. Trammel net fishery :Southeast Asian Experience

Everywhere, trammel nets are consists of an inside wall of loose small mesh webbing and two outside walls of large webbing. All three walls are hung to the same float and lead line. The net's depth is determined by that of the outer walls. The inside net has a greater depth and hangs loosely between the outer panels of webbing. Fish are usually captured by entanglement. The mechanism is described earlier. Most trammel nets are hung with a 0.5 hanging ratio. The hanging of trammel nets varies by area and type of fish (DeAlteris and Castro, 1990). In Southeast Asian countries different types of trammel nets are available. These are made of monofilament or multifilament twines. Size of the net and meshsize varies area to area.

3.1. Thailand : In Thailand, trammel nets are used for catching shrimp. Nets are of nylon multifilament; the yarn size for the net is 210 d/2 and for the outer net it is 210 d/4. Mesh size of inner net is mostly 40mm and outer ones ranging from 140 to 260mm. The hanging ratio of innernet varies between 0.46 to 0.48 on the floatlines, and 0.55 to 0.57 on the sinkerline. But hanging ratio of outer layer varies significantly from 0.37 to 0.79(Okawara *et al.*, 1986). Particulars of different types of trammel net of Thailand are given in Figures 5 and 6.

Fishing is done in day time, as well as, night time. The net is shot according to tides and allowed to drift by the tides for one hour before hauling. The water depth of fishing grounds is between 5 and 10 meters. However, trammel nets for cuttlefish fishing are set along the coast for about 12 hours in the day time (Okawara *et al.*, 1986).

3.2. Philippines : Different types and modifications of trammel nets are met in the Philippines. The target species is the garfish. A single layer gill net is not suitable to catch them. Three designs of trammel net are described by Munprasit *et al.*(1990).Figures 7 and 8 represent the trammel nets of the Philippines.

The original design of trammel net consists of three layers. The two outer layers have the same twine and meshsize, and the hanging ratio is more stretched than the inner layer. The inner layer has a smaller meshsize, fine twine and is more slack.

Other design consists of three layers of nets, with the same twine, but different meshsizes and hanging ratio from the first layer, which has a bigger meshsize, and the last layer with the smallest mesh. Fish that will not be caught by the first or second layer, will be caught by the last layer. This design results in gilling rather than impounding the fish. Commonly used netting is the nylon monofilament PA of 0.30mm to 0.40mm diameter and meshsized at 76.2mm (first layer), 50.8mm (second layer) and 38.1mm (third layer).

The third design is modified one and modified by the local fishermen. This is of two layer webbing. The first layer has a meshsize of 60.9mm while the second layer has a meshsize of 43.5mm with the same twine size PA of 0.3 mm monofilament. The first layer is hung at 51% while the second layer is 47% (direct method).This net is used in the Davao Gulf for catching garfish and other pelagic species (Munprasit *et al.*, 1990).
Fishing operation of the three types of trammel net is similar. The net is set on schools of garfish considering the fish and current direction. The net is set against the current, or where the fish is heading, while the scareline drives them towards the net. This net is usually operated during day time for garfish fishing and during night time for other species.

3.3. **Malaysia** :In Malaysia, trammel nets are bottomset and used for catching shrimps. Most nets are similar but different in sizes(Figs.9 &10). Meshsize of outer layers of a net is same and that of inner layer is smaller. Meshsize of outer layers in different nets varies from 110mm to 250mm and meshsize of inner layer varies from 40mm to 45mm. Net materials are also different. The outer main nets are made of PA (210 d/12,210 d/6) and inner net is of PA mono(0 0.20mm ,0 0.23mm) and sometimes white multifilament (210 d/4). At the floatline and sinkerline, the three layers are joined by nets made of PE 380 d/6 or PE 250 d/6. Its meshsize varies from 40mm to 47mm.

3.4. Indonesia : In Indonesia, trammel nets are bottomset and operated for mainly shrimping. The outer two panels are of 125mm meshes and made of PA R 152 tex. and inner layer of 44mm meshes and made of PA R 152 tex. Hanging ratio of the outer layers is 0.70 and that of inner layer is 0.40. The diagram described by Rosadani and Fachruddin (1982)is attached as Fig.11

4. Discussion:

Von Brandt (1984) and Nedelec (1975) classified trammel nets as entangling nets. In Indonesia it is used as alternative to trawl fishing (Martosubroto, 1989). In Srilanka, the fishery is welldeveloped and extended upto the South Indian coast. In Kerala of India , fishermen were advised to pay greater attention to trammel nets, because of their high earning capacity (Engvall, 1991).This net is operated in European part of the Mediterranean sea for flatfish fishing, but in the Bay of Bengal region this is used for shrimping, especially, in shallow waters (Islam and Khan, 1993).In the Philippines, this gear is used for fishing garfish and other pelagic fishes (Munprasit *et al.*, 1995). From a bio-socio-economic analysis of the trammel net fishery in Bangladesh, it is revealed that this fishery is economically and socially efficient(Khan *et al.*, 1994).

Trammel nets differ significantly and selection of gear depends on the target species, ecological condition of the fishing ground, suitability of operation and also by the choice of the users, i.e., the fishermen. Seagor (1990) described a trammel net of Philippines which is typical to original design by Munprasit *et al.* (1995),and also has some similarities with the nets operating in Bangladesh. Typical nets with two outer layers with same twine and meshsize and inner smallermeshed layer used in Thailand have similarities with those of Myanmer and Bangladesh. Myanmer imports trammel nets from Thailand (Personal communication). Indonesian trammel nets are also similar to those of Srilankan ones. They use the same materials but different in twine size and meshsize (Fig.12).

Different types of nets are made of different materials and twines, meshsizes and hanging ratio also different. Different ecological conditions prevail in this region. So, comparison of cost-effectiveness and catchability is difficult. But most authors agree that trammel nets are selective and viable. Kitahara (1968) reported a selective curve for a sweeping trammel net and showed that the net is selective at a certain length range.

Lasanes (1991) studied the selectivity of trammel nets having different vertical slacks (the ratio of the depth of the smallmeshed net to the depth of the largemeshed net) analyzing data from the Tokyo Bay fishing experiments. He found that the influence of the variations in vertical slacks were present in the catch of some species but not significant in other species . He assumed that the presence of vertical slack is important factor influencing the catch. His studies revealed that the optimum vertical slack of the trammel net for gizzard shad (*Konosirus punctatus*), the most abundant species of the study that the presence of vertical slack is important factor influencing the catch. His studies revealed that the optimum vertical slack of the trammel net for gizzard shad (*Konosirus punctatus*), the most abundant species of the study area, is between 1.1 and 1.6 and a value higher than this appeared to lower its efficiency.

The probability of escape is lower once the fish is caught by the trammel net because of higher degree of entangling. Higher degree of entangling of some fish (i.e., spiny goby) is complicated and took more time for its removal from the net (Losanes, 1991). Similar observation also reported by Munprasit *et al.* (1995). In the Philippines , fishermen have negative approach towards trammel net might be for this difficulties of removal of catch.

Largemeshed nets are more visible in water. The trammel net may be seen from a large distance by the fish and thus fish can avoid the net. Vertical slack 2.0 had a negative effects on catch of trammel net to gizzard shad. The excess netting of the small-meshed net becomes more shady when the vertical slack is increased. This increase the visibility of the net (Losanes,1989).

Combined gillnet-trammelnet is also available. The bottomset gear is made with a gillnet, the lower part of which is replaced by a trammel net (Fig.13). It may catch bottom fish in the lower trammel net part ,together with semi-demarsal or pelagic fish in the upper gillnet part (Nedelec, 1975).

In 1986, semi-trammel net was introduced to the existing nets used for Tokyo Bay experiment. This net looks like a trammel net except that one of the panels of the large-meshed net was missing.(Losanes, 1991). Losanes (1991) compared the selectivity and catching efficiency of trammel net and semi-trammel nets. He found that sometimes semi-trammel nets caught more fish of certain species. Semi-trammelnets are also efficient passive type of gear and easier to construct, easier to repair and costs also less than trammelnets. He emphasized more attention for studies on semi-trammelnets.

5. Conclusion:

Expansion of trammel net is important for its selectiveness ,espicially, in multigear and multispecies fisheries situation. It is more important to find out proper size of net, as well as, mesh size and hanging ratio of net, twine number and colour, and size of float and sinker. The learnings and experiences of trammel net fishery of this region will be helpful for future studies on expansion process of trammel net fishery in Bangladesh.

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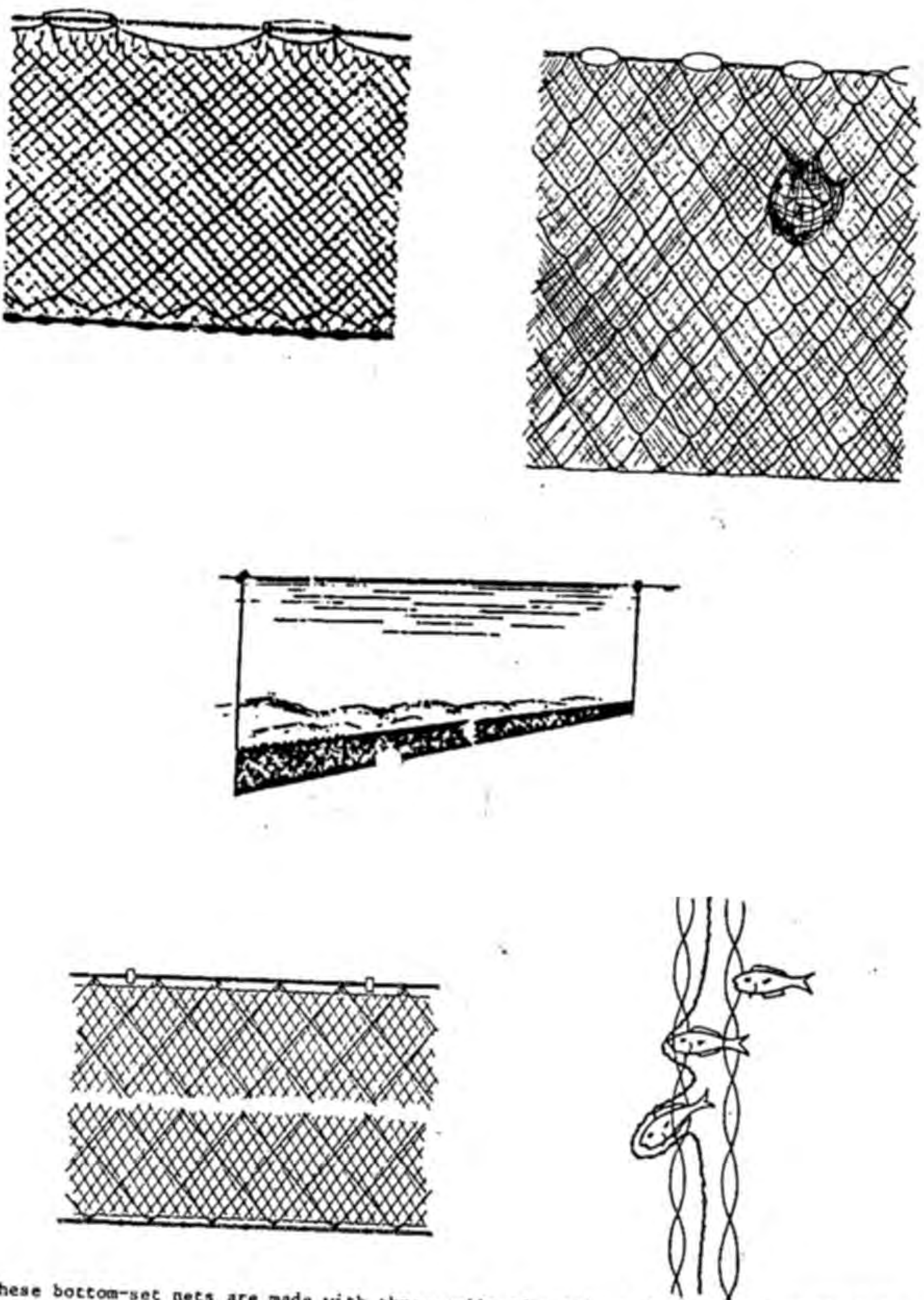
Fig. 1 : Trammel net.



These bottom-set nets are made with three walls of netting, the two outer walls being of a larger meshsize than the loosely hung inner netting panel. The fish get entangled in the inner small meshed wall after passing through the outer wall.

