SEAFDEC Training Department

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

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LIFT NET FISHERIES

Compiled by

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I. INTRODUCTION

The lift net is an extremely adaptable fishing method which is practiced world-wide in rivers, lakes, marshes, coastal waters and even the open sea. The nets range widely in both scale and operation from small scoop nets operated by one man to large-scale lift net operations involving the crews of up to eight boats.

A lift net consists of a sheet of netting surrounded by a round, rectangular, square or fan-shaped frame which is submerged, then raised or hauled upward out of the water to catch the fish above them. Several large sheets of netting may be loosely hung on the frame allowing the net to take on a bag-like appearance when under water. The lift net, as in all types of fishing nets, also consists of a main net and rope of synthetic fibre with a float and/or a sinker attached.

When the net is set, fish are lured into the area either with chum bait or by attraction lamps. The ideal species to be caught in this way are those who gather in large schools and can be attracted by lights or natural bait. These species include sardines, anchovy, mackerel, squid, horse mackerel, Pacific saury etc.

The most important examples of this fishing method are the stick-held dip nets of Japan where saury, mackerel and horse mackerel are all harvested in this way.

II. CLASSIFICATION

The basic characteristics of the lift net have been adapted to local conditions and the life habits of the fish to be caught. The sea areas where the lift net is used are divided into two groups: bottom, and floating.

The fish-gathering methods are divided into the following three basic types:

1) Active fishing by scattering bait above the net, or at night, by shining lights on the water to attract fish (See Fig. 1- Fig. 9).

2) Passive fishing where a bag net is set in a strategic position for trapping fish migrating with the tidal currents (See Fig. 10).

3) Using supplementary fishing gear, such as surrounding gill nets, to drive schools of fish into the area above the lift net (See Muro-ami, Fig. 11a & 11b).

The methods used to haul the nets are as follows:

(1) SMALL-SCALE HAND-OPERATED NETS NOT USING BOATS (Fig. 1-4)

Traditionally, these fishing methods which include scoop nets; push nets; and four armed scoop nets; were popular throughout Japan's rivers, lakes and marsh areas. At present their use is limited to commercial fishing for sweet fish in Lake Biwa, catching eel fry in estuary waters for seeding culture operations, or other specialized, regional fisheries such as icefish catching in estuary waters.

(2) LIFT NET FISHING USING ONE BOAT (Fig. 5-6)

a) The most common fishing method, especially in Japan, used in this group is a stick-held lift net. Two sticks with a net attached by means of net-rising ropes, are held out over the water from one side of the boat. Fish luring lights are shone on the water on the opposite side of the boat. When the fish have gathered, these lights are turned off and another set

of lights, on the net side of the boat, are displayed to attract the fish into the net. In a well timed action, the net-raising ropes are pulled, suddenly closing the net into a bag shape and thus entrapping the fish.

The types of fish caught by this method are surface fishes which are easily attracted to fish lights, such as: saury; mackerel; horse-mackerel; and sardine. This active fishing method is repeated at selected sites around the fishing ground and, making full use of the fish attracting lights, it is a very effective method.

b) In the second method, used mainly in rivers and shallow sea areas, a net is fixed to a framework made of wood or bamboo (Note 1). Although this particular method is seldom seen in Japan, it is widely used throughout Southeast Asia. A boat is used for transportation between land and the net site.

The boats range in size from small-scale coastal water fishing boats of the 3 to 5 ton class, to large-scale off-shore fishing boats of the 100 ton class. Constraints are imposed by the length of boat. The smaller the boat, the smaller the net used. In which case skillful use of mobility is essential.

Note 1: Large-scale four-armed lift net (Fig. 4):

c) In the third type a large-scale scoop net is attached to the bow of a motorized boat to scoop up the fish and mysid.* One example of this fishing gear (Fig. 5) is native to Northeast Japan where it is used for catching sand lance and mysid. In this method a relatively high catch is achieved using very simple fishing gear.

(3) MULTIPLE-BOAT FISHING METHODS USING 2 OR MORE BOATS (Fig. 7-9)

In general, when using two or more boats, a square or fanshaped net is set out in a fixed position in the water. Bait are scattered on the water and/or lights are used to attract fish to the area above the net. The net is pulled up suddenly from the sinker edges into a bag shape and the trapped fish are landed with a scoop net.

a) Two-boat lift net (Fig. 7)

Two boats lay out the net in a fixed position. The net design enables the tidal current to cause it to billow out into a bag shape. At night fish lights are used to attract surface fishes such as mackerel, horse mackerel and sardines. Although the net is larger than that used in stick-held lift net operations, this method lacks mobility. If, in order to increase mobility, the two boats haul the net around, this fishing method must then be classified as two-boat seine fishery.

*Note; Mysis stage (mysid): Larval stage in penaeoidean development equivalent to zoeal stage of Nephropaidea; of *zoea;* syn., *Schizopod Larva.*

b) Four-boat and eight-boat lift net (Fig. 8-9)

As in the case of 2-boat lift nets, fish are caught after being lured to the net by the scattering of bait or the use of fish lights. The lift nets are set on the sea bottom, or suspended in the water and held in place by the boats. The latter method is used primarily in areas with a reefy sea bed or in areas with a particularly strong tidal flow. In spite of the large net area, given the number of boats and the labor required for its operation this is not a very effective fish catching method. For this reason, it is on the decline in Japan today.

(4) SPECIALIZED LIFT NETS (Fig. 10-11)

a) "Fukuro-machi-ami" (net with bag net) (Fig. 10)

In this waiting-type method a bag-shaped net uses the tidal currents. The net is set with its opening facing the tidal flow at the mouths of rivers or in shallow tidelands, to trap the fish which ride in the currents. Sometimes the net is set vertically in the water, the mouth facing upwards, and fish which have been lured into the waters are caught by suddenly raising the net. The fish caught by this method include sardine fry, launce, seabream, croaker, porky and small shrimps.

b) Oikomi-ami, Muro-ami (drive-in net) (Fig. 11a & 11b)

A bag-shaped net is fitted with wing nets or fence nets and set in the water. By using divers, surrounding gill nets or making threatening noises on the water from the boat, fish are driven into the net. The "takabe" drive-in type bottom lift net, is one of the nets that falls into this category.

We also found that within different regions, several combinations of fishing nets of varying shapes are used, some of them being very similar in appearance to small-scale set nets.

III. STICK-HELD LIFT NET

Stick-held lift net fishing has been widely operated in Japan for centuries. This fishing practice has proved to be suitable for small-scale operations; is relatively low cost; needs less manpower than other types of fishing gear, such as the purse seine, large set net etc. and; it can be carried out by most types and style of fishing boats.

For example, saury is commonly caught by stick-held lift nets from salmon gill net fishing boats during the salmon off season, in the northern part of Japan.

In Thailand, catching squid by stick-held lift net was introduced in 1978. Previously the squid had been caught by trawl net, or cast net fishing. Although cast net fishing is very effective the small size of the operation severely limits the amount taken in each catch.

With the more widespread acceptance of electric luring lamps, the squid cast net was replaced by stick-held lift nets, whose popularity is increasing rapidly.

1. Outline of the stick-held lift net

1.1 Description

The stick-held lift net (Fig. 12) is one of many types of lift nets used for catching pelagic fishes such as sardine, saury, horse mackerel, squid etc.

The net is composed of a cod end, main net, side net and selvage net and designed to scoop fish which are attracted by the fish luring lamps or bait. A number of small sinkers are attached on the sinker line and heavier sinkers, connected to about six or more ropes, are spaced along the front end of the net for hauling purposes.