Fig 2 : Annual percentage species composition of trammelnet catch

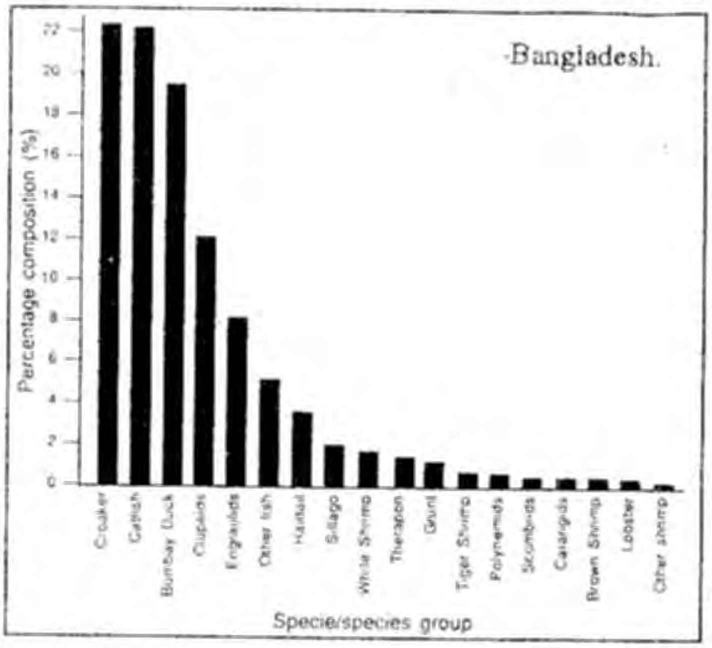


Fig 3 . (a) Size ranges and predominant size ranges of major shrimp, lobster and finfish caught in the trammelnet fishery and (b) Size composition of *P. monodon*, *P. indicus*, *M. monoceros* and *L. savala*

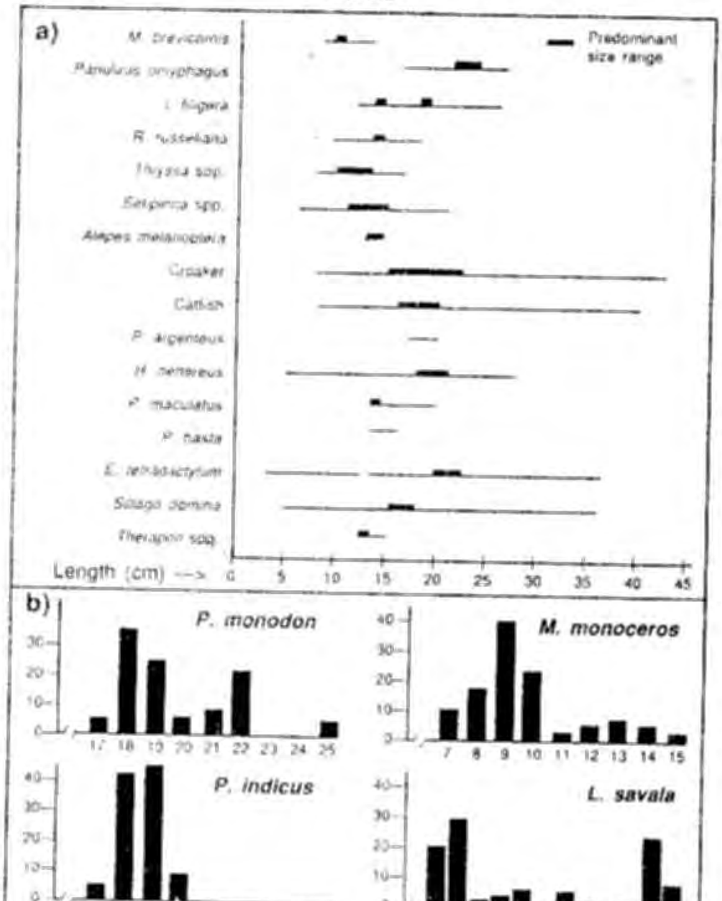


Fig 4 : Monthly cost and earnings analysis of trammelnet fishery - Bangladesh.

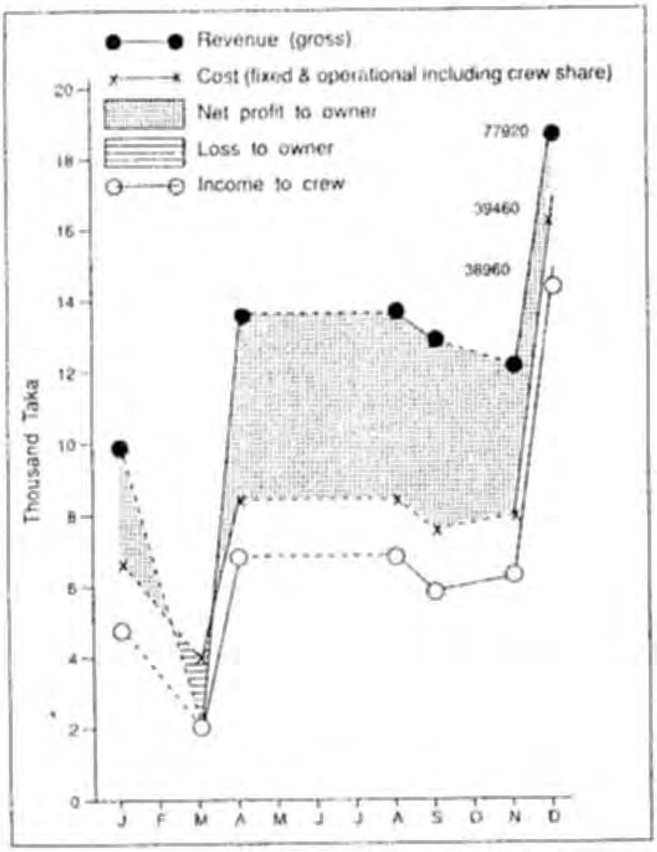


Fig. 5 : Design and specification of a trammel net used in Thailand.

GILL NET	VESSEL	LOCATION
Trammel, Bottom set	Loa 5 m	Huasai
Cuttlefish	hp 4 LT	Nakhonsithammarat

Fig. 6 : Design and specification of a trammel net used in Thailand.

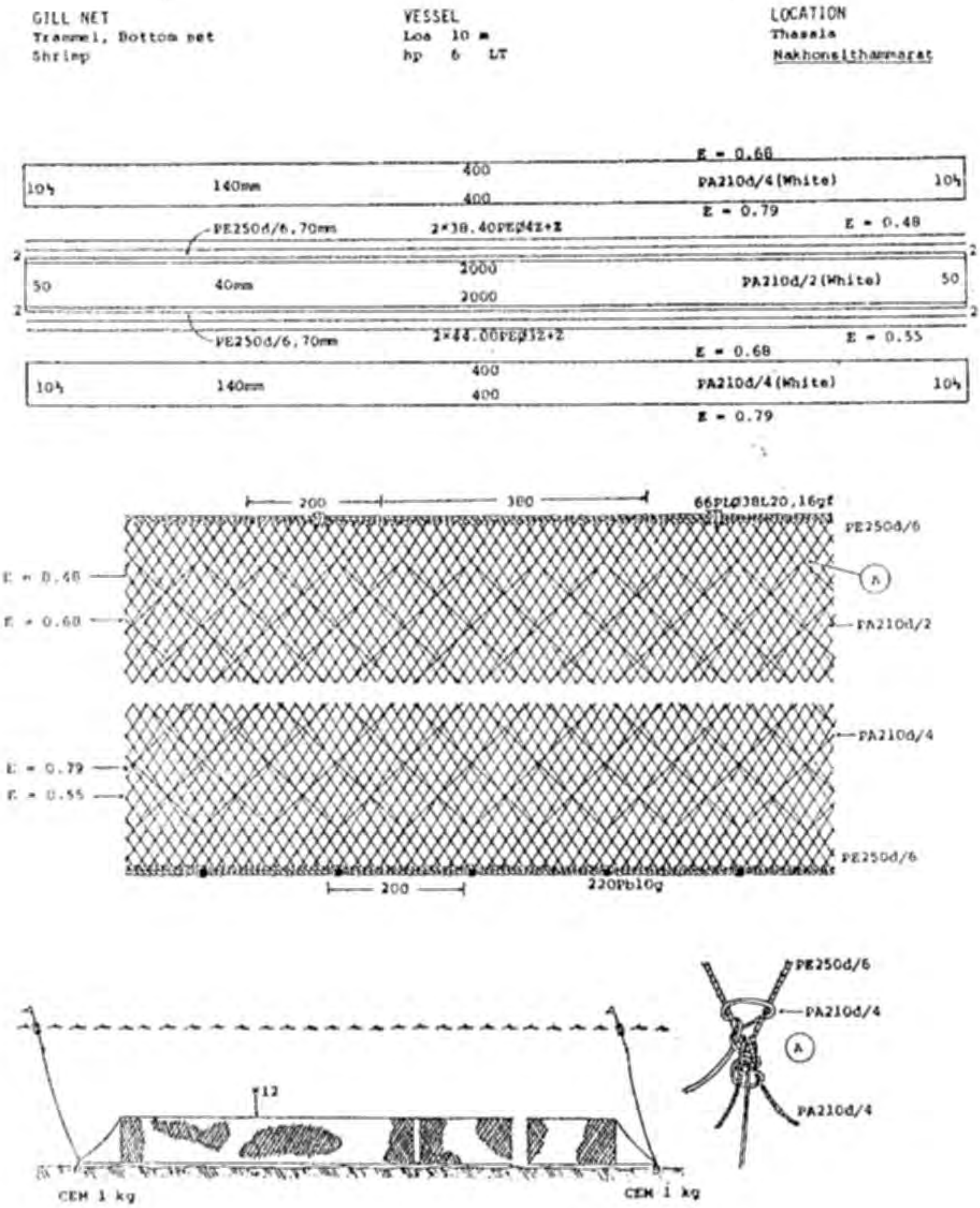


Fig. 7 : Design and specification of a trammel used in the Philippines.

GILL NET	VESSEL	LOCATION
Trammel net with scareline *Pukot Pamalo-auluwanid*	Loa 10 m	Nailon, Bogo
Garfish, halfbeak fish	hp 16	Cebu

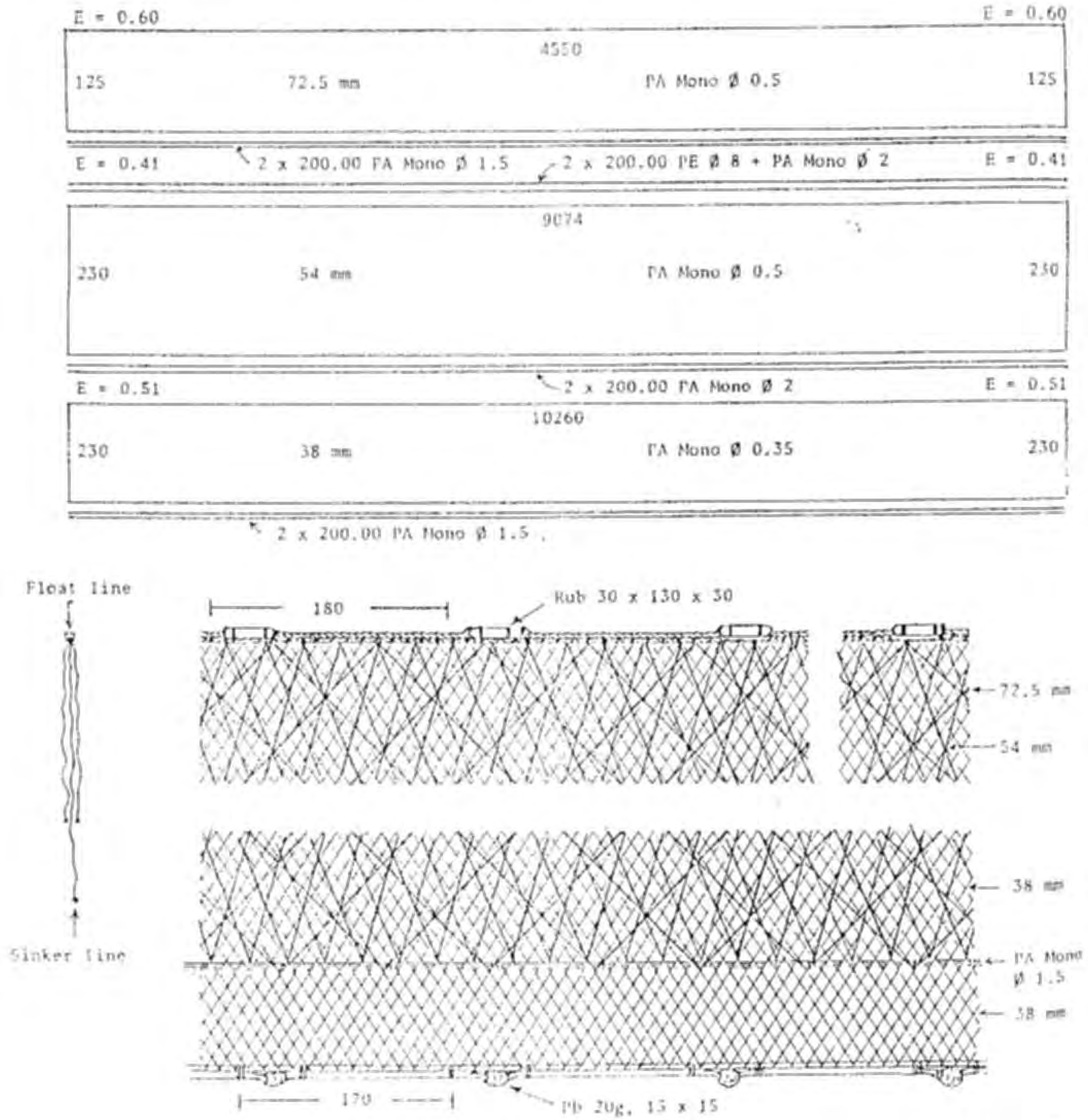


Fig. 8 : Design and specification of a trammel net used in the Philippines.

GILL NET	VESSEL	LOCATION
Trammel net with scareline	Loa 10 m	Santa Cruz
Transmaliyo	hp 16	
Garfish, other pelagic species		Davao del Sur

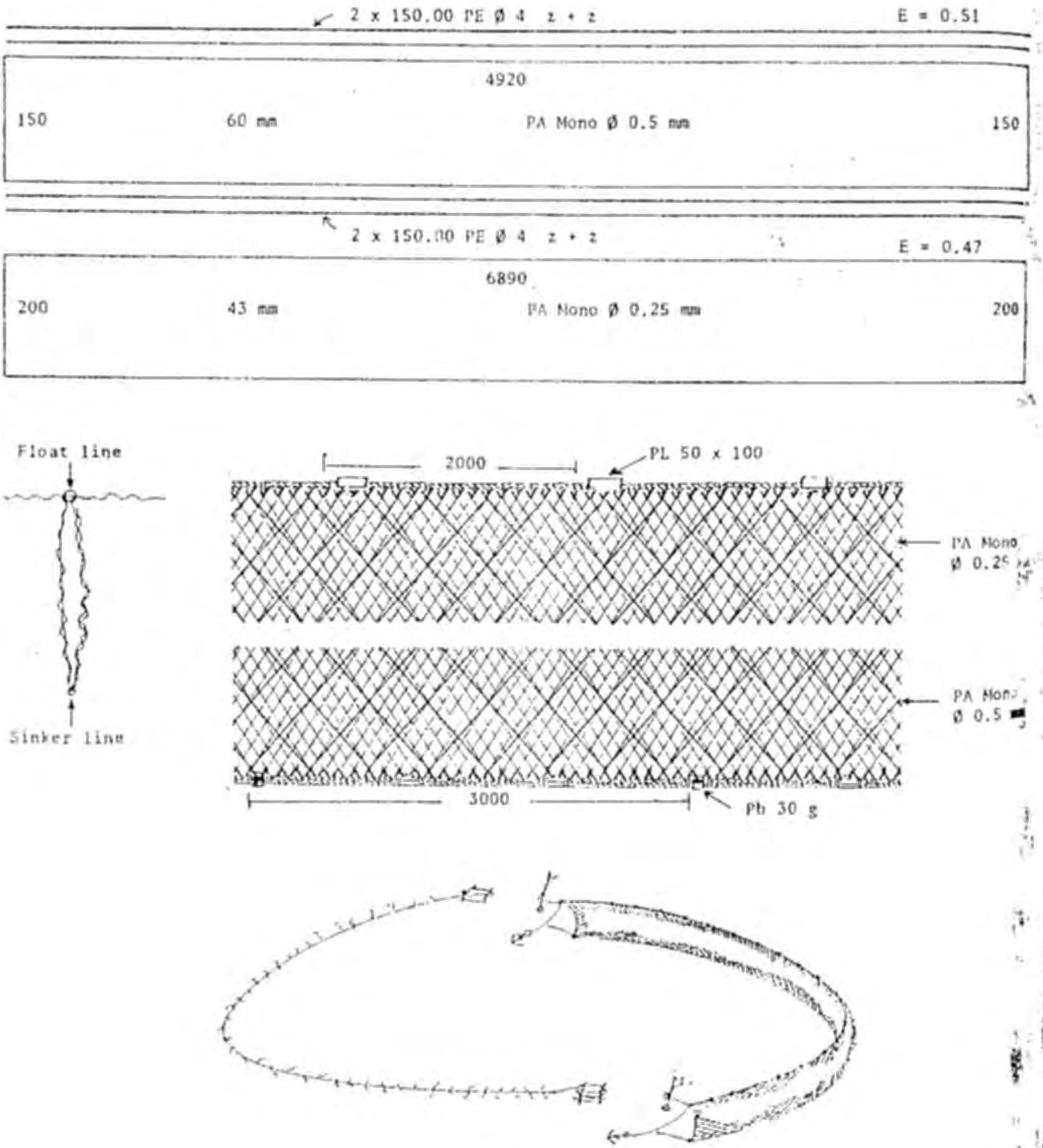


Fig. 9 : Design and specification of a trammel net used in Malaysia.

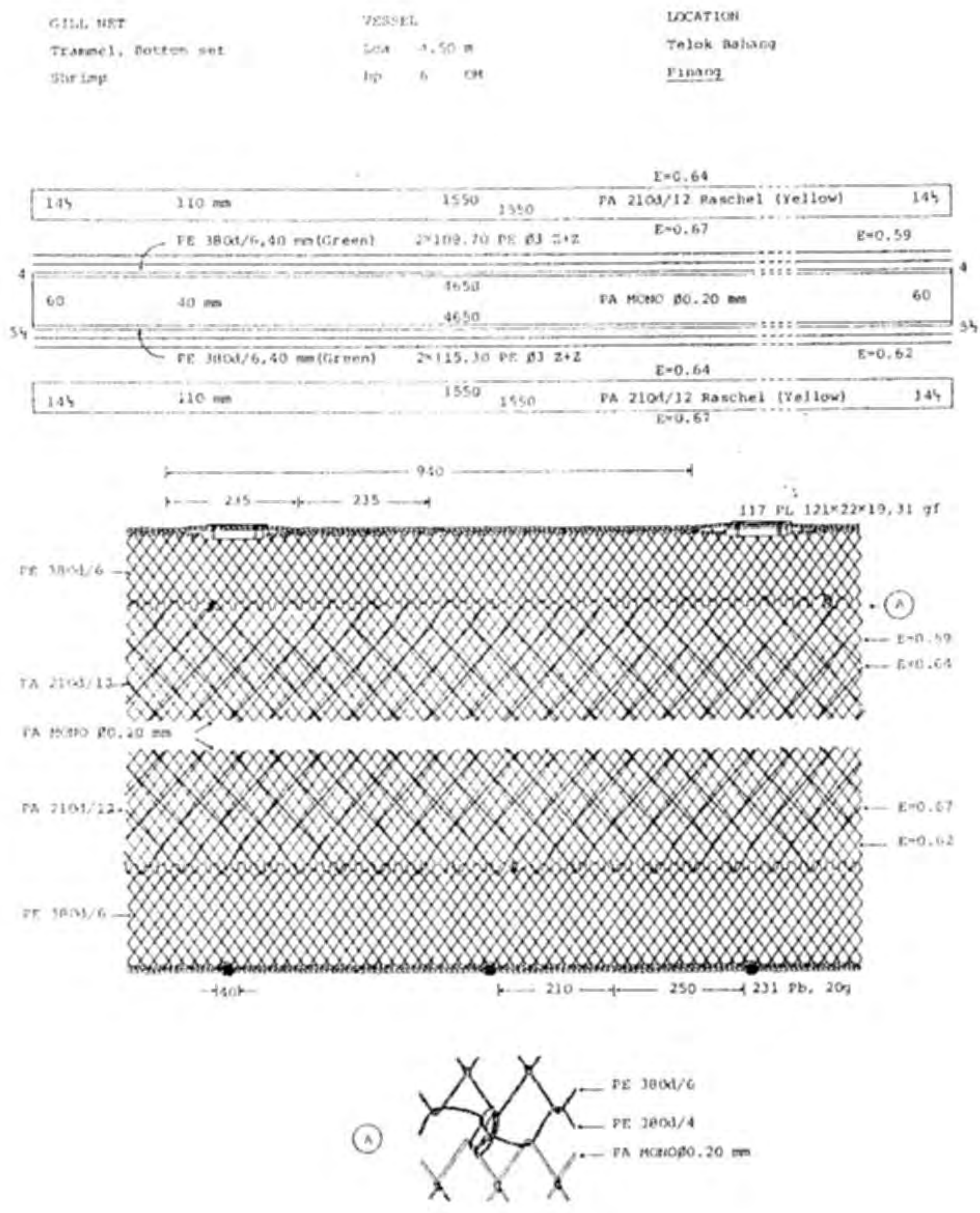


Fig. 10 : Design and specification of a trammel net used in Malaysia

GILL NET	VESSEL	LOCATION
Trammel, Bottom set	Loa 11 m	Pontian Kechil
Shrimp	hp 22	Johor

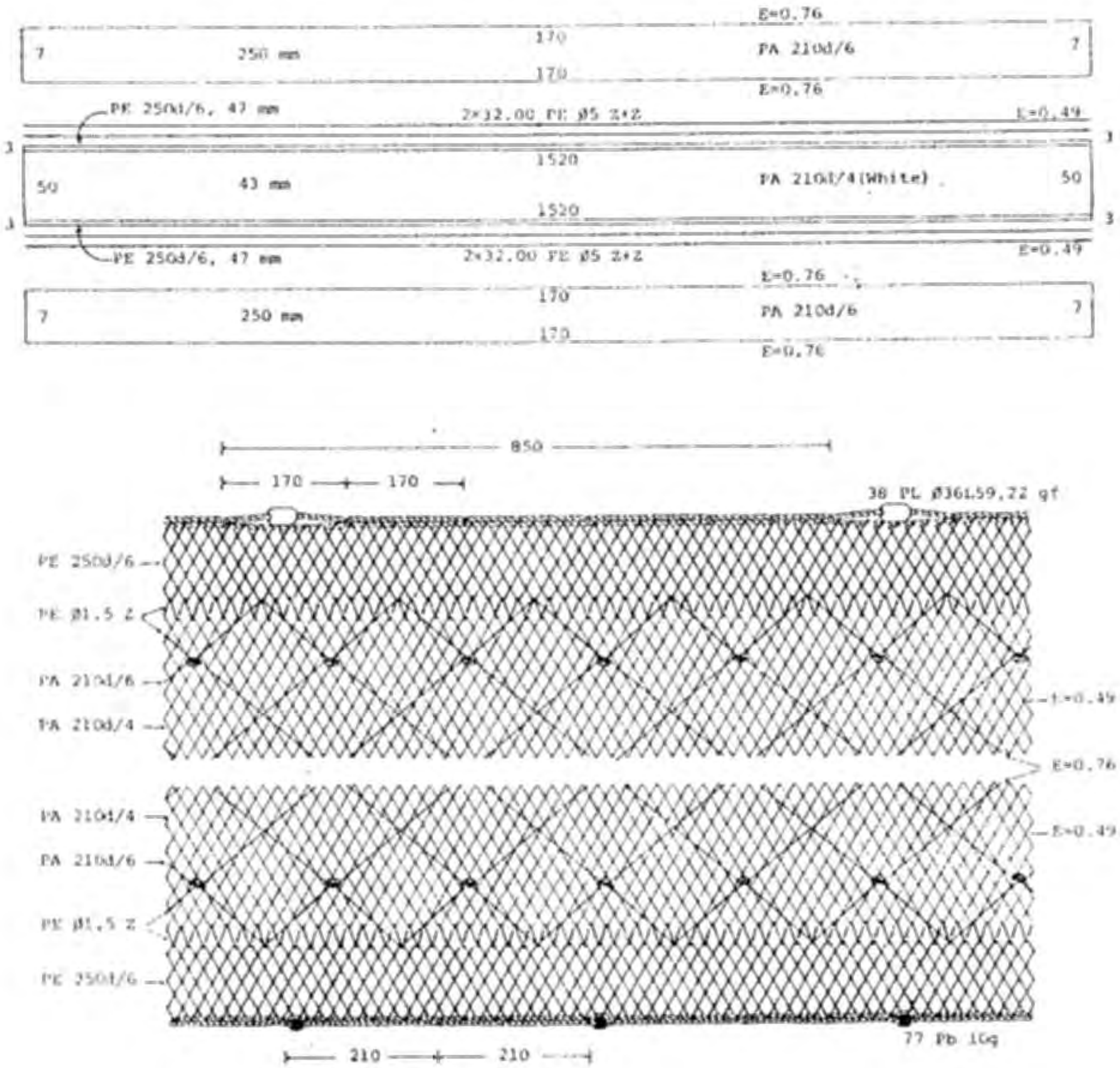


Fig. 11 : Design and specification of a trammel net used in Indonesia.

REFERENCE :

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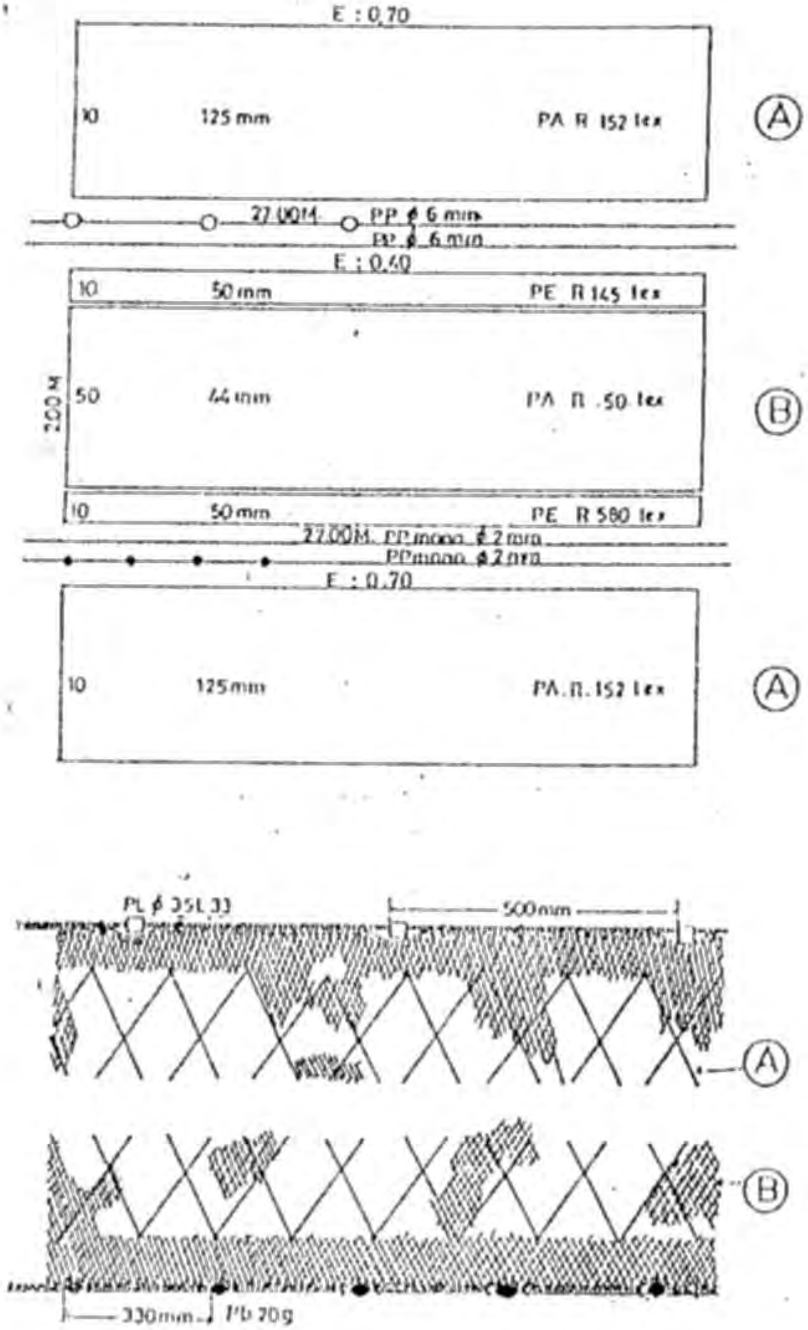
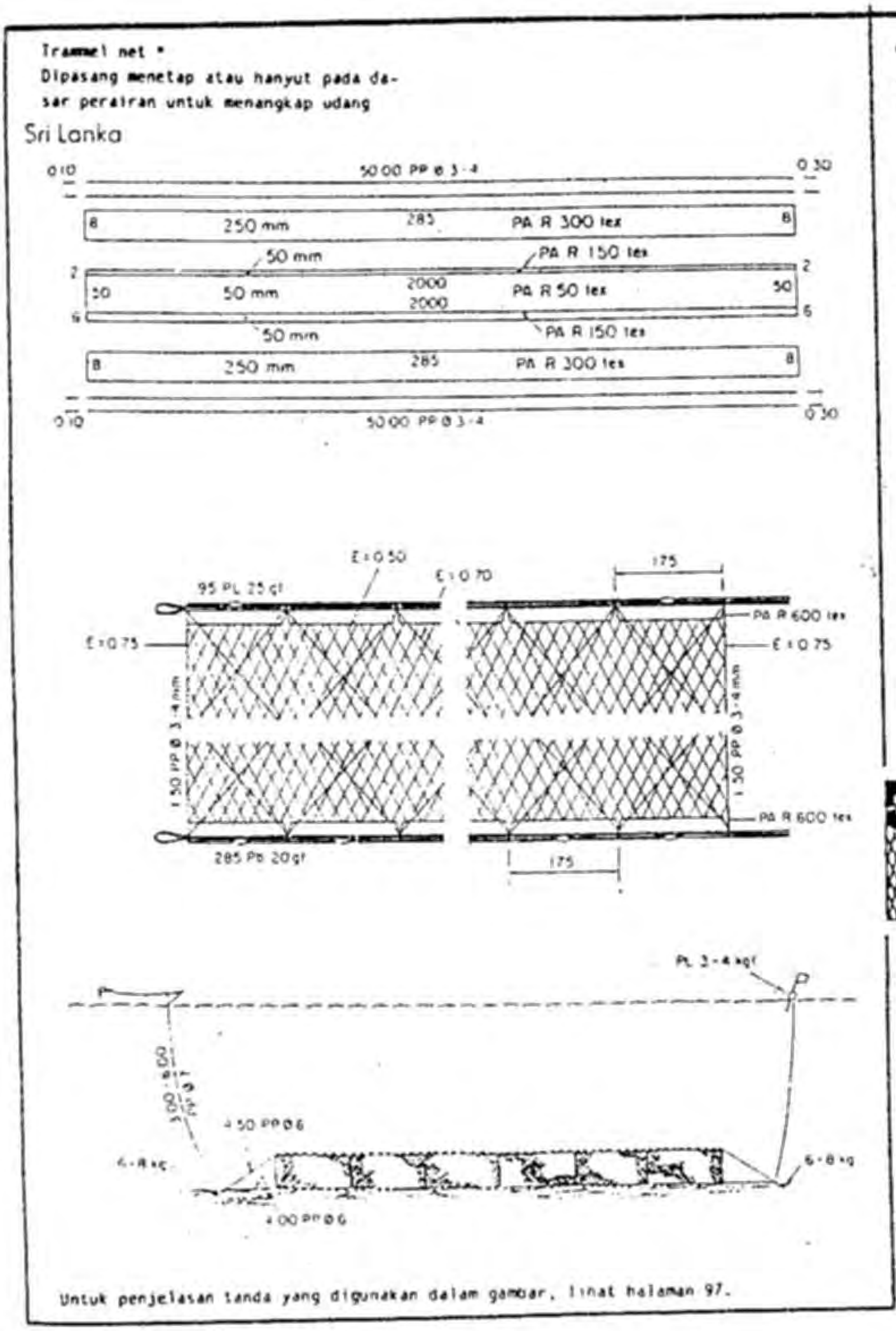
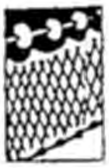