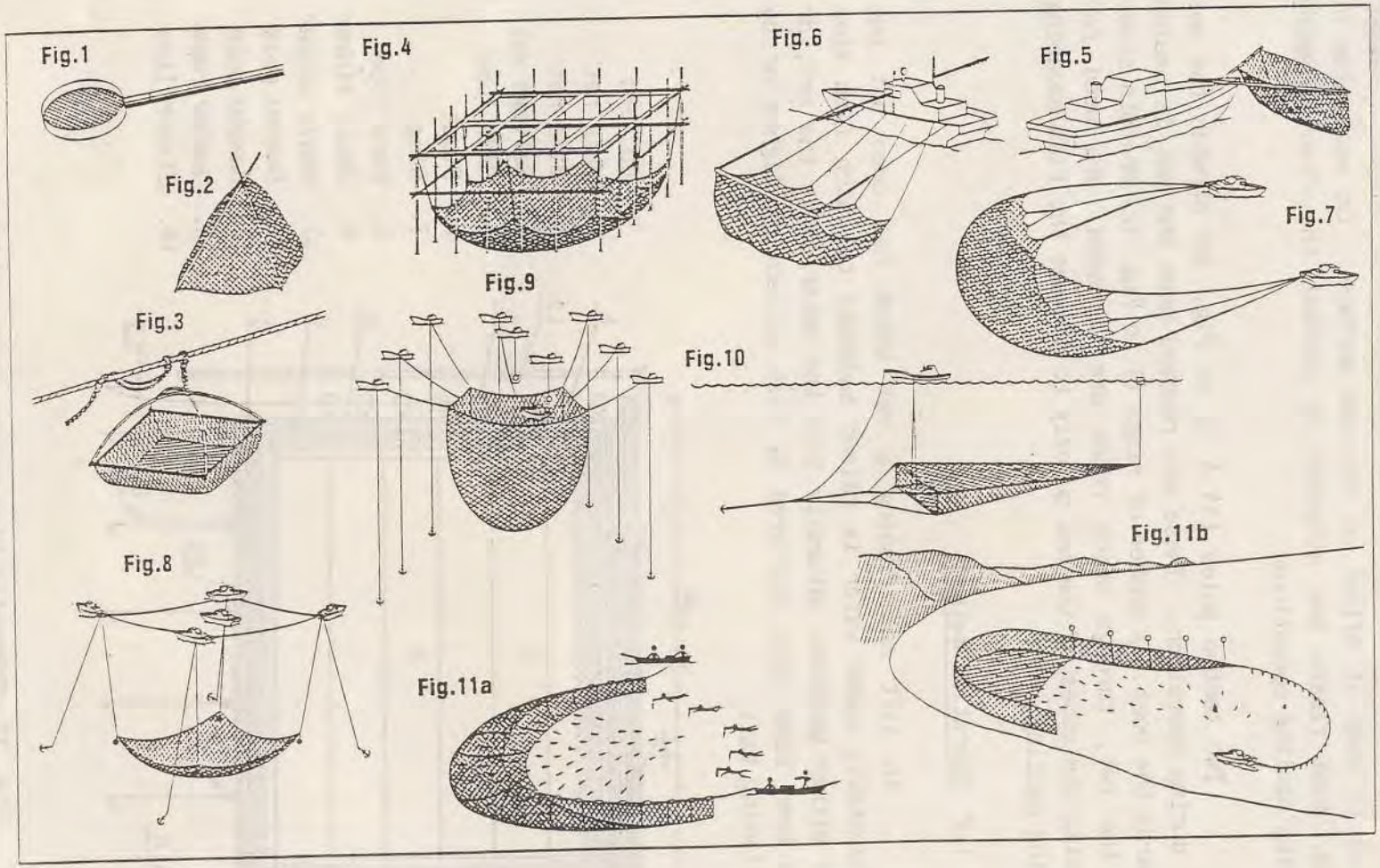


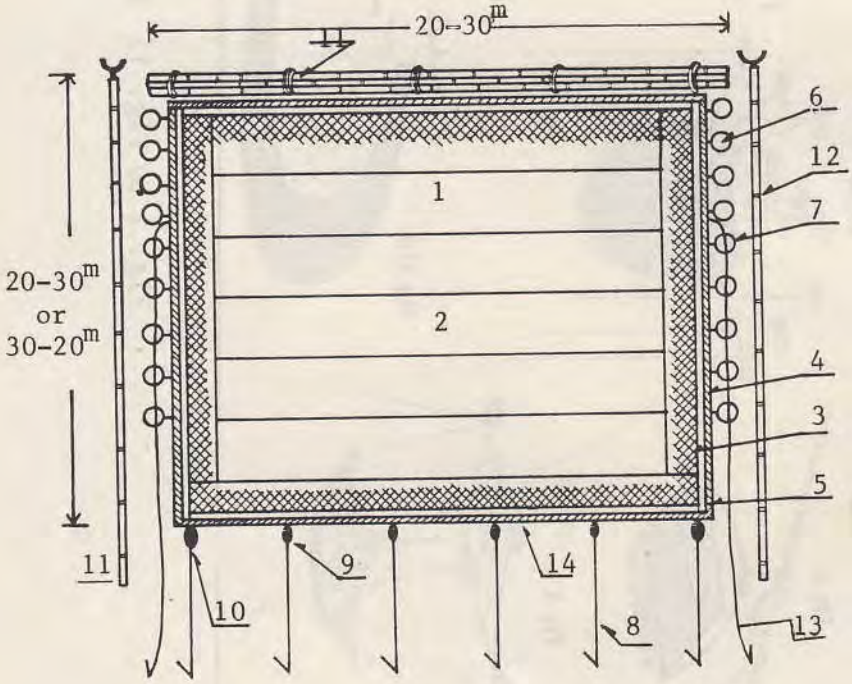
Fig. 1 to Fig. 11 Various types of lift nets.

The back of the net is connected to a bundle of bamboo poles to keep it afloat on the sea surface. On each side of this, some floats are attached to prevent the fish escaping during hauling operations.

Two bamboo poles (11 & 12 in Fig. 12) stretch the net out during operation. These are removed when the net is hauled towards the boat. A number of rings (7 in Fig. 12) on both sides of the net, through which ropes are threaded, are used for closing the sides of the net quickly to prevent the fish escaping during hauling.

1.2 Operation method

In lift net fishing a net which has been set out horizontally under water is raised suddenly to catch fish that have either wandered naturally into the water above the net, or have been lured into the area by fish attracting lights or by scattering bait.



1. Cod end
2. Main net
3. Side net
4. Selvage net
5. Side rope
6. Float
7. Ring
8. Fore rope
9. Small sinker
10. Heavy sinker
11. Bamboo pole
12. Bamboo pole
13. Quater rope
14. Sinker line

Fig. 12 Schematic view of the stick-held lift net

For example, in Japan, the most effective lift net operations are ones in which a single, powered boat using a stick-held dip net catches fish by attracting the migrating schools with fish-lights. However, when the gear is operated in the daytime, some natural bait is used.

Hauling lines are pulled until the front part of the net is closed and hauled to the surface to prevent the fish from escaping. The bamboo poles are then removed and the net pulled towards the boat so that it will be easier to scoop up the catch.

This procedure is repeated 2 to 5 times a day as follows:

1.3 Fishing boat

The saury fishing season in Japan lasts only from August to December. Therefore, there are no boats engaged exclusively in saury stick-held lift net fishing. Most boats are also used for salmon gill net fishing, skipjack pole and line or mackerel pole and line fishing, depending on the particular season.

The size of boat varies from 10 to 300 GT. There is no specific design used but preferably the boat should have some of the following characteristics:

a) Shallow draft

To enable the fish to pass underneath the bottom of the boat to the side where the net is placed a shallow draft is recommended.

b) Shallow freeboard

For easier net handling and scooping operations a shallow freeboard is recommended.

c) Wind resistance

As it is important that the relative position between the boat and the net be maintained during fishing operations, the boat should have resistance against wind to avoid drifting.

d) Fish hold

The fish hold should be partitioned into small chambers to keep the catches as fresh as possible by separating those caught at different times during the fishing expedition.

2. Squid stick-held lift net in Thailand

2.1 Squid cast net

The basic cast net was very popular among small-scale fisherman in Thailand. Used mainly in inland and shallow coastal waters, it was operated by a single fisherman, with or without a boat. Before the adoption of the squid stick-held lift net, the squid had been caught by trawl net or cast net along with other fish and shrimp and were only of secondary importance.

A comparatively large cast net, which had been used for Indo-Pacific mackerel, became popular in the 1970s for squid-fishing from a boat with luring lights. An improvement was made by adding a purse line to the bottom edge of the net and this type of stick-held cast net is now one of the most widely used fishing gear in Thailand.

The following example of a squid cast net in Thailand was surveyed at Pranburi district in September 1979 by staff of SEAFDEC/TD.

Pranburi is located 250 km south of Bangkok on the West Coast of the Gulf of Thailand. Approximately 200 small fishing boats, 6-10 meters long with 30-40 HP outboard engines, are engaged in squid cast net fishing in the area.

The cast net is operated during the night by a two-man crew. Most of the boats use three gas or oil lamps as a fish luring device, but some also use 500 w electric fish lamps powered by a 2.5 kw generator.

The fishing grounds are situated in an area within 3-4 hours sailing from the port. A set of drift gill nets are used as a sea anchor to allow the boat to drift slowly during operation.

Normally the operation is done during moonless nights, i.e. about 20 nights per month. The best squid season is during the three months from February to April. About 40 castings are done in one night and the average catch is 50 kg per trip. About 1,000 kg of squid per month is said to be a good catch.

2.1.1 Operation method

The fishing boats leave the port in the afternoon and reach the fishing ground before dark. The three fish luring lamps are then lit to attract squid.

When a sufficient number of squid are around the boat, the cast net is thrown out by one fisherman while the other fisherman keeps the boat in position.

The foot side of the net is closed by a ring of lead being threaded through the net from the head to the foot side (Fig. 13) to prevent the squid from escaping. The net is then slowly hauled up on board.