Fig. 12 : Design and specification of a trammel net used in Srilanka.



Jaring puntal



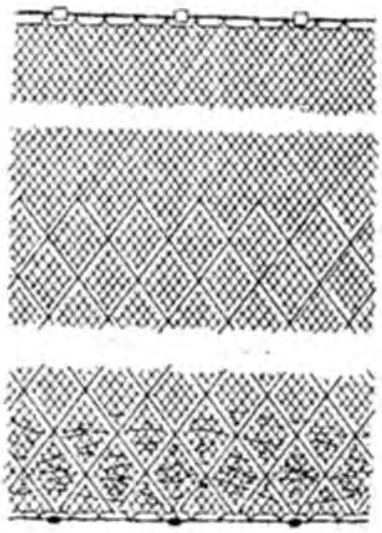


Fig. 13 : Combined Gillnet-Trammelnet.

This bottom-set gear is made with a gillnet, the lower part of which is replaced by a trammel net. It may catch bottom fish in the lower trammel net part, together with semi-demersal or pelagic fish in the upper gillnet part.

Table 1. Population parameters of *P. monodon, M. munoceros* and *L. savala*

Species	L_{∞}	K	M	F	L_c	E	C	M/K
P. monodon	31.3	0.72	1.4	2.8	18.1	0.66	0.548	1.89
M. monoceros	19.2	0.58	1.41	1.16	10.1	0.55	0.52	2.43
L. savala	108.6	0.72	1.0	0.33	73.65	0.25	0.64	1.44

SET NET FISHING (LAMBAKLAD) IN THE PHILIPPINES

A study report
presented to the
South East Asian Fishery Development Center
(SEAFDEC)
Training Department
Thailand

for the
Regional Training Course in
Fishing Technology and Resource Conservation
(1997)

MARITES B. CHIUCO
Philippines

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I. INTRODUCTION

[1] Set net or *"lambaklad"*, as locally known, is the largest existing trap in the Philippines. The country's physico-demographic characteristics, which is archipelagic in nature, provides a good fishing site for set net fishery owing to the presence of numerous inlets such as bay, gulf and cove areas. Also, the coast lines are situated facing the high seas which are the migratory path of big pelagic species (i.e., China Sea, Sulu Sea and Pacific Ocean).

This is an introduced gear from Japan known as *"otoshi-ami"*. In 1957, two units were installed in Palauan Bay, Occidental Mindoro and has found to be very effective in catching tuna and tuna-like species. Its mode of operation is similar to a fish corral, a traditional small-scale entrapping gear. But it differs on the depth of deployment since the later is confined in shallow portions of the coast (> 25 m deep) and make use of bamboo as post. While lambaklad could be set at deeper areas ranging from 25 to 100 m deep and where bigger pelagic fishes thrives. Set net is one of the ideal form of fishing gear in the country because of the widespread fishing ground (Fig.1).

The average fishing season is eight (8) months in a year for those gear facing the open sea and year round for those units installed in bigger bays (Aguilar, 1989). As to date, around ninety (90) units are deployed in provinces of Antique, Aklan, Iloilo, Cagayan de Oro, Negros Oriental and Zambales. Although capital intensive, lambaklad units are steadily increasing due to positive feedback gained from its users. Proprietorship could be in individual or joint (fishing associations) form. Current estimated cost per unit is about P700,000 to 1 Million ($23,000-33,000).

In cognizance of its potential, the national government is encouraging small-scale fishers to engage more in this type of fishery in order to alleviate poverty among them. The transition of fishery industry from small-scale to a more bigger and more profitable fishing ventures are currently being intensified. Subsidies are being given in terms of loans, free or minimal lease right fees, lower tax imposition and technical assistance in field survey and construction. More importantly, in line with the resource conservation and management scheme of the national government --- lambaklad is identified as one of the most suitable fishing gear for use since it provides less fishing pressure and danger on the natural habitat of marine resources because of its passive character. And, recovery of degraded fishing grounds and fishery stocks enhanced.

Since set net is a naturally complex gear, this paper will try to simplify the approach on its construction and operational procedure for better understanding of Fishing Technology trainees who could be new in this field. It also aims to promote its use, where applicable, among the neighboring countries in Asia.

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[1] In this paper, the term will exclusively refer to one of its type (i.e., lambaklad) since there are other traditional forms of set net in the country.

II. REVIEW OF LITERATURE

Among the countries in the South East Asian Region, set net is most popular in Japan. Intensive studies were carried out to improve the technological performance of the gear by understanding the behaviour of target species. Behavioural patterns such as feeding and feeding migration, spawning period and area, swimming speed and fright reactions relative to environmental stimuli has greatly helped in finding the suitable set net design and fishery tactics in different fishing conditions (Nomura, 1981 as cited by Laevestu, 1997). Increase of gear efficiency could also be attributed to the advent of synthetic nets, usage of mechanical and electronic equipment that made the scale of operation intensified from small to large scale fishing.

Locally-published papers about set net is still minimal. A construction manual was comprehensively made by Aguilar (1989) which is one of the pioneers in setting lambaklad in the Philippines. Other studies concerns cost and profit analysis (Guerrero, 1989) of single- and joint-prorietorships in set net fishing. These are conducted in provinces of Antique, Aklan and Zambales. Results indicated that with proper management of set net, a good profit and early return of investment (less than a year) could be achieved.

III. DESCRIPTION OF THE GEAR

Lambaklad is classified as a stationary trap because it is fixed by anchor or sand bags to the sea bottom and buoyed by floats at the surface. Aside from this, it could also be categorized as a trap net because the largest and most important part of it consists of net materials. The mode of catching is through entrapping and largely dependent on the fish behavior of target species in the chosen fishing site.

It has four (4) distinct parts, namely : (1) the leader; (2) playground; (3) slope; and, (4) bag (Fig. 2). The *leader* is a fish intercepting device that leads fish inside the gear. The *playground*, on the other hand, has two pointed netting which serves as mouth opening of the trap. The entire netting part is like a semi-circular curtain that serves as an extended fish swimming area. To hold the fish inside the trap, the luring and non-return mechanism of it is provided by the *slope*. This funnel-like part is composed of two sections : the outer and inner slopes. The outer section is angled and the portion is wide which slowly tapers at the end (i.e., inner slope). Connected to the slope is the bag. After the fish has entered, they are impounded in its pocket which is made of finer meshed net. In the Philippines, one-end bag net could be uniformly found while in Japan double-end bag is currently being used.

IV. FISHING GEAR AND METHODS

.1. *EVALUATION OF THE PHYSICAL SITE*

Before designing the gear, a site inspection is being conducted to assess the suitability of the fishing ground and the depth of gear to be deployed. Generally, the fishing ground is usually characterized by a steep coastal drop off with approximate depth of about 25 to 35 meters or more. The conditions for site preference could be categorized into two : meteorological and biological factors. Specifically, they are listed below :

I. Meteorological Factors

(1) *calm to moderate current.* The maximum current speed should not exceed to three (3) knots during high and low tides. This typical condition could be found in a bay, gulf or cove areas;
(2) *current direction.* It is essential to know this condition to plan the proper alignment of the parts of the gear. Problems such as swaying of net in different directions could be avoided which, in turn, affect the entrance of fish;
(3) *wind direction and pattern.* Prevailing winds should be determined to know the wave direction in relation to fish movement; and, weather condition during monsoon season;
(4) *clean seabed and muddy substrate.* Good water quality and firm substrate is suitable for set net fishing; and
(5) *highest tide.* The depth of the net structure is designed accordingly on the highest level of water it could be deployed.

II. Biological Factors

(6) *abundance of plankton.* These organisms serves as basic food for small fishes. An area where an inter-mixing of warm and cold currents occurs is suitable for plankton growth;
(7) *biological indicators.* Presence of squids, anchovies, juveniles of sardines, herrings and mackerels are good indications that the fishing ground is appropriate. Where small fish are abundant, bigger fish stop their migration and take small fish for food.
(8) *seasonality of migrating species.* The period and season of their occurrence.

The hydro-biological factors of the fishing ground could be determined by using instruments such as echo-sounder or sounding lead, current meter, thermometer, portable compass and maps. Secondary information from well-experienced fishermen in the area could be used such as fish season and weather condition of the locality.

B. DESIGN AND MATERIALS

After site survey, the design of the gear could be prepared. Information on the depth of soundings and the contour of the seabed are pre-requisite for planning the length, width and depth of gear and estimation of materials to be used.

A diagram for the net design is provided in Fig. 3. Each part of the gear has its own netting mesh size, twine size and kind of material (Table 1). For obtaining the proportion of the net parts to a given depth of water Miyamoto's methods are adopted (Table 2). The type of rope and twine size to be applied for each intended part is listed in Table 3.

Some terms used in the gear construction are provided in Appendix A.

C. GEAR CONSTRUCTION

The major net portion are constructed in the following order :

C.1 The bag.

The initial part to be constructed is the bag. The strips of netting are cut according to its prescribe sizes. It has three (3) parts, namely : bag entrance; side walls with flooring; and, impounding bag or pocket. After cutting, the strips are joined together by lacing. Two (2) whole meshes are taken on both sides to serve as rib line. Its purpose is to prevent tearing of the webbing from strong outside forces (e.g., current).

Meshes along the four (4) sides of the flooring are reeved by a double twined tying rope (6 mm ∅ PE). For the bag entrance, same procedure as the later. However, some portion of the nets are tapered based from the design. Reeving of side meshes are also done along the walls of the bag entrance. The bag's pocket has a central netting which are made up 25.4 mm. mesh size while its impounding wall are made up of two (2) pieces of tapered nettings with bigger meshes (i.e. umbrella netting which acts as a ceiling at the top portion of the bag to prevent fish escape in case the mainframe is submerged).

After the side walls and floorings are joined or hung together, said nets are attached to a single leadline by stapling. Meshes along the four (4) side walls and the floorings are distributed by counting the number of meters of the hanging line. Subsequently, after the bottom nettings are hung with the floorings, these are hung into four (4) single ropes attached to the leadline. A vertical hanging of 30% or 1.3 applied.

After the four walls are hung vertically, these nettings are hung again horizontally at about 40% or 1.4 hanging rate at the bag entrance. Finally, the umbrella netting will be attached along the float line of the bag.

C.2 The slope.

The construction of the slope or ramp starts from the flooring or center netting. It has a base width of 1.5 times the depth of the gear and its length of about 1.6 to depth. Strips of netting are laced together taking one whole mesh at outer sides and a single clove hitch being applied for every after three whole meshes as a fastener. Two identically cut tapered nets will be laced at the side of the center netting. Following this, the measurement of two side walls are taken from the actual depth corner of the division line of the slope and playground. The sidewalls are constructed with vertical meshes. Bottom meshes are tapered and double twined according to its required depth and angled at about 15° from the sea bed floor. Then, these are reeved using a 6 mm rope. The two tapered side walls and two side floor nettings are hung by stapling into a single leadline. Similarly, the base netting to be settled at the sea bed will be hung with a heavier leadline. The upper portion of the nettings are also hung horizontally to the floatline using the same hanging rate.

C.3 The playground.

As mentioned earlier, the playground is like a curtain like netting with a tapered bottom along the leadline to fit the bottom contour. Mesh size nettings of 152.4 mm PE material are horizontally laced from the prescribed length and depth of the design. Bottom nettings are tapered accordingly based from the actual depth soundings along the mainframe of the playground. After doubling the twine of the outer nettings, these are reeved and hung to a heavier line. Each corner has its own ribline where stone weights are attached including the pointer nettings. The heavy netted stones prevent the swaying of the net caused by currents.

C.4 The leader.

The length and depth of the leader nettings depend on the length of the leader frame. Soundings at an interval of 5 meters starting from the entrance towards the shoreline are taken beforehand. Strips of nettings are laced horizontally to their required length and depth. Again, the bottom nets are aligned with the bottom contour. These are double twine and reeved with a 6 mm rope. Bigger mesh nettings are used (304.8 mm PE) for the leader to lessen the resistance to current as it is set perpendicular to it.

C.5 Fishing accessories

The accessories being used for lambaklad fishing are as follows :

C.5.1 Anchor bags

The anchor bags are made of polyethylene net with about 21 horizontal meshes and 8 vertical meshes with mesh size of 203.2 mm (8 inches). Mesh to mesh joining are made at the side panels. A polypropylene rope with 18 mm ∅ is attached at the side nettings to serve as a support rope. It is constructed by splicing a nine (9) meter long rope and tying at the mid-portion forming four (4) ropes. The joint is placed at the base of the anchor bag by tying the ropes equally around the bag meshes. The two loop ends are where the anchorline is tied for the anchoring of the mainframe.(Fig.4)

C.5.2 Mainbuoy

The round or rectangular shaped mainbuoys are two types being utilized for set net fishing. The pressurized steel made round buoys has a measurement of 25.4 mm thick and 1500 mm diameter (Fig. 5). The rectangular form, on the other hand, is a locally made mainbuoy made of four steel plates measuring 2 x 4 x 8 inch.(Fig. 6)

C.5.3 Secondary float

The number of floats depends on the load to be carried by the floats. Commonly used are made to order rectangular styro floats (12 in. height x 14 in. length). A 6 mm. diameter polyethylene rope are tied along the float as netting. The tying rope connect the floats to the mainframe (Fig.7).

C.5.4 Leadline

Application of lead weight depends on the current velocity. The common size being used is no.8 or 9. The lead are inserted to ropes (PA, PP or PE) according to its required distances (Fig.8). Each of the net part have leadlines to bring the nettings down to the seabed.

D. *CONSTRUCTION AND INSTALLATION OF THE MAIN FRAME*

The mainframe is the skeleton part of the set net. It is where the nettings are hung altogether with the fishing accessories. Two coils of 36 mm polypropylene rope of about 220 m/coil are spread out side by side and measured according to its design (Fig. 9). The division line is tied permanently to the mainframe conforming to the length of the bag, slope, playground and briddles at both ends. The ends of the briddle mainframe are eye-spliced to the ring of the mainbuoys. The opposite ring serves as the attachment for the anchorlines. The floats are tied following the required distance. At the bag part, the floats are placed at a closer distance while wider intervals are placed at the slope and playground parts.

Before installing the mainframe, one mainbuoy will be placed either at the locality of the bag side or playground considering the direction of wind and surface current. The anchorline is tied with the buoy. The entire mainframe are brought along the intended site by a motor boat where the float and anchorline have been placed. The mainframe is stretched at its right portion marked by a flag buoy with two anchor bags dropped. After the mainframe is anchored, the soundings of the mainbuoy area will be verified. Adjustment of the position of the two mainbuoys is done by a series of dropping anchor bags to different directions until its placement is satisfied and permanently placed.

The mainframe is opened wide by anchoring of the division lines. The center of the division lines are marked with floats to determine its proper alignment with the mainbuoys. After all the division lines are centered, simultaneous dropping of anchors are made until the framework is installed according to its design. Sounding of depth follows along the frame of the slope, playground and leader.

E. *INSTALLATION OF NET PARTS*

Tying ropes (6 mm) are placed along the framework where the net parts will be hung. First to hang is the bag part starting from the briddle rope where the impounding net is situated. Both sides of the bag are hung evenly until it reaches the division line of the bag and slope. The two parts are joined together. Next to hang is the slope part. Two side walls are hung simultaneously until the division line for the slope and playground is reached and is joined to the playground. Playground nettings are hung into the playground framing until reaching the pointer nettings. The last part to be hanged is the leader towards the shoreside following the same procedure.

F. *FISHING OPERATION*

After the gear is completely installed, the operation could take place. Usually, the hauling is conducted twice (i.e., once in the morning and afternoon) to prevent fish spoilage of gilled and entangled fishes in the net. During the peak season, operation is conducted thrice a day because of the large volume of fish entering the net.

Two locally-made wooden flatboats (Fig. 10) are used in fishing operation and one small motorized-banca (16 hp) for transporting them. The flatboats are positioned at the bag entrance and pull rope are hauled simultaneously. The nettings are lifted and released accordingly going to the opposite side where the fishes are impounded to the pocket netting. Hauling procedure is illustrated in Fig. 11. For the gilled or entangled fishes, portions of the gear are inspected by at least two fishermen through manual diving and removes the fishes found.

As mentioned earlier, the fishing operation varies from 8 months to year round continuous operation. Although, cleaning of nets are done every after two or three months upon installation and depends on the density of seaweed growth or attached barnacles on it.

G. *HANDLING OF CATCH*

In lambaklad fishing, around 80% of the catch are composed of big fishes such as tuna and tuna-like species, spanish mackerel, *Caranx spp.*, stingrays, sharks, marlin and other pelagic fishes. In handling the catch, gaff hook and scoop nets are used by the fishermen to protect their hands from injuries in hauling the fishes on board. Tuna species such as yellowfin (*Thunnus albacares*) and blackfin tuna are the common catch with average weight of 80 kgs. per piece. For small-sized fishes such as sardines, scad and herrings, these are scooped and dumped in containers with iced water. Fish buyers are stationed in the area and most of the catch are sold on the spot. The average catch per haul is 80 kgs. Average catch per month ranges from 3.5 tons and 7 tons during peak season (April).

V. SUMMARY AND RECOMMENDATIONS

Trap fishing has been regarded as one of the most ideal form of fishing which requires less of regulations in Philippine marine capture. It ranges from simple (portable traps) to complicated types (stationary traps). Traditional forms of stationary trap fishing are usually categorized as small-sized, simply constructed, easy to operate and utilizes indigenous materials (e.g., bamboo). Thus, capital requirement is low. Weak point of such gear, however, are limitations in depth deployment, low market value of species caught (usually small-sized), easy to be destroyed from weather forces and short-life span of the gear, hence, frequent alteration or re-construction of units.

With the introduction of lambaklad, designed for longer durability and resistance, made this type of fishing a more profitable business venture. Although, its construction could require higher capitalization because of high-costing of materials and large gear size. The advantages and disadvantages of using it is shown in Appendix B. The most important consideration after it has been set, fishing operation is relatively simple and energy-saving.

Local set nets in the country could still be improved through mechanization of hauling techniques. The adoption of net rollers, net haulers and winches could make the process faster and easier with less labour requirement. Moreover, the usage of hydroacoustic equipment (e.g. echo sounder) to survey the bottom contour of fishing ground could be very advantageous in attaining more precise measurements.

The development of this fishing type could provide a big help to small-scale fishermen especially those who are engaged in traditional fish corral fishing because of the reduction in maintenance cost and longer life span of fishing gear. Through this, socio-economic standard of their living could be improved. For the consumers, in return, will have fresh and more abundant fish supply for consumption. Thus, marketing standards of the produce will be highly-competitive.

Finally, the environmental implications of its usage will greatly reduce fishing pressure on the marine habitat because of its passive character and selectivity with less possibility of overfishing.

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Table 1. Net specifications.

PARTS	MESH SIZE (mm)	TWINE SIZE	MATERIAL
Bag (impounding)	25.4	400d/18	PA
(entrance)	76.2	210d/30	PA
(side wall)	50.8	210d/30	PA
Slope (inner)	27.5	210d/30	PA
(outer)	101.6	400d/18	PA
Playground	152.4	400d/18	PE
Leader	304.8	400d/18	PE

Table 2. Proportion of net parts in relation to water depth (meters).

PART OF GEAR	LENGTH	WIDTH	DEPTH
Bag	1.5 to 2 : 1	1.5 : 1	1 : 1
(a) entrance	-	2 or 3 : 1	0.5 : 1
(b) non-return valve	¼ bag length	2 or 3 : 1	0.5 : 1
Slope	1.6 : 1	2 or 3 : 1	0.5 : 1
(a) side wall	1.6 : 1	2 or 3 : 1	0.5 : 1 to 1 : 1
(b) base	1.6 : 1	1.5 : 1	0.5 : 1 to 1 : 1
Playground	2 : 1	1.5 : 1	1 : 1
Leader	Individual preference	1 : 1	1 : 1

Table 3. Rope and twine specifications.

PARTS	SIZE (mm)	MATERIAL
Mainframe	36	Polypropylene
Division line	32	-do-
Leader frame	32	-do-
Anchor line	24	-do-
Hanging line	20	-do-
Supporting rope for anchor bag	18	-do-
Leadline	16	-do-
Tying rope and seizing line for stone anchor	6	Polyethylene
Knitting twine	2	-do-

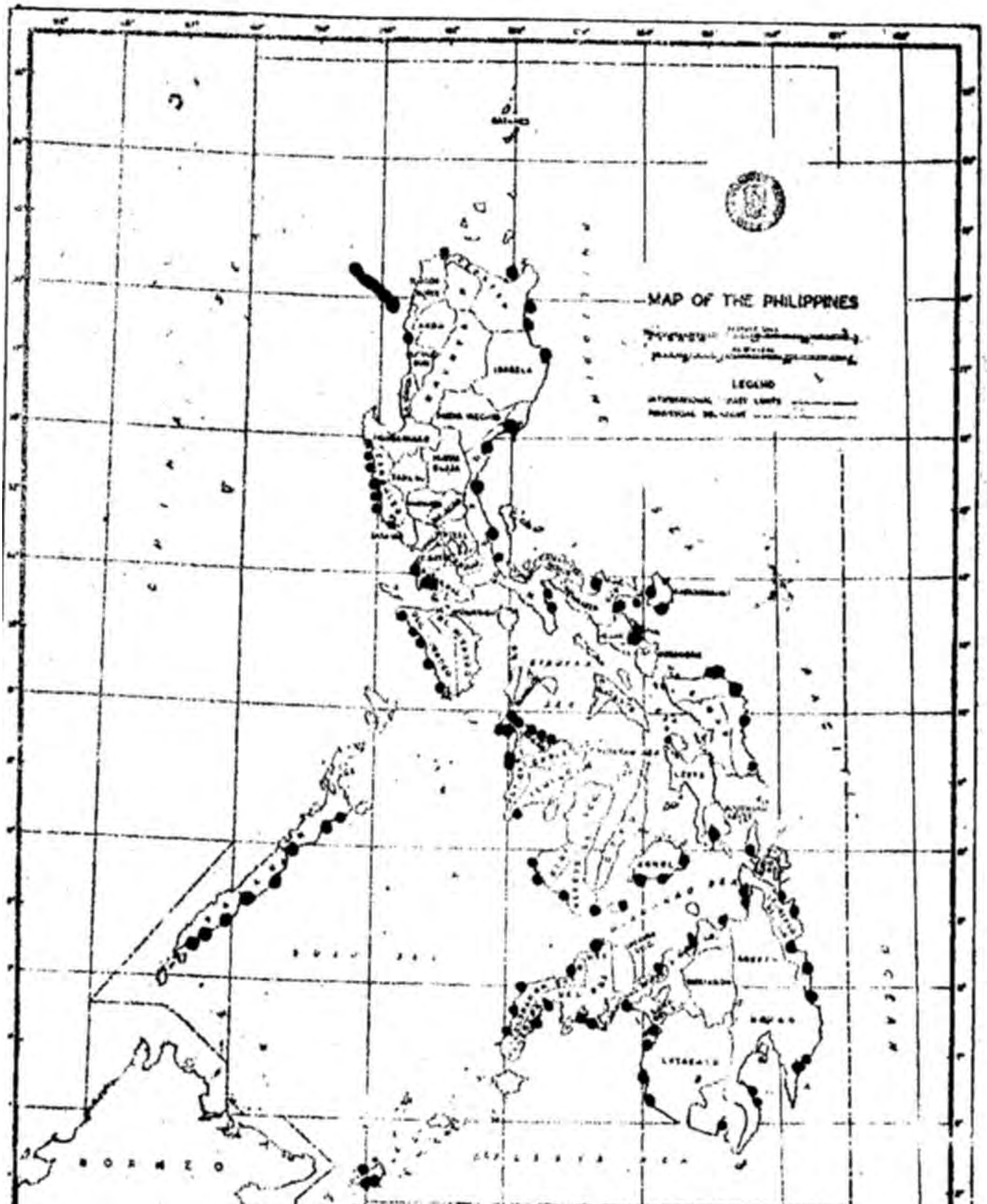


Figure 1. Map Indicating Feasible Sites for Set Net Fishing in Coastal Areas Around the Philippines