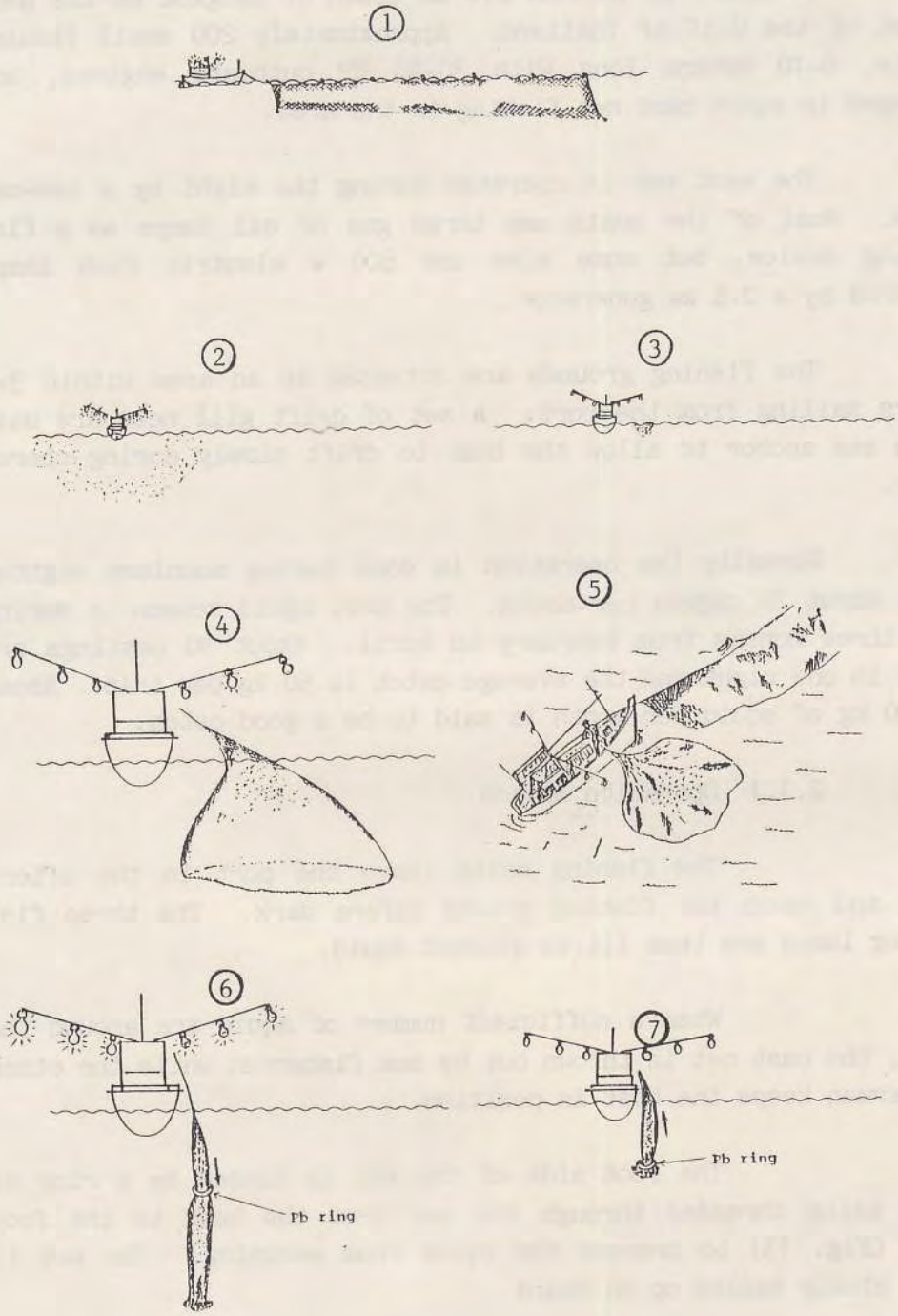


Fig. 13 Fishing operation of cast net

This operation is repeated about 40 times during the course of one night and is finished before dawn. The boats return to port in the morning.

Most of the catch is sold to the squid processing factories around the Pranburi District. At present, squid is also an important export commodity.

2.1.2 Fishing gear

The net (Fig. 14) is made of 210 deniers 2-ply nylon, and the stretched mesh size is 3.5 cm. The height of the net is 4.5 meters when stretched. A 9.5 kg galvanized iron chain is connected to the foot of the net as a sinker. The ring, weighing 2.7 kg, is made of lead, its outside diameter 21 cm, inside diameter 17 cm. At the head of the net a six meter length of polyethylene rope is connected as a hand rope.

The price of the net is about 1500 Baht (75 US$)

Particulars

1.	Net:	nylon 210d/2-ply - 3.5 cm
2.	Sinker:	iron galvanized chain 13 m 9.5 kg
3.	Ring:	lead inside dia 17 cm 2.7 kg outside dia 21 cm
4.	Hand rope:	polyethylene 6 m dia. 10 mm

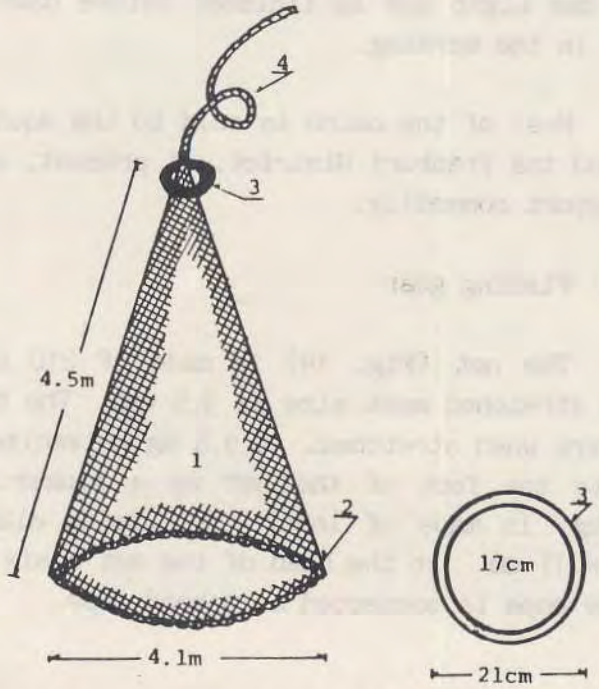


Fig. 14 Construction of Squid cast net

2.2 Squid stick-held lift net (Surveyed at Ban Phe district, in Rayong province in November 1980)

There are two types of stick-held lift net in Rayong Province. One is used by rather large boats (15 meters up), and to catch the squid the net is pulled towards the boat.

The other type, which is used by small boats (below 14 meters), catches squid by being pushed against the boat.

These two types are quite similar in construction. The size of net is dependent on the length of boat and ideally should be a little shorter than the boat.

2.2.1 Pulling type net

The boat leaves the pier at five o'clock in the evening and proceeds to a suitable fishing ground (leaving time varies slightly with the lunar cycle). The journey to the fishing ground takes about two-three hours. After arrival, the engine is stopped, and the boat allowed to drift for some time. One set of the mid-water gill nets (300-400 meters long and 14 meters deep) are then thrown out as a sea anchor, (Fig. 15) and the end of the net is attached to the bow side of the boat.

The boat takes its position in the direction of the sea current, and is held in place by the gill net.

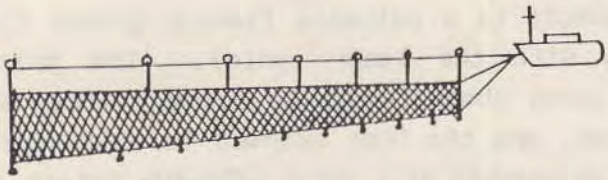
The boat is equipped with 10 - 500 Watts fish luring lamps and one 200 Watts red lamp. They are distributed as follows: four luring lamps are suspended on the outrigger of the port side, another four and the red lamp are suspended on the starboard side. The remaining two lamps are suspended on the stern and bow.

All fish luring lamps, with the exception the one red coloured lamp, are switched on.

After some time (30 - 60 minutes) the squid are attracted around the boat. The net is set under water and the ends of three lift lines, connected to the sinker lines are held by three fishermen. The masterfisherman then switches off all lamps simultaneously (within 1 - 2 seconds). Then, one of the four lamps on the starboard side is quickly switched on. All the squid attracted around the boat will then move to the starboard side, where the net is. By reducing the illuminating power of the lamp the squid are enticed to the surface. (If they fail to surface, only then is the red lamp, which is more concentrated than the white ones, switched on.) The net is quickly hauled by three fishermen, pulled to the boat side, and the catch lifted on board.

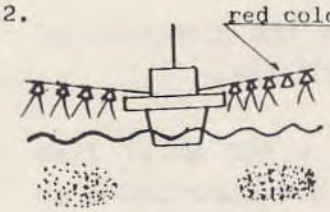
The whole operation is repeated 15 - 20 times in the course of one night. Fig. 15

1.



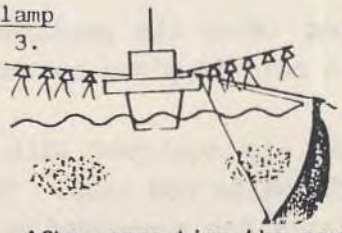
One set of the mid-water gill net is thrown out to the sea as a sea anchor.

2.



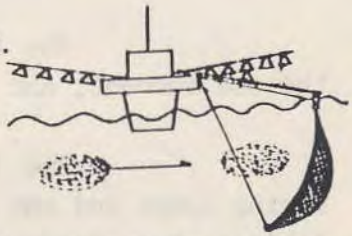
All fish luring lamps except the red coloured lamp are switched on to attract the squid around the boat.

3.



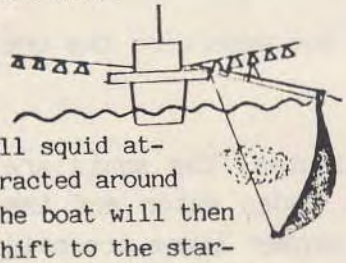
After some time the squid are attracted around the boat. The net is set under water.

4.



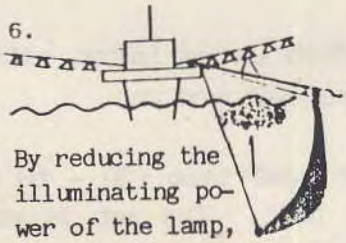
One of the four lamps on the starboard side is switched on.

5.



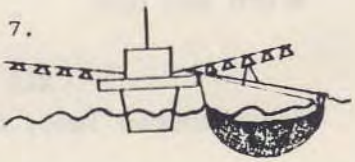
All squid attracted around the boat will then shift to the starboard side where the net is

6.



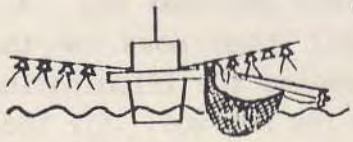
By reducing the illuminating power of the lamp, the squid are attracted to the sea surface.

7.



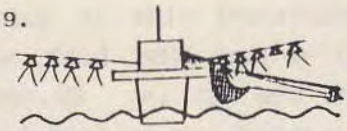
The net is quickly hauled by three fishermen.

8.



The net is pulled to the boat side.

9.



The catch is hauled on board.

Fig. 15 Operation method of stick-held lift net (Pulling type net)

2.2.2 Pushing type net

This type of gear (Fig. 16) is operated at the same fishing ground as the pulling net and a set of mid-water gill nets also serve as a sea anchor.

After arriving at the fishing ground, all fish luring lamps are switched on for about 30-60 minutes.

Then, after checking that the squid are attracted around the boat, the port side lamps and bow and stern side lamps are switched off. When all squid are attracted to the starboard side the net is set under the water. Three of the lamps are switched off, and the fourth has its illuminating power reduced slowly.

When the squid come up to the surface, the net is pushed up quickly by two fishermen.

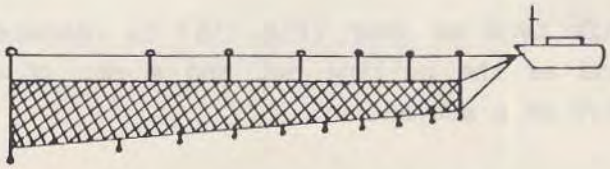
The operation is repeated about 20 times in one night by 3 fishermen.