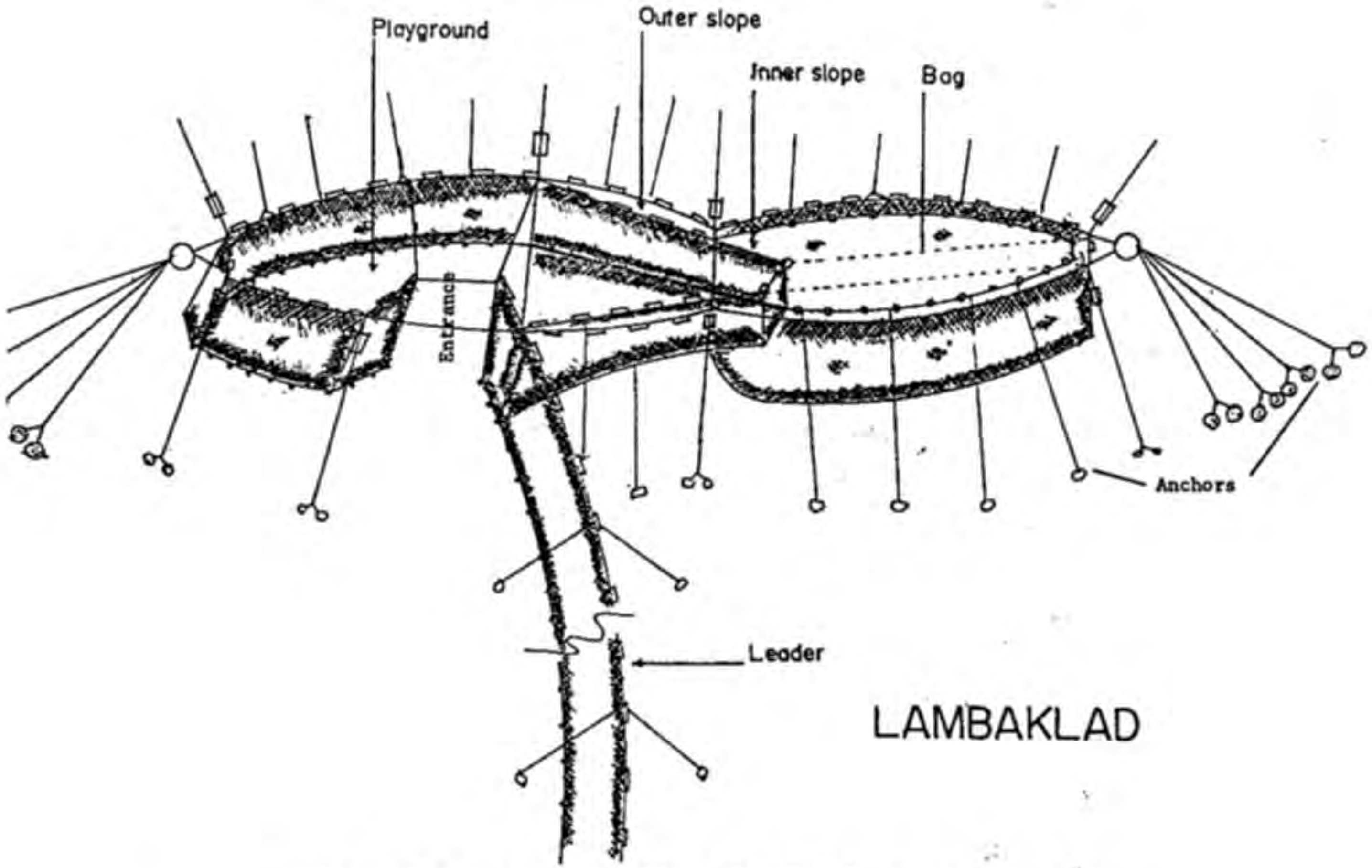


Figure 2. Perspective View of a Set Net and Its Parts

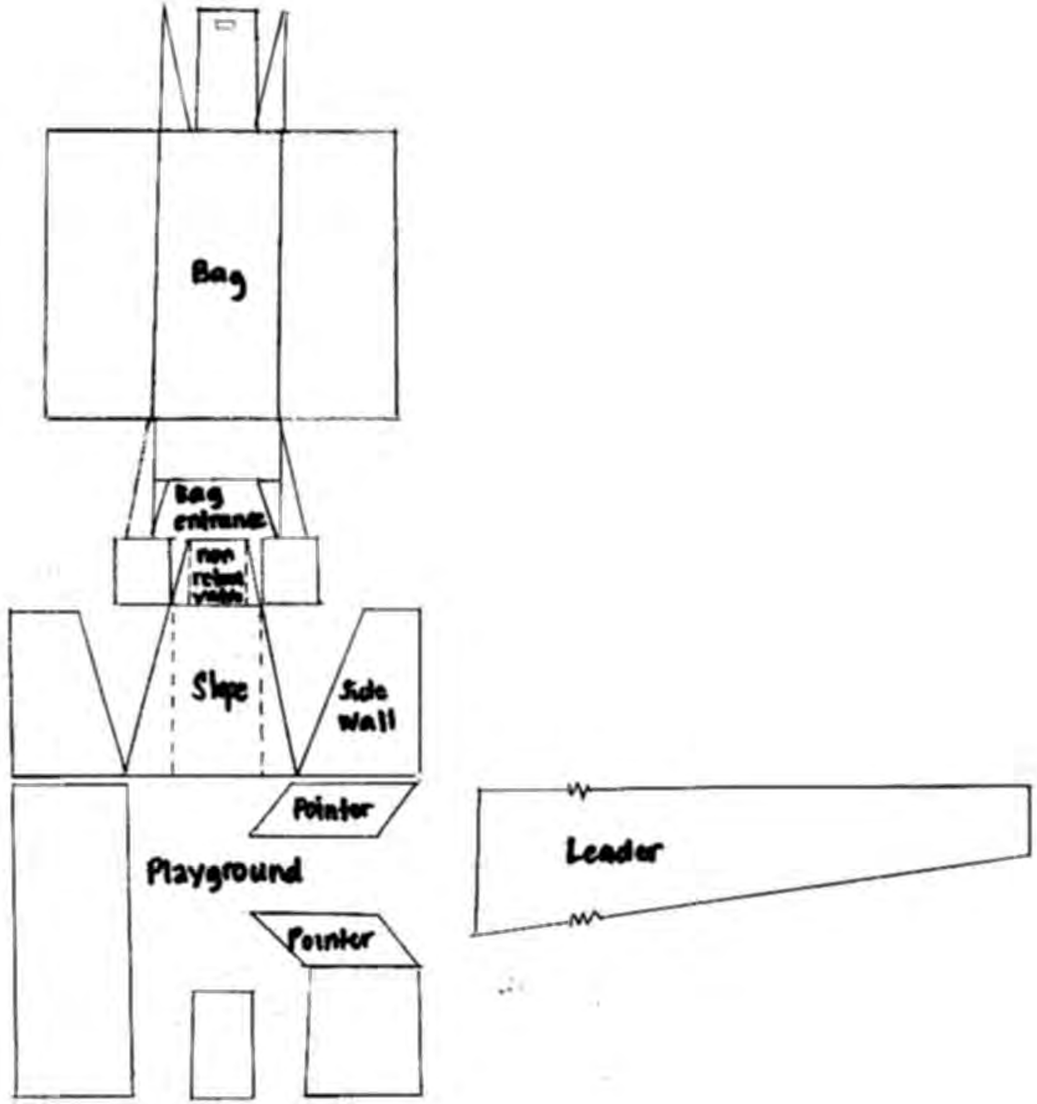


Fig. 3 Net design of a set net .

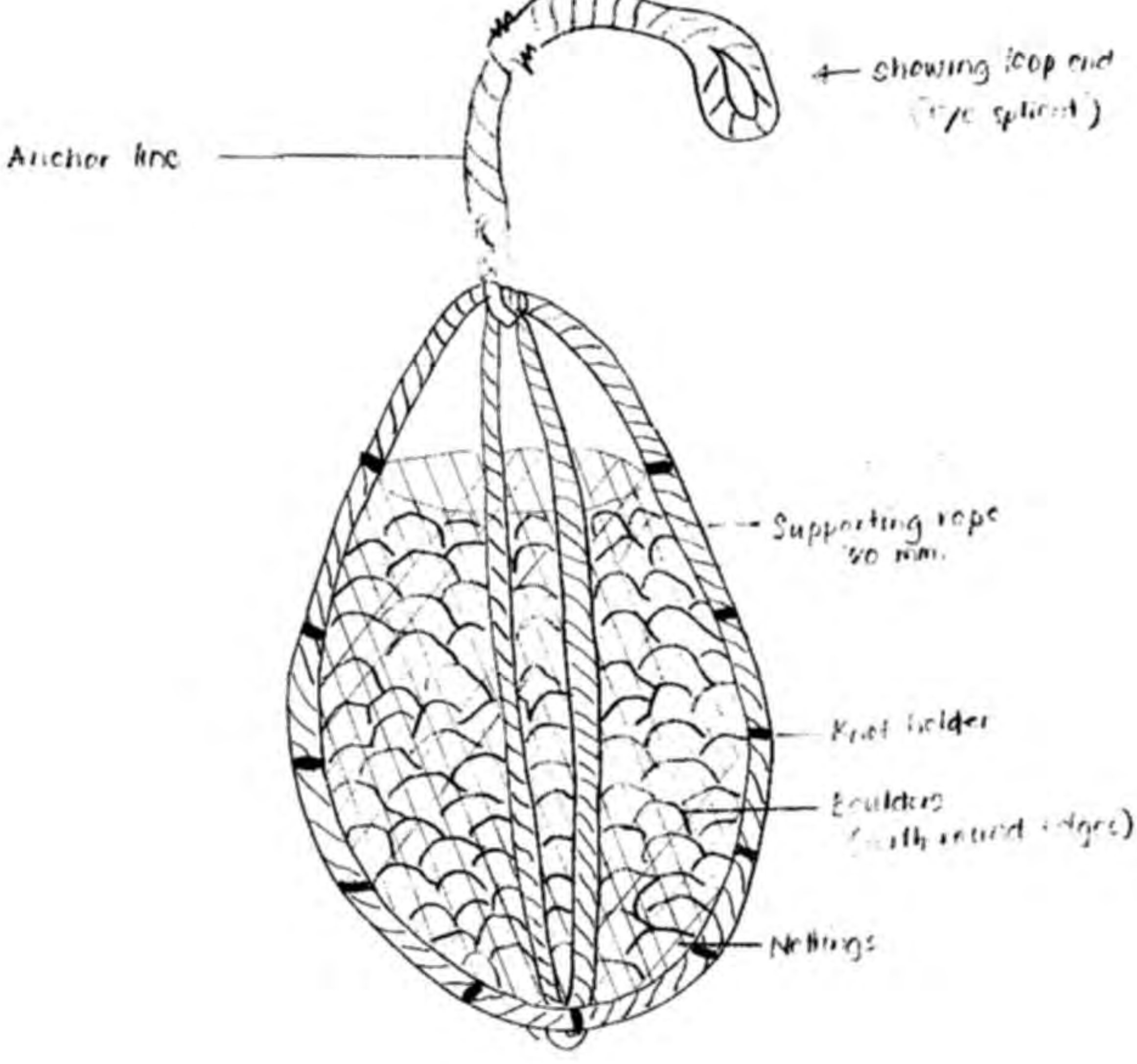


Fig. 4 ANCHOR BAG

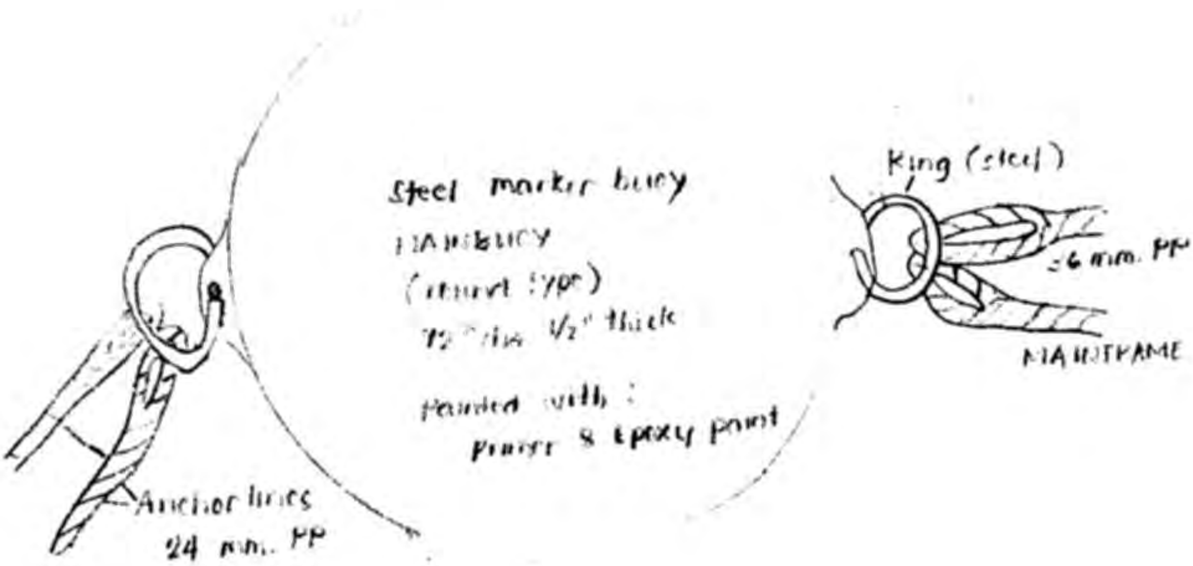
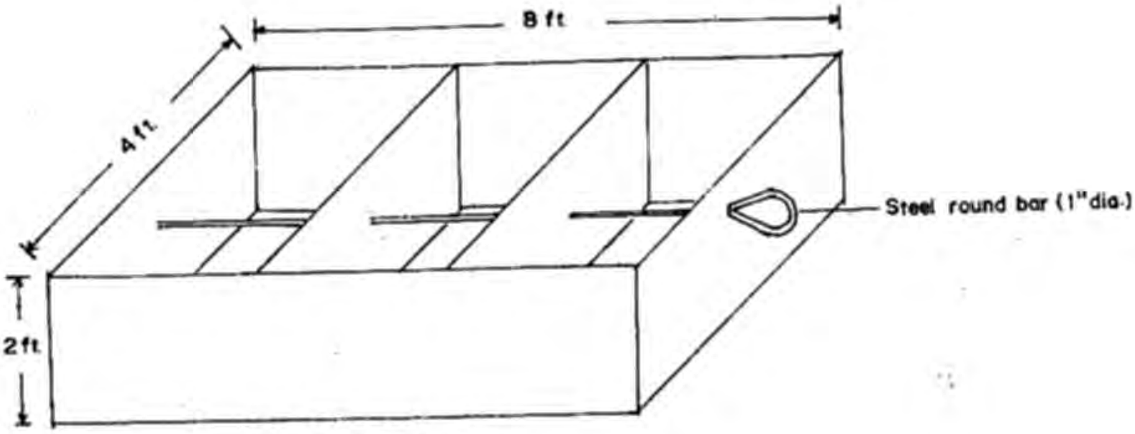
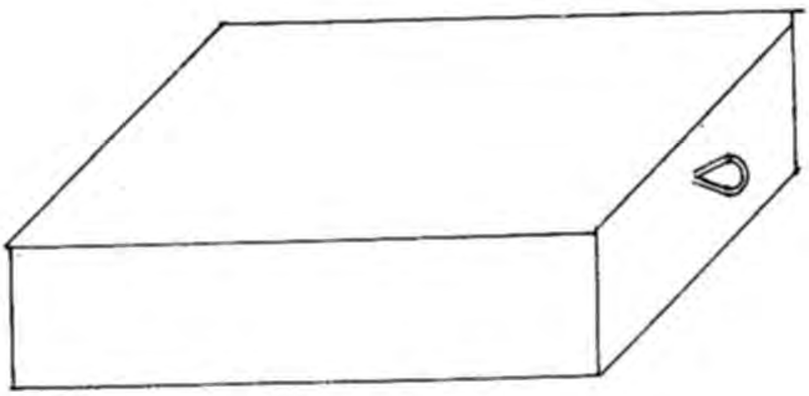


Fig. 5 Pressurized steel round buoy.