In addition, there are two other types of stick-held lift nets in Thailand. They are operated in fishing grounds of 10-20 meters depth and are as follows:

2.2.3 Stick-held cast net

This is an improved version of the squid cast net (Fig. 17), which incorporates elements of a stick-held lift net. The net is 10-20 meters deep, 20-50 meters in circumference. The main net material is nylon 210 d/4-6, 25-30 mm mesh-size, and the cod-end and bottom selvage are polyethylene 380 d/9-12, with the same mesh-size. There are two patterns of net construction: (1) 6-8 triangular pieces are joined (Fig. 18) with the cutting pattern of 1N2B, and; (2) rectangular pieces of different lengths are joined (Fig. 19) so that the shortest one is at the top of the finished product and the longest one at the bottom. At the bottom of the nets there is an iron chain sinker, with plastic,

1.



One set of the mid-water gill nets is thrown out to the sea as an anchor

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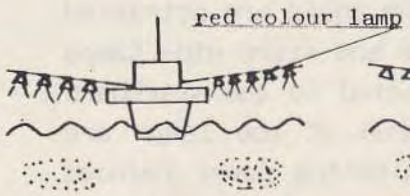

All fish luring lamps except the red coloured lamp are switched on to attract the squid around the boat.

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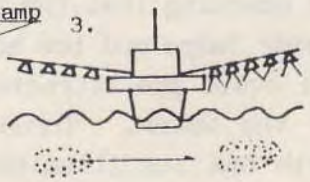

Port side lamps and bow and stern side lamps are switched off.

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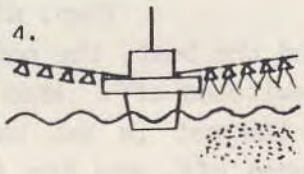

All squid are attracted to the starboard side.

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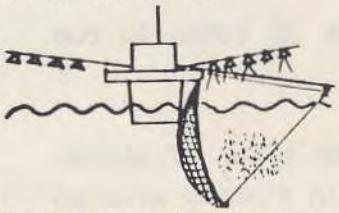

The net is set under the water.

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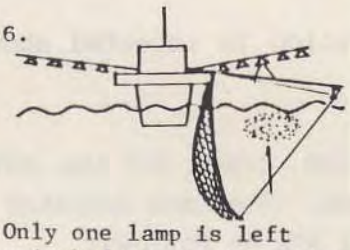

Only one lamp is left switched on and its illuminating power is reduced slowly. The squid come up to the surface.

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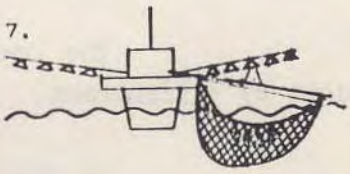

The net is pushed quickly by two fishermen

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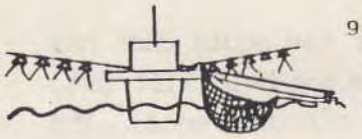

The net is pulled to the boat.
All fish lamps are switched on for next operation.

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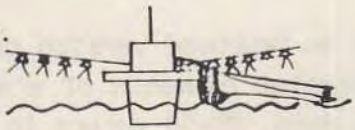


The catch is hauled on board.

Fig. 16 Operation method of stick-held lift net (Pushing type net)

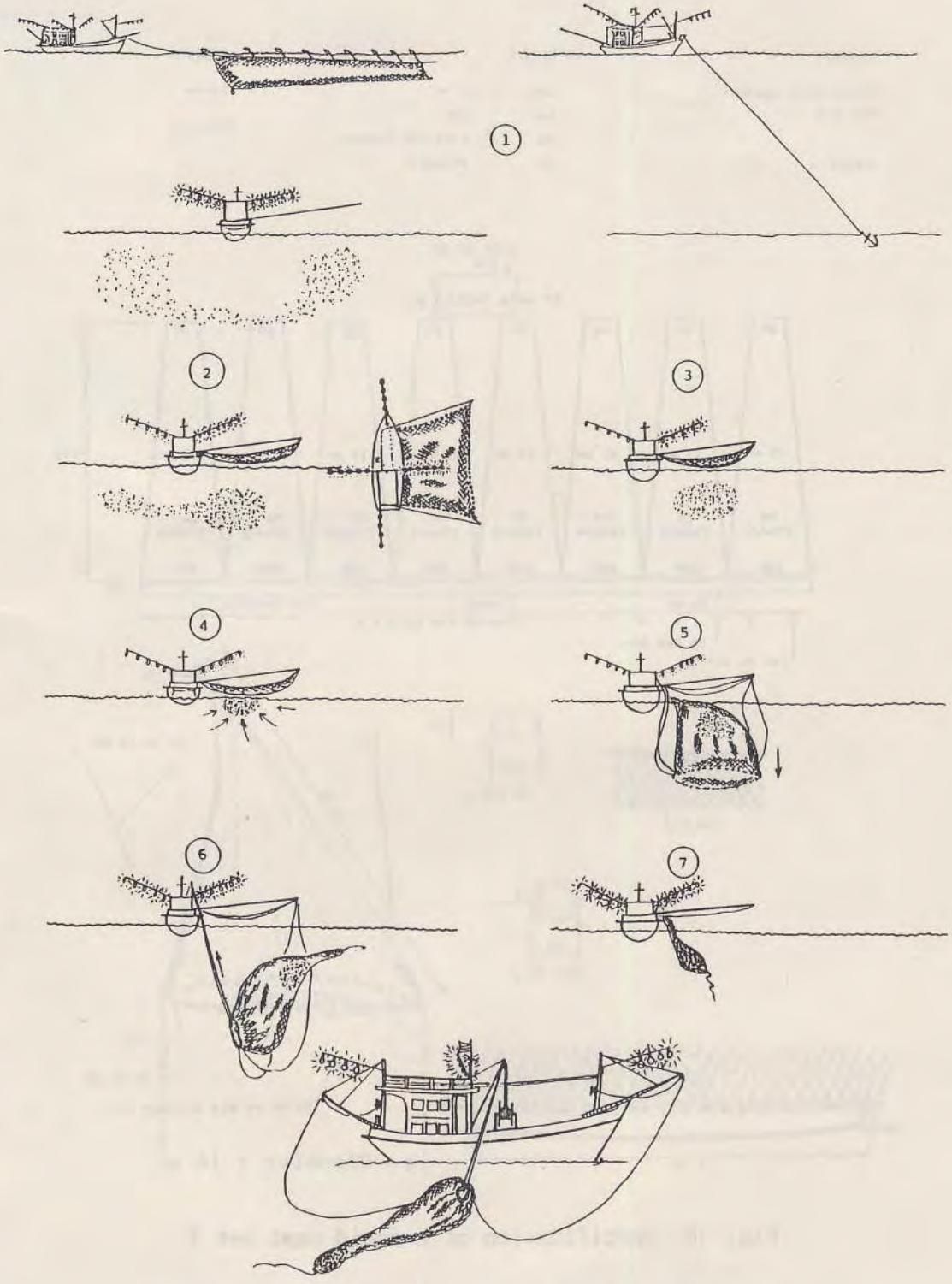


Fig. 17 Fishing operation of stick-held cast net

CASTNET

Stick held castnet

Mae Vak

Squid

VESSEL

Loa	17 m
hp	180
EG	2×10 KVA dynamo
LL	38×500 W

LOCATION

Thanun

Phangnga

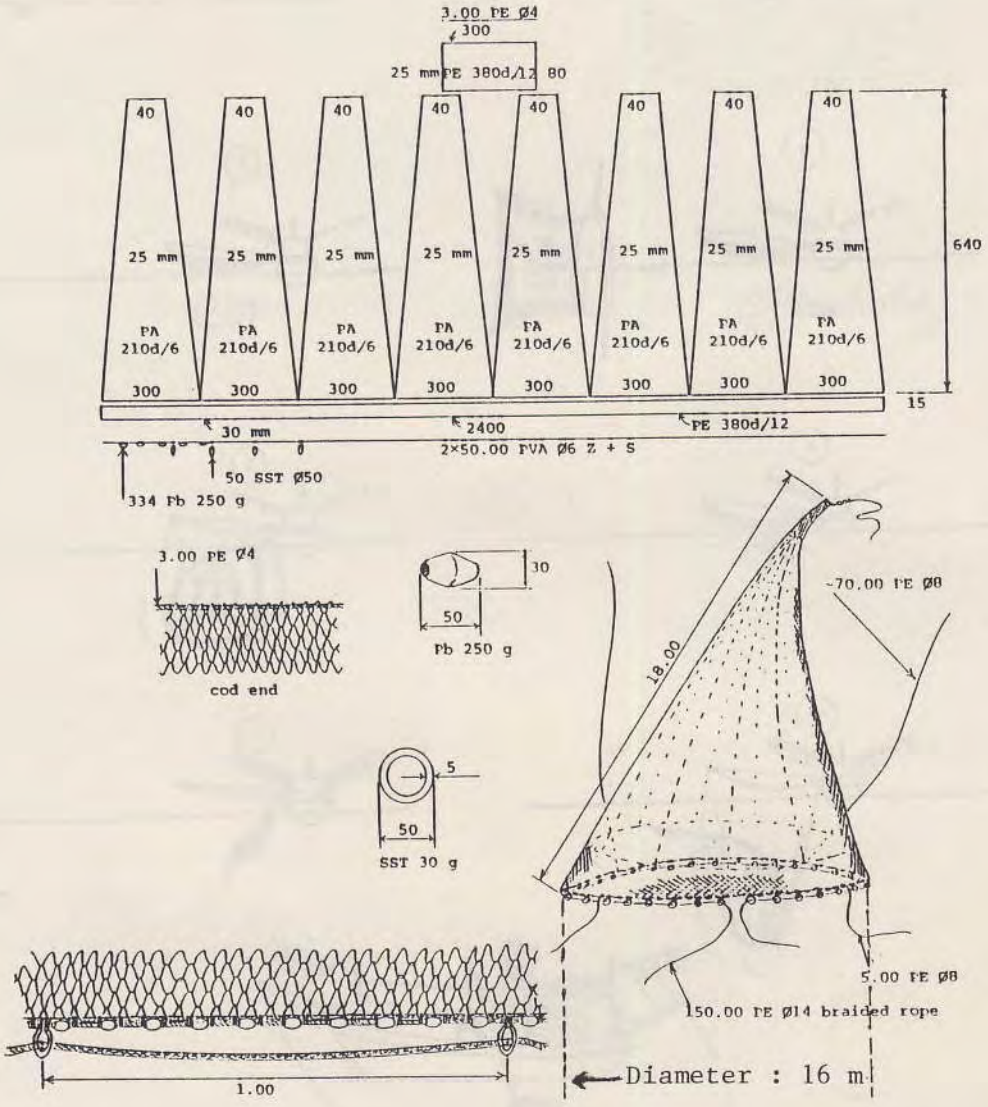


Fig. 18 Specification of a squid cast net I

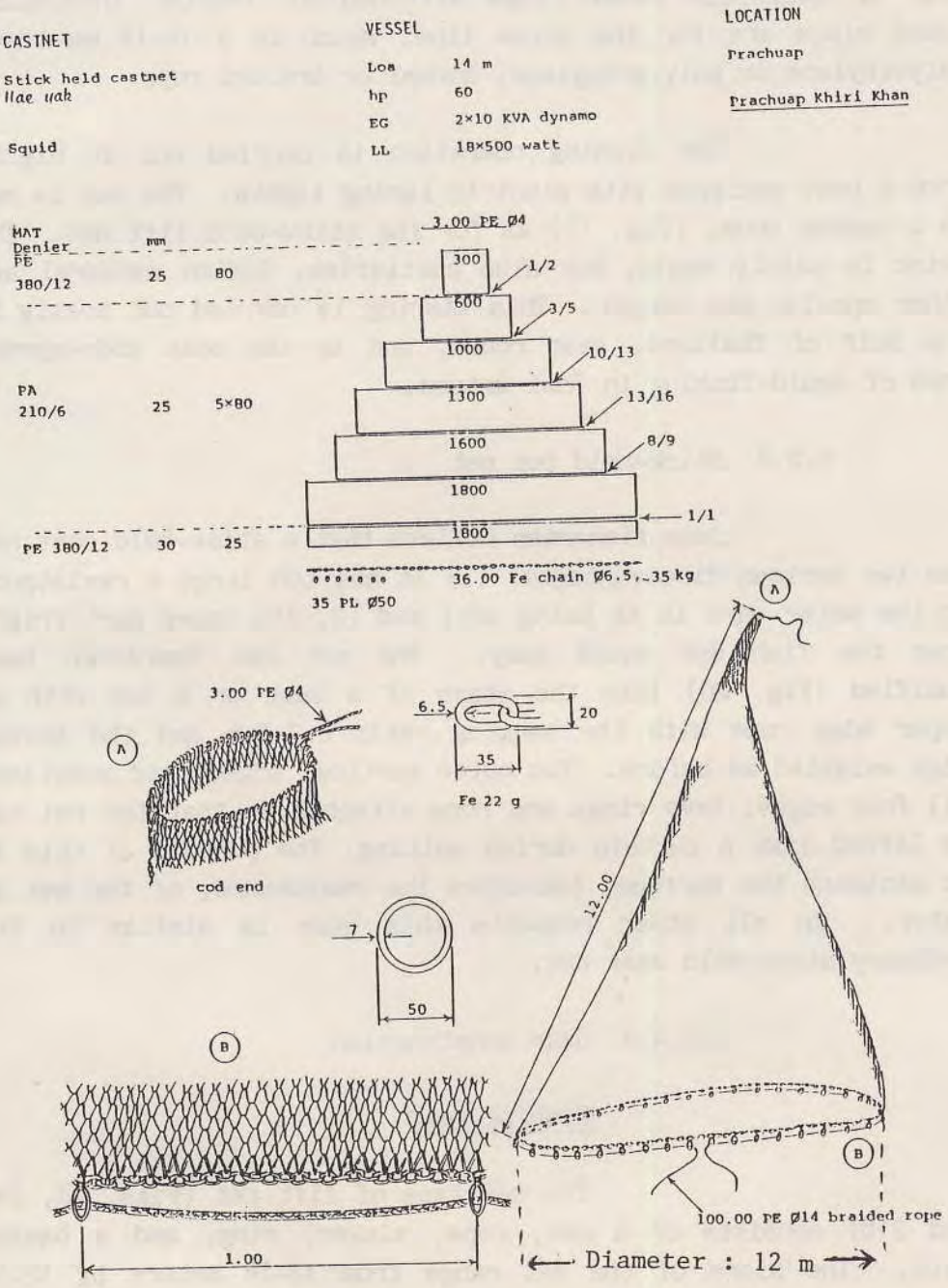


Fig. 19 Specification of a squid cast net II

iron or stainless steel rings attached at 1-meter intervals. These rings are for the purse line, which is a 12-14 mm thick polyethylene or poly-propylene, normal or braided rope.

The fishing operation is carried out at night, from a boat equipped with electric luring lights. The net is set on a bamboo boom, (Fig. 17) as for the stick-held lift net. The catch is mainly squid, but also cuttlefish, Indian mackerel and other species are caught. This fishing is carried out mostly in the Gulf of Thailand, year round, and is the most wide-spread form of squid-fishing in Thai waters.

2.2.4 Stick-held box net

Some fishermen believe that a stick-held cast net has two serious disadvantages: (1) it has too large a resistance in the water when it is being set; and (2) its upper part frightens the fish and squid away. The net has therefore been modified (Fig. 20) into the shape of a cube or a box with an upper edge rope with the hanging ratio 0.7-0.6 and the bottom edge weighted as before. Two outer vertical edges, and sometimes all four edges, have rings and rope attached so that the net can be lifted like a curtain during setting. The purpose of this is to minimize the surface, therefore the resistance, of the net in water. In all other respects this gear is similar to the ordinary stick-held cast net.

2.2.4.1 Gear construction

Fishing gear

The new type of lift net (Figs. 20, 21a and 21b) consists of a net, rope, sinker, ring, and a bamboo pole. The sizes of the net range from 12-14 meters by 12-14 meters, and 11-16 meters deep.

This gear is very simply constructed and is light enough to be operated by 6-7 fishermen. This type of net is used only at night.

Mesh and twine size

The netting is made of synthetic fibers; nylon is used for the main net and polyethylene for the selvage. The mesh size of the net is 3.0 cm in stretched measurement, and the twine size is nylon 210 denier 6 ply and polyethylene 380 denier 6-12 ply respectively.

The main net is dyed black to make it less visible to squid, and the selvage net is green.

The hanging coefficient is 13-30 percent on each side of the net.

Floats and sinkers

No floats are used on the float line. Seventy-two lead sinkers, each weighing about 0.5 kg, and another 72 small sinkers (75g each) are attached to the sinker line, and divided equally along the four sides of the net.

Lines

Two polyethylene ropes, one with a "Z" and the other with an "S" twist of 8 mm in diameter, are used for float and sinker lines.

Polyethylene crossed rope, 14 mm in diameter is used for the lift line.

Bamboo poles

Two bamboo poles, 14 cm in outer diameter and 15 meters long, are used as supporting sticks for the net. One end of each pole is fixed to the bow and the stern respectively, so that the other end projects over the sea surface.

GEARNET	VESSEL		LOCATION
Stick held boxnet	Loa	16 m	Ban Nang-Yon
Mung	hp	130	Ranong
	EG	2×5 KVA dynamo	
Squid	LL	18×500 Watt,500 red lamp	