MAINBUOY
(MATCHBOX TYPE)



INNER VIEW



PROSPECTIVE VIEW

Scale: 1 cm = 1 ft

Figure 6. Mainbuoy (Rectangular shaped)

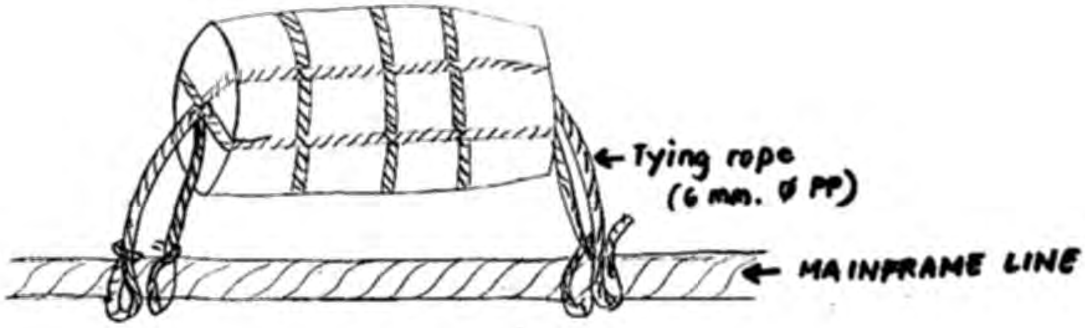


Fig. 7. Secondary float

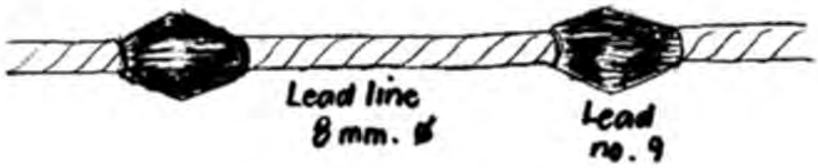


Fig. 8 Leadline

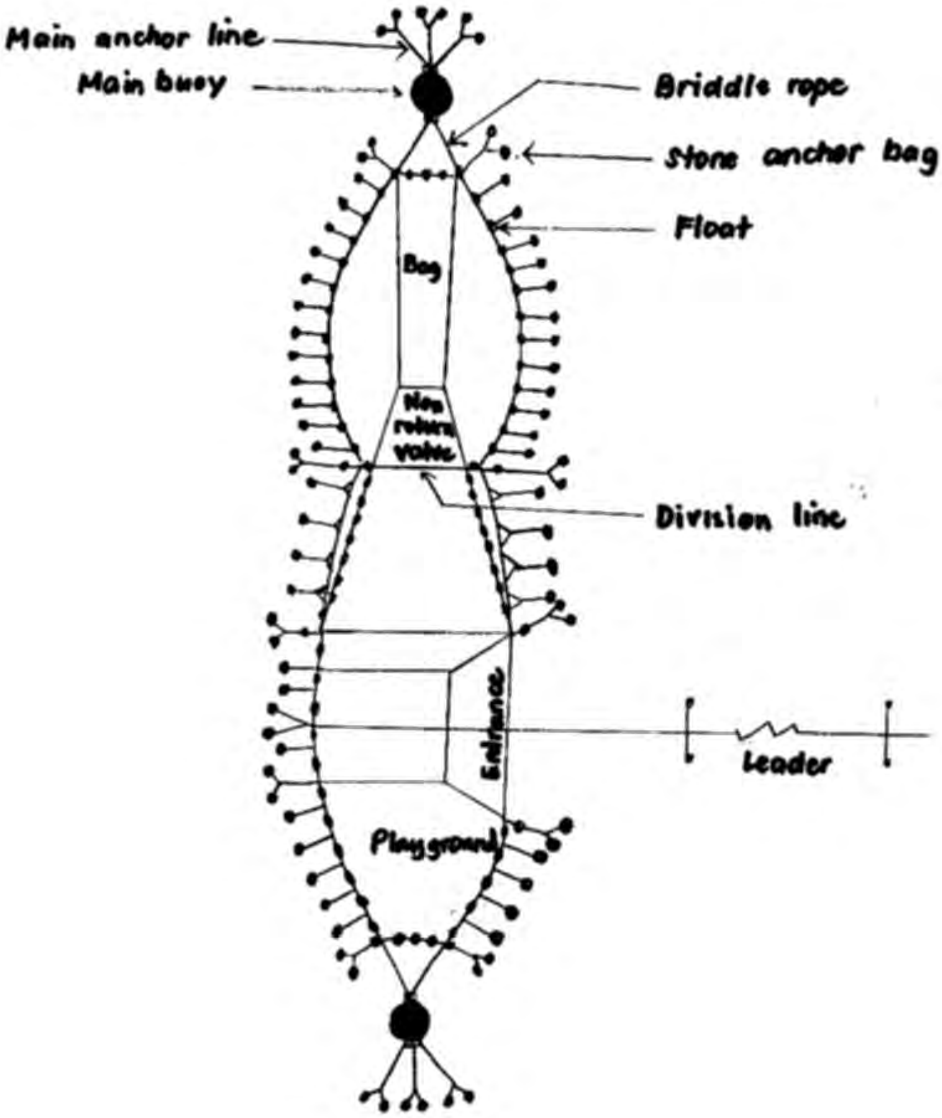
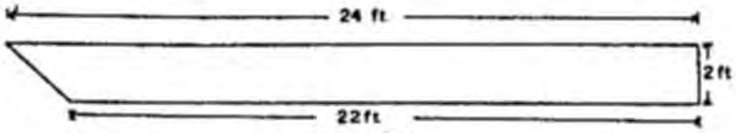
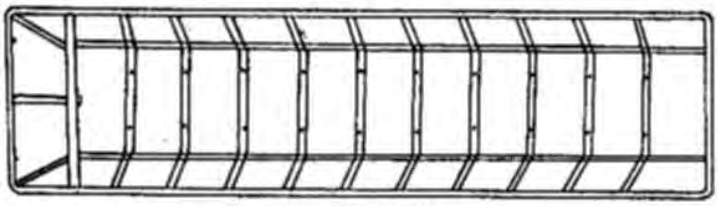


Fig. 9. Mainframe (installation) design

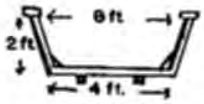
FLAT BOAT FOR HAULING OF CATCH



SIDE VIEW



TOP VIEW



FRAME

<u>MATERIALS</u> for one(1) unit

4 pcs	3/4"X4'X8'	Marine Plywood - Flooring, Back & Front
3 pcs	1/2"X4'X8'	Marine Plywood - Side
15 pcs	2"X3"X10'	Apitong / Yakal – Frame
2 pcs	2"X6"X24	Yakal – Railings
2 pcs	2"X6"X10'	Yakal - Railings
32 pcs	1/2"X3"X12'	Apitong – Flooring (Detachable)
2 pcs.	3" X 3"X24'	Apitong — Keel w/ 1" clearance
36 pcs	5/16 X 7"	Galvanized bolt
5 kls.	2"	Nail
8	Gallons	Epoxy Paint
2	Gallons	Marine Epoxy

Fig. 10. Flatboat

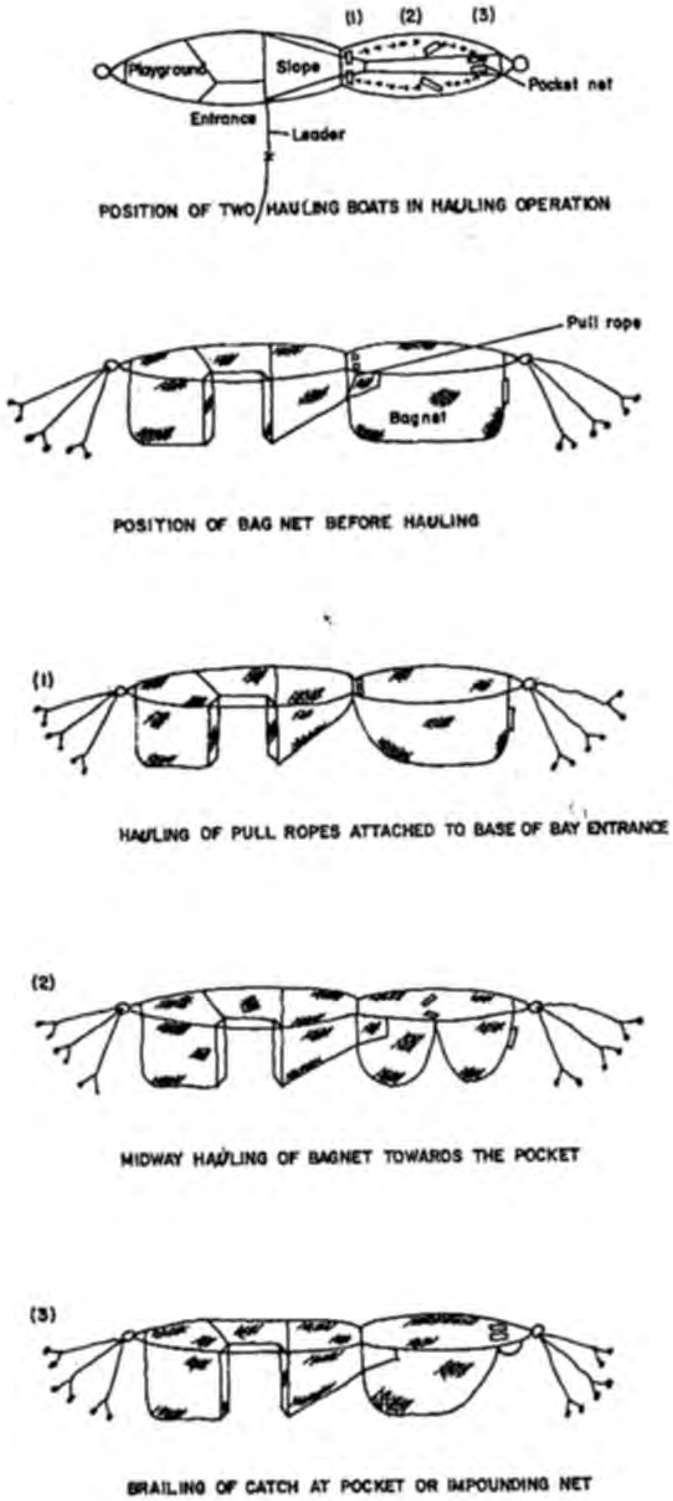


FIGURE 18. Hauling Operation of Set Net

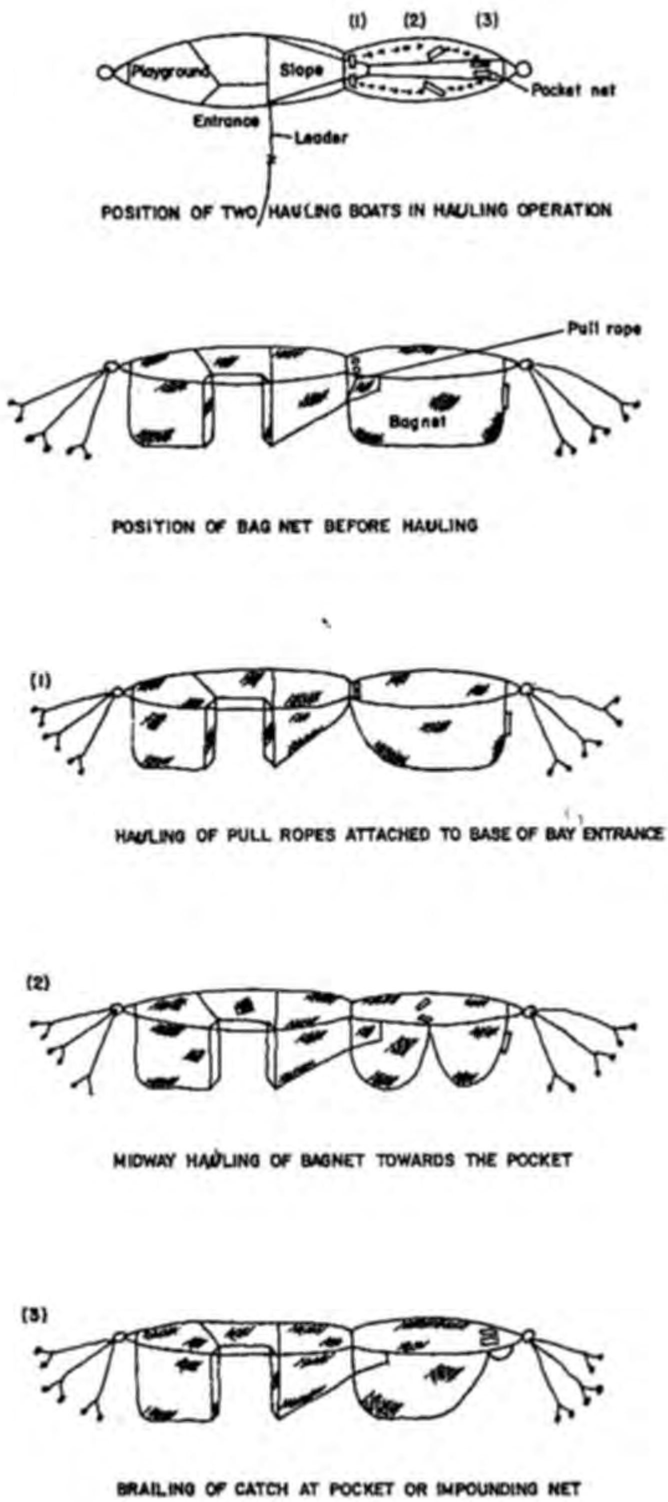


FIGURE [illegible]. Hauling Operation of Set Net

Appendix B ___. Advantages and disadvantages of a lambaklad.