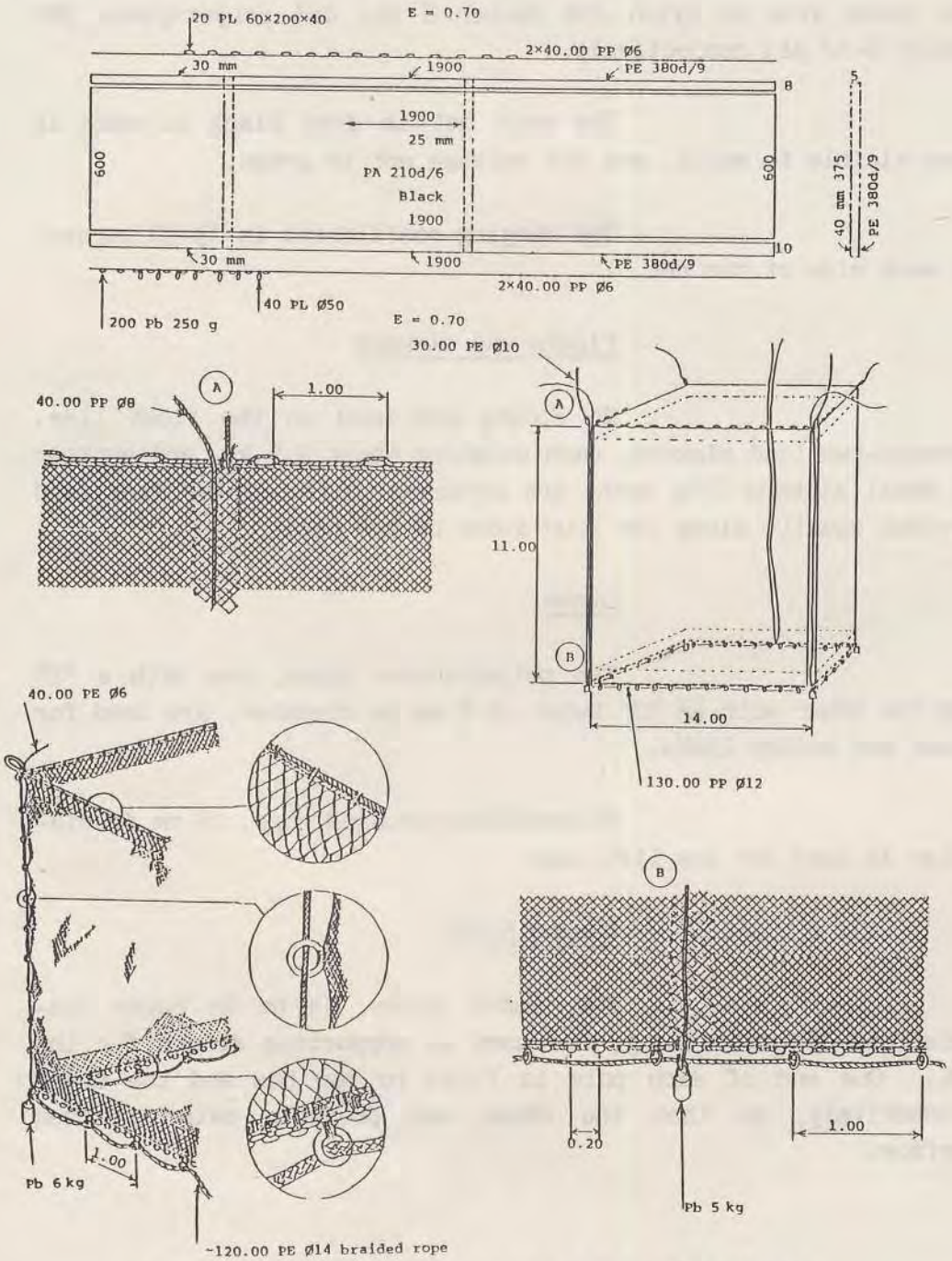
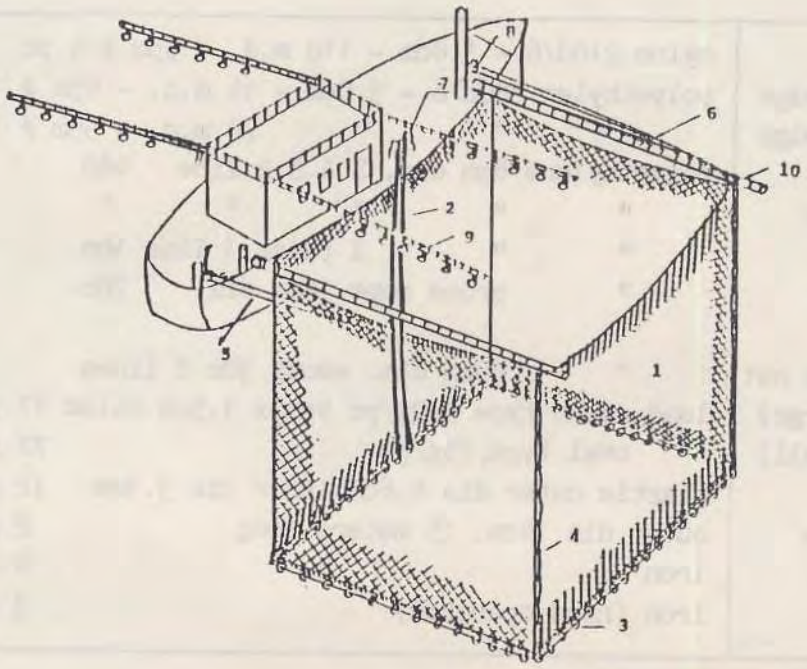


Fig. 20 Specification of a stick-held box net



1. Net
2. Purse line
3. Sinker
4. Ring
5. Lift line for pulling the net
6. Bamboo pole
7. Main warping dram
8. Side warping dram
9. Luring lamp
10. Block

Fig. 21a Operational figure of a stick-held box net

Table 1. Particulars of the net

1	Main net	nylon 210d/6 - 3.0cm - 110 m.d. - 55m # 1 pc	
2	Upper selvedge	polyethylen 380d/6 - 3.0cm - 16 m.d. - 55m # 1 pc	
3	Lower selvedge	" " " 20 m.d. - 55m # 1 pc	
4	Head line	polyethylene 8mm dia. Z & S 2 line	48m
5	Sinker line	" " " " "	
6	Side line	" " Z twist 1 line	16m
7	Purse line	" cross rope 14mm dia.	70m
8	Line for pulling the net	" 10mm dia. about 30m 2 lines	
9	Sinker (large)	lead round type 500g/pc 9cm x 1.5cm thick	72 pcs
10	Sinker (small)	" oval type 75g/pc	72 pcs
11	Ring	Plastic outer dia 4.8cm inner dia 3.3cm	72 pcs
12	Bamboo pole	outer dia 14cm, 15 meters long	2 poles
13	Block	iron	4 pcs
14	Dram	iron (hand operated)	3 sets

d : denier m.d. : mesh deep

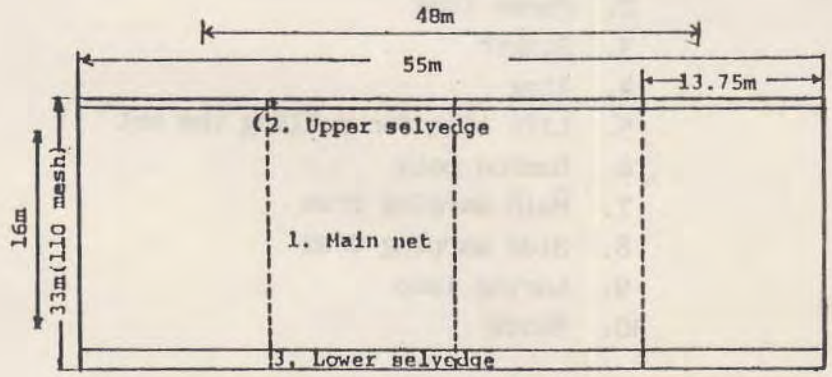


Fig. 21b Design diagram of the net

2.2.4.2 Fishing Method

The boat leaves the pier at about four o'clock in the afternoon and goes to a suitable fishing ground (the exact time of departure from the pier varies with the lunar cycle). The journey from the pier to the fishing ground may take up to four hours.

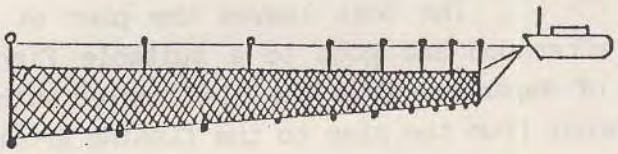
On arrival the engine is stopped and the boat is allowed to drift for some time. One set of mid-water gill nets, 300 - 400 meters long and 14 meters deep, (Fig. 22) is then thrown out to sea as an anchor, and the end of the net is attached to the bow side of the boat.

The boat is positioned in the direction of the current and is held in place by the gill net.

All fish-luring lamps are switched on to attract the squid around the boat. The boat is equipped with 24 fish luring lamps, each one having the power of 500 Watts. Six lamps are suspended on each of the four outriggers. Two outriggers are positioned on the port side and two on the starboard side of the boat.

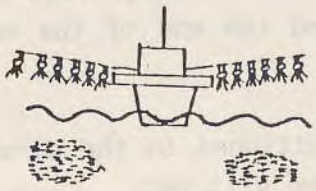
After some time the squid are attracted around the boat. The net is prepared for operation, (Fig. 22a) and when completed, the luring lamps on the port side are switched off by the masterfisherman. The squid will then shift to the starboard side where the net is. By reducing the illuminating power of the lamps on the starboard side the squid are attracted to the surface.

The fishermen then quickly cast the net, keeping the float line 30-50 cm above the sea surface. The bottom of the net is closed by pulling the purse line, it is slowly pulled towards the side of the boat and partially hauled on board.



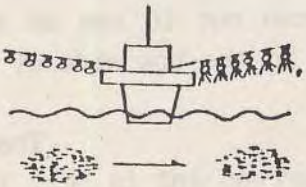
One set of the mid-water gill net is thrown out to the sea as a sea anchor.

2.



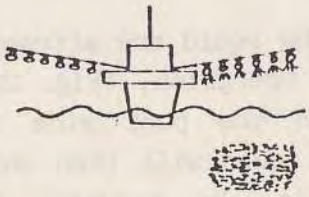
All fish luring lamps are switched on to attract the squid around the boat.

3.



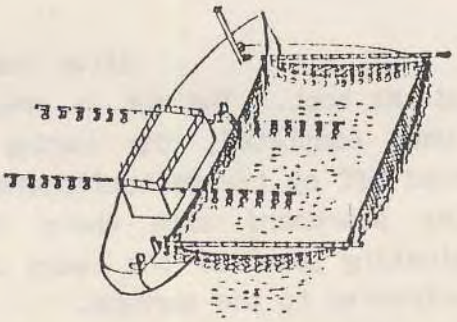
Port side lamps are switched off.

4.



All squid are attracted to the starboard side.

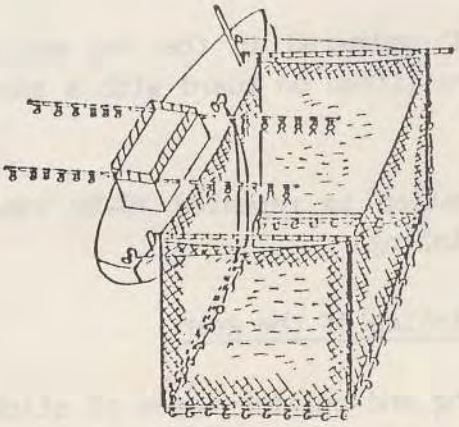
5.



Squid are attracted underneath the net which is held by fishermen. Then, by reducing the illuminating power of the lamp, the squid are attracted to come up to the sea surface.

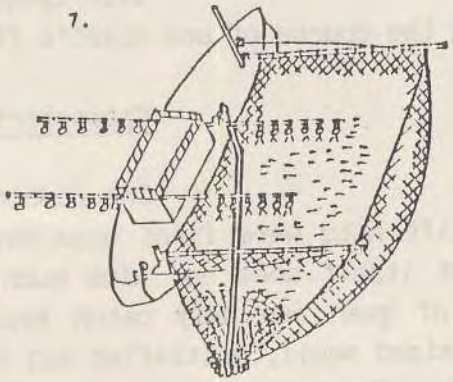
Fig. 22 Operation method of stick-held box net

6.



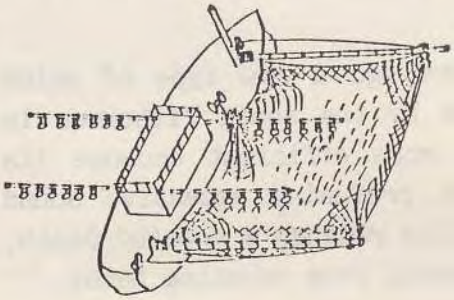
On the masterfisherman's command, the net is quickly thrown into the water

7.



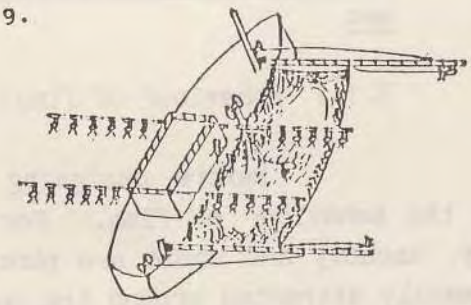
The foot side of the net is closed by the purse line, to prevent squid from escaping underneath the net.

8.



After closing the foot side of the net completely, the net is hauled on board

9.



The squid is gathered in the cod end and the catch is lifted on board with a scoop net.

Fig. 22a

The squid, gathered in the cod end of the net which is left in water, are lifted on board with a scoop net.

This operation is repeated 10-20 times during the course of one night's fishing.

Characteristics of the gear

The pushing and pulling types of stick-held lift nets were first used several years ago. But, because the net itself does not sink much below the surface, these two types of gear can only catch squid swimming near the surface. Large-sized squid, cuttlefish and other species escape underneath the net. The casting type of stick-held lift net, which has been used as an alternative squid fishing gear, has a somewhat higher catching efficiency, but is still inadequate for catching large-sized squid or fish.

About 2 years ago a new type of stick held box net began to be widely used by the squid fishermen in Ban Phe District. The new net is more efficient because its bottom edges sink into water without producing excessive sound which frightens the squid. This net also reaches a greater depth, thus preventing most of the trapped squid from escaping below.

3. Design of stick-held lift net

3.1 Factors to be considered in designing a stick-held lift net

3.1.1 Behaviour of fish:

Before designing the net, it is necessary to know the behaviour of fish. For example, some fishes such as saury, anchovy and squid are phototactic animals; and therefore are easily attracted around the boat by using fish luring lamps. These fishes are caught at night.

On the other hand, mackerel and horse mackerel, for example, are more easily attracted with the aid of bait. These fish are caught in the day-time.

3.1.2 Condition of the fishing boat:

Many types of fishing boats are used for operation of the stick-held lift net. It is however necessary to know the size of the boat, size of the engine, the number of fishermen, and equipment required on board, etc.

The size of the net should be decided by the length of the fishing boat.

3.1.3 Effective length of the boat:

Two bamboo poles are used for the purpose of stretching the net during operation. One pole projects from the bow and the other from the stern.

To allow for the proper distance between the poles, about 80 per cent of the boat length is usually considered to be the effective length.

3.1.4 Shape of the net: (Fig. 23)

The shape of the net can be square, rectangular or trapezoid and varies slightly between night- and day-time operations. The type of boat and the behaviour of fish should also be taken into consideration.

3.1.5 Material of the net:

It is very important to select the best materials for making the net and ropes. The success or failure of the stick-held lift net is dependent on its ability to withstand the influence of sea currents and winds and maintain its desired shape during operation. The net is also operated many times

during day or night, and this constant handling requires that the material of the net and rope should have the following properties:

i) High breaking strength,
ii) High abrasion resistance,
iii) High density (specific gravity),
iv) Low price
v) Easy handling

Materials which best satisfy these requirements are the following synthetic fibers:

1) Nylon (Polyamaid),

2) Vinylon (Polyvinyl alcohol),

3) Saran (Polyvinylidene chloride) and nylon mix twisted fiber,

4) Tetoron (Polyester).

3.1.6 Size of the netting twine, rope and accessories used for the net.

The scale/gauge of the netting twine, the rope and accessories should be selected taking into account the size of the net; the boat; and the target fish.

3.2 How to design a stick-held lift net

Together with the factors discussed in 3.1, the design of the net should also include the following steps:

3.2.1 Step 1. To determine the length of the rope connected to the net: (Fig. 24)

1) The length of the rope connected to the front end of the net should be; (a) equivalent to the distance between the two out-stretched poles on the boat.

2) The length of the rope connected to the foot end of the net (b) should be: equal to (a) or 10 to 20 per cent longer than the length of (a) depending on the shape of the net to be used.

When (a) and (b) are the same length, the shape of the net will be square or rectangular.

If length (b) is longer than length (a), then the shape of the net will be trapezoid.

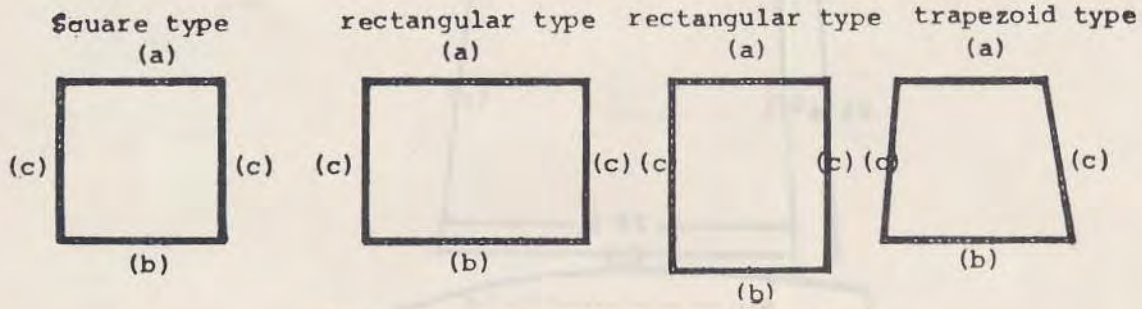


Fig. 23 Types of stick-held lift net

3) To calculate the length of the rope connected to the side of the net:

For the trapzoid net: The length of rope (c) is equal to half of the sum of the length (a) and (b); or equal to length (b).

For the rectangular net: There are two types; one long laterally and the other short laterally. Therefore, rope (c) can either be longer, or shorter than (a) and (b) as shown in Fig. 23.

For square net: The length of rope (c) is equal to (a) and (b).

For example: In the trapezoid type, if the effective length of the boat is 20 meters, then the length of the ropes (a), (b) and (c) of the net can be found as follows:

(a) = (b) or 1.1 x (a) - 1.2 x (a) = (b)

$$(c) = (b) \text{ or } (c) = \frac{(a) + (b)}{2}$$

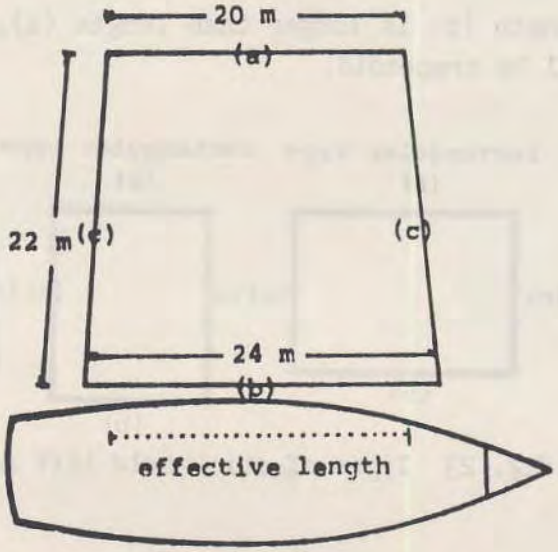


Fig. 24 Determining the length of the rope

The length (a) is the same as the effective length of the boat.

The length (b) is 10 to 20 per cent longer than (a). If length (b) is 20 per cent longer than (a), then length (b) will be 24 meters.

The length (c) is equal to a half of the sum of lengths (a) and (b). Therefore, the length (c) will be $\frac{20 + 24}{2}$ = 22 (m)

3.2.2 Step 2. To determine the number of sections of the net. (Fig. 25)

(1) The depth of one piece of net webbing is 5 meters or 7.5 meters.

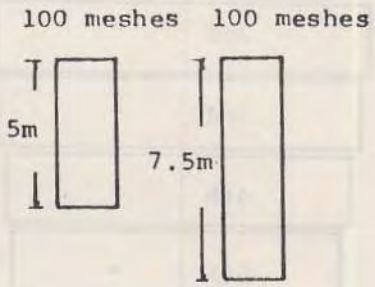


Fig. 25 Depth of one piece of net webbing

2) The depth of net before hanging is 1.5 to 2.5 times the length (c). (Fig. 24)

Example: Depth of one piece of net webbing = 7.5 meters
Length (c) = 22.0 meters

If we select twice the length of (c) for the depth of the net (2), then the depth (2) will be 44 meters. The number of sections of the net is determined as follows:

44 meters ÷ 7.5 meters = 6 (sections)

3.2.3 Step 3. Determine the length of each section by the curvature line drawn on the section paper. (Fig. 26)

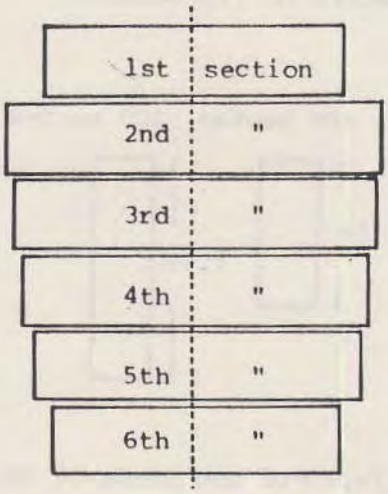


Fig. 26 Illustration of size and placement of sections

(i) The length of the 1st section of the net is 1.5 to 2.5 times the length of the rope of the front end of the net (a). (Fig. 23)

(ii) The length of the 2nd and 3rd sections should be longer than the length of other sections to form a pocket for the cod end.