PARTICULARS	ADVANTAGES	IMPACT	DISADVANTAGES	IMPACT
Efficiency	Larger sized nets; more efficient	High-economic profit		
Design and construction			Too technical or complex in nature; require skills of a Technologist	Minimal number of units
Operation and frequency	Simple harvesting technique; usually twice a day (morning & afternoon)	Requires less supervision		
Operational time & mode of employment	Less fishing time requirement	Part time fishing; other co-existing job	Seasonal occupation	Idle during off-season
Energy cost	Less	Low operational expenses		
Quality of catch	High-quality & fresh	Good market price		
Rearing potential (mariculture)	Source of parental stocks; cage culture	Provides other potential source of income		
Fishing areas	Vast area available; unexploited grounds	Potential setting areas	Territorial use rights and conflicts	Conflict with other fisheries
Fishing locality	Nearshore	Monitoring capability		
Volume of catch	Peak season	High-volume; High-profit	Lean season	Inconsistent amount of catch
Period of Operation			Limited (for those units facing open sea - 8 months operation)	Incontinuo-us business profit
Durability of gear	Long span (10-15 yrs); durable; removability of net part during off season	Low maintenance cost		
Investment	Not labour intensive	Shorter-pay back period	Capital intensive	Limitation on ownership

BOTTOM SET GILL NET FOR SHRIMPS IN SAN MIGUEL BAY, PHILIPPINES

A Study Report presented to
South East Asian Fisheries Development Center (SEAFDEC)
Training Department
Thailand

for the
Regional Training Course
in Fishing Technology and Resource Conservation 1997

Submitted by

DOMINGO S. MIGUEL
Philippines

Philippine Marine Jurisdictional Boundaries

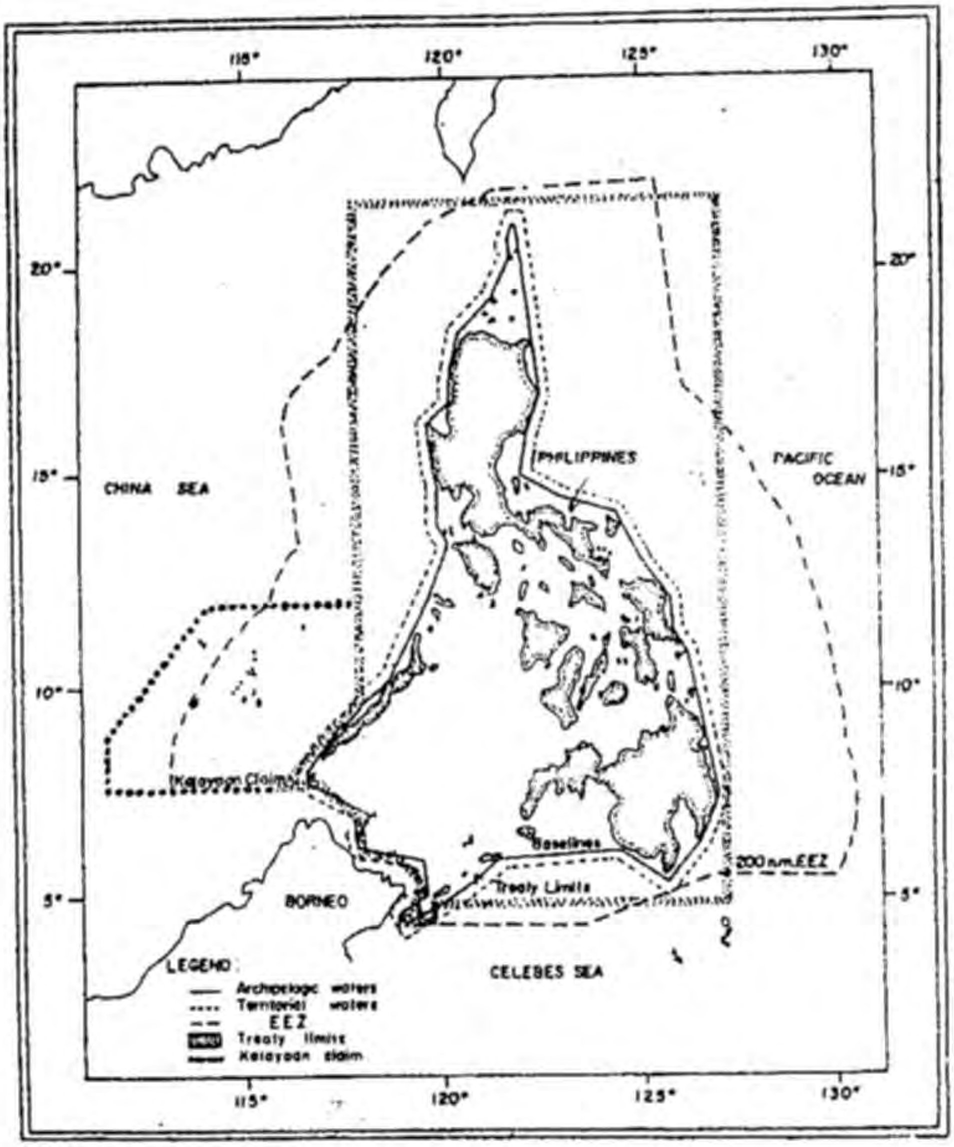


Figure 1

2

TABLE OF CONTENTS

GILLNET

Bottom Set Gillnet

Panti

Shrimp (white)

BOAT

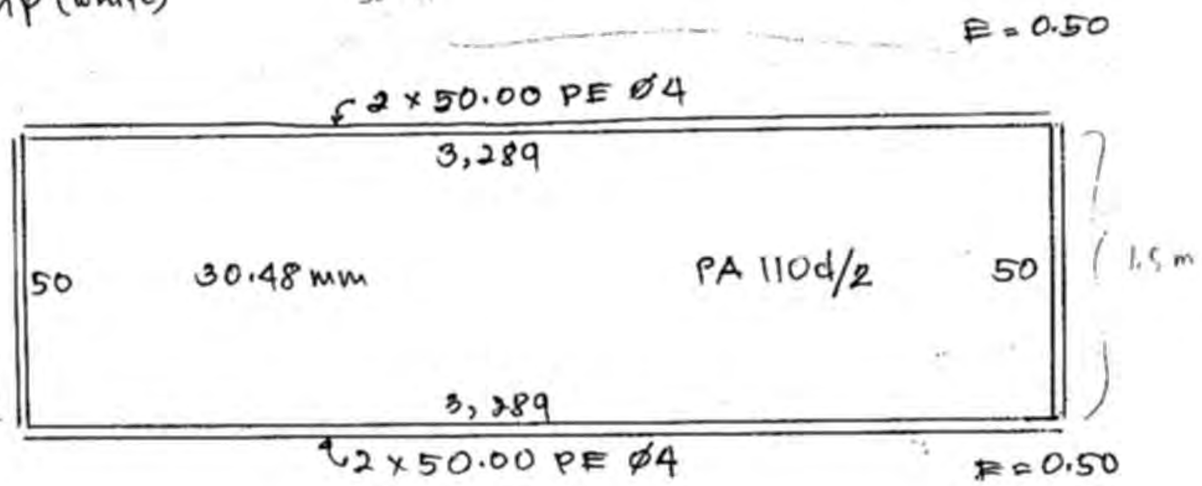
LOA - 7.92 m

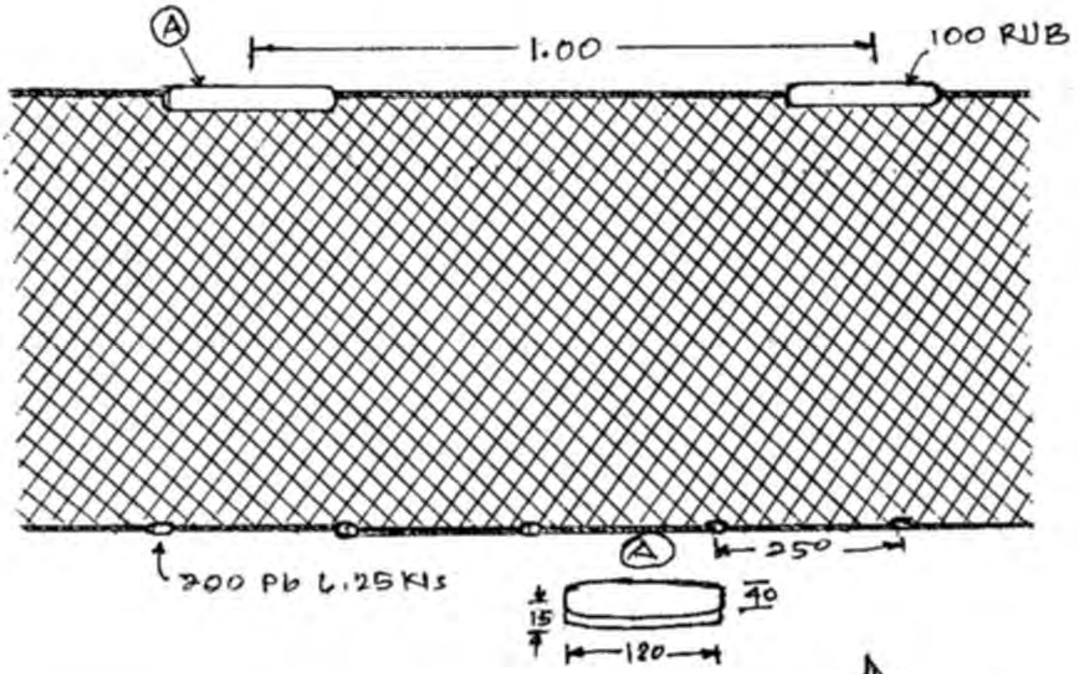
hp - 10-12

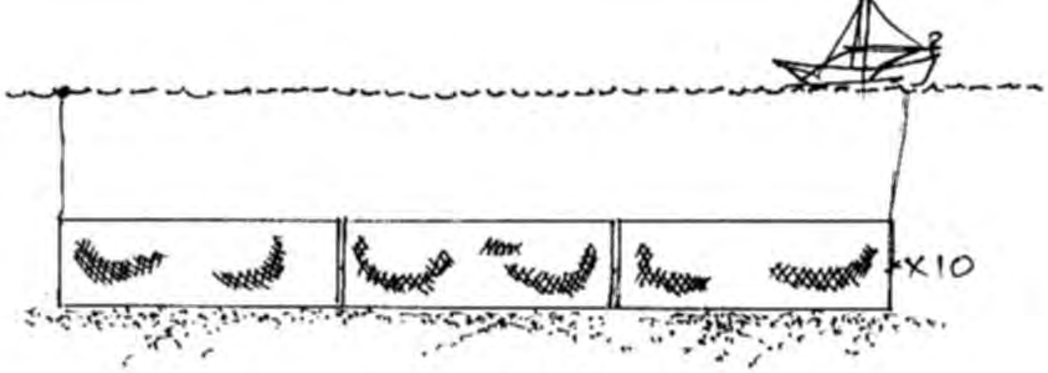
LOCATION

Calabanga

Camarines Sur







I. INTRODUCTION

The most popular gear being used in the country today is the gill net. It could be described as one of the fishing gear with simple structure and easy to operate even with the use of a small boat. Aside from bottom trawling, the mode of harvesting shrimps from wild is the bottom set gill net. It is most popular in San Miguel Bay since the highest-priced caught shrimp species is abundant in this area (i.e. white or banana prawn, *Penaeus merguiensis*).

San Miguel Bay is located at the north eastern part of Bicol region (Fig.1). Around five (5) coastal municipalities are surrounding the bay namely, Calabanga, Sipukot, San Miguel, Mercedes and Ragay, Camarines Sur. It is identified as one of the twelve priority bays of the Fishery Sector Program (FSP) of the national government for instituting the fishery resource management. The dominant gears in San Miguel Bay are gill nets followed by lift nets. The seasonality of fishing is during the months of March to September.

Basic information on how the said gear is being operated in the bay will be presented. It was also chosen as the topic to be discussed because of its selective nature and less pressure to marine habitat.

II. MATERIALS AND CONSTRUCTION

Nylon multifilament (Poly amide, PA) in white color is popularly used as netting material with mesh size of 30.48 mm and twine size of 110d/2. Each strip of net has a length of 100 meters and shortened to 50 meters after hang-in (50%), with depth of 1.5 meters.

The float line is made of polyethylene rope ∅ 4 mm with rubber float. The float measures 120 mm length, 40 mm height and 15 mm thick. A total of 100 pcs of floats are attached at every one meter interval. Leads are used as sinking material with a weight of 6.25 kgs. which usually comprised around 300 pcs. at every 250 mm distance. One set of bottom gill net are composed of about 10 strips.
The illustration of the gear is shown in Fig.2.

III. THE BOAT

A motorized outriggered banca with 10 to 12 horse power capacity are commonly used in the area. The engines are specifically branded either as briggs and straton, kohler or robin. Boat length measures around 8 meters with breadth and depth of 0.7 and 0.8, respectively.

IV. OPERATION

Shrimp gill net is operated before sunrise (0400-0500 hours) and before dusk (1700-1800 hours). The fishing ground has characteristics of sandy-muddy substrate with weak to moderate current. The gear is being operated by two fishermen. One end of the net is dropped while the other end is attached to the banca (see Fig. 3 for illustration of operation). It is set for about an hour and hauled for 20 to 30 minutes.

V. SPECIES CAUGHT

Aside from white shrimps, bottom gill net could also catch other species such as croaker (*Pennahia macrophthalmus*), sea bream (*Nemipterus spp.*) and blue-swimming crab (Portunus pelagicus). The relative percentage composition are as follows : white shrimps (50%), croaker (30%), crab (15%) and sea bream (5%). Average catch during peak months is about 10 kgs per hour. The shrimps upon harvest are placed in a plastic container with ice. These are sent to nearby market. A kilogram of white shrimp cost around P150.00 at the said area while retailers commonly brought these and being transported to Manila with higher-market price from P250 to P300/kg.

VI. SUMMARY and RECOMMENDATION

The bottom set gill net is the most preferred gear by small-scale fishermen because of its simple design, construction, operation and low-investment cost in San Miguel Bay area and even throughout the country. Gill net could be categorized as selective because of the mesh size being used and not creating pressure to the habitat of target species. Although, the appropriate number of fishing units should be decided by the local government to balance the economic and biological pressure on the fishing ground. It is one of the fishing gear which is identified suitable alternative for bottom trawl in harvesting demersal species. Gear improvement relating to attachment of bag for impounding or for the purpose of recovering more shrimp should be studied to suit local conditions.