(iii) The length of the last section (6th section) should be the shortest to reduce resistance and keep the net in good shape.

Example: Using the calculations in step 2, 6 sections have been determined; the length of each section will be found by the curvature line drawn as follows:

If we select twice the rope length (a) for the length of the 1st section, then we will obtain 20 meters x 2 = 40 meters.

The length of the 6th section should therefore be less than 40 meters. 38 meters was chosen for the length of the 6th section.

(Note: Even though the length of the last section should be the shortest of all sections, the hanging ratio against the length of the rope (b) should be more than 35 per cent).

The lengths of the 1st and the 6th section, found by applying step 3, are then drawn to scale on the section paper. (Fig. 27)

The length of the 2nd to 5th sections can be then determined by drawing the required net shape on the section paper. The length of each section may be adjusted to reach the desired shape.

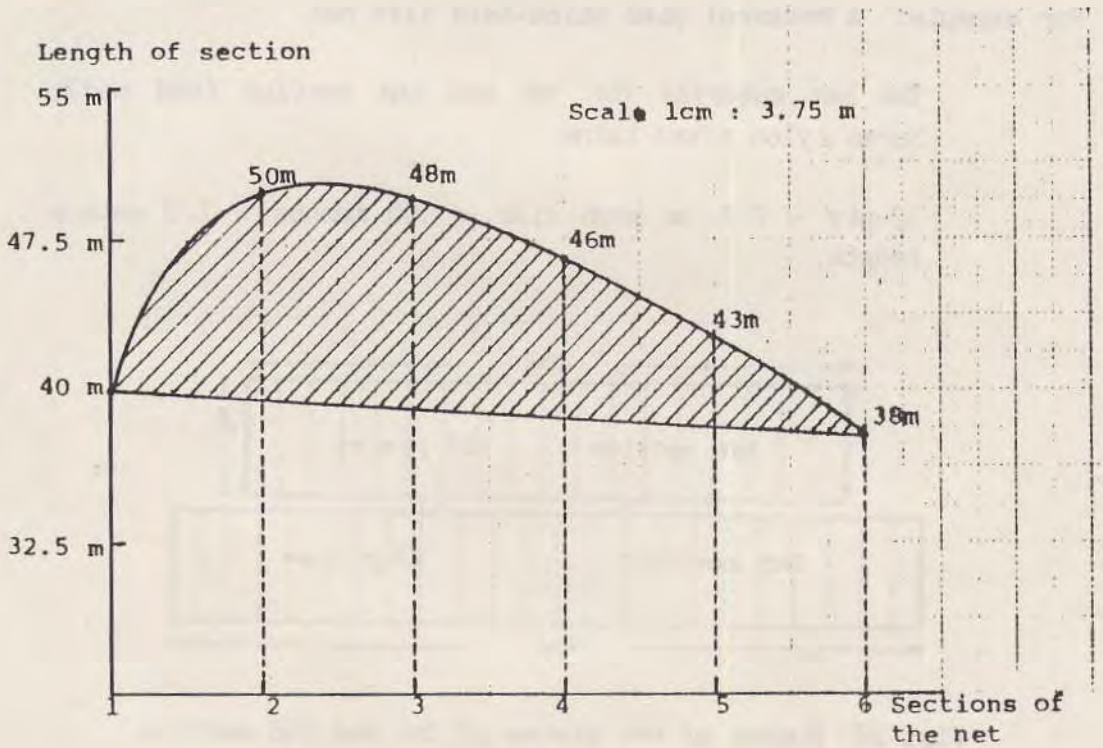


Fig. 27 The shape of the net in water

According to the curvature on Fig. 27, the length of each section is as follows:

1st	section	=	40 meters
2nd	"	=	50 meters
3rd	"	=	48 meters
4th	"	=	46 meters
5th	"	=	43 meters
6th	"	=	38 meters

3.2.4 Step 4. To determine the material, size and number of the net pieces. (Fig. 28)

The size and the materials used to construct the net should be selected taking into consideration all the factors discussed in section 3.1.

For example: A Mackerel pike stick-held lift net

The net material for 1st and 2nd section (cod end): Saran nylon mixed twine

12-ply - 2.2 cm mesh size = 100 meshes = 7.5 meters length.

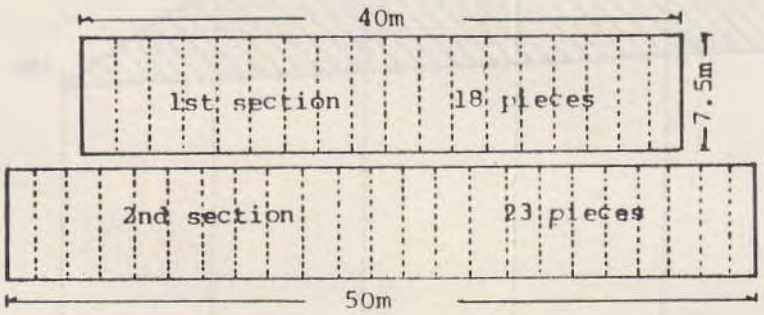


Fig. 28 Number of net pieces of 1st and 2nd section

The length of the 1st and 2nd sections were established at 40m and 50m respectively. Therefore, the number of net pieces will be found as follows:

For the 1st section

The width of one piece of the net is 2.2 cm. x 100 meshes = 2.2 meters. Therefore, the number of net pieces will be: 40m ÷ 2.2m = 18 pieces.

For the 2nd section

Using the same procedure, the number of net pieces will be 50m ÷ 2.2m = 23 pieces. The net material for the 3rd - 6th section (main net) is Saran nylon mixed twine

9-ply = 2.2cm mesh size = 100 meshes = 7.5 meters long.

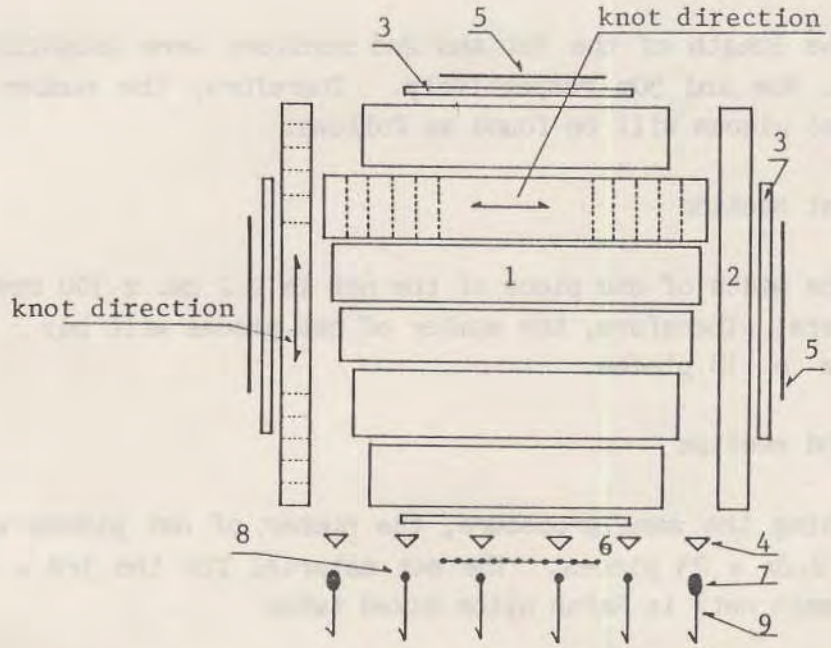
The number of net pieces will be found as follows:

3rd section: 48m - 2.2m = 22 pieces
4th section: 46m - 2.2m = 21 pieces
5th section: 43m - 2.2m = 20 pieces
6th section: 38m - 2.2m = 17 pieces

3.2.5 Step 5. To determine the length of side net and selvedge net. (Fig. 29)

1) The length and depth of side net

A side net is required for a large net. The side net is placed between the main net and selvage net and it runs perpendicular to the mesh direction of the main net.



1. main net
2. side net
3. selvage net
4. triangle net
5. side rope
6. small sinker
7. heaviest sinker
8. heavy sinker
9. lift line

Fig. 29 Position of net pieces of stick-held lift net

The depth of one piece of side net may be either half the depth of the main net or the same the depth as the main net, i.e. 3.7 m or 7.5 m in the case of 7.5 m depth of main net.

The length of the side net is the same as the total depth of the main net or it may be a little shorter. Therefore, it will be 7.5 m x 6 = 45 m or between 43 - 44 m.

2) To determine the length of selvage net

The length of selvage net is determined by adding the length of the side net, or the main net (when there is no side net) and side rope length, and dividing by two.

Example 1: Length of side rope (c) : 22 meters

Length of side net : 45 meters

The length of side selvage net will be found as follows:

Length of side selvage net = $\frac{22m + 45m}{2}$

= 34m

Example 2: Length of rope (a) : 20 meters

Length of 1st section : 40 meters

Length of upper selvage net : $\frac{20m + 40m}{2}$

= 30m

Example 3: Length of rope (b) : 24 meters

Length of 6th section : 38 meters

Length of lower selvage net = $\frac{24m + 38m}{2}$

= 31m

3.2.6 Step 6. To determine the accessories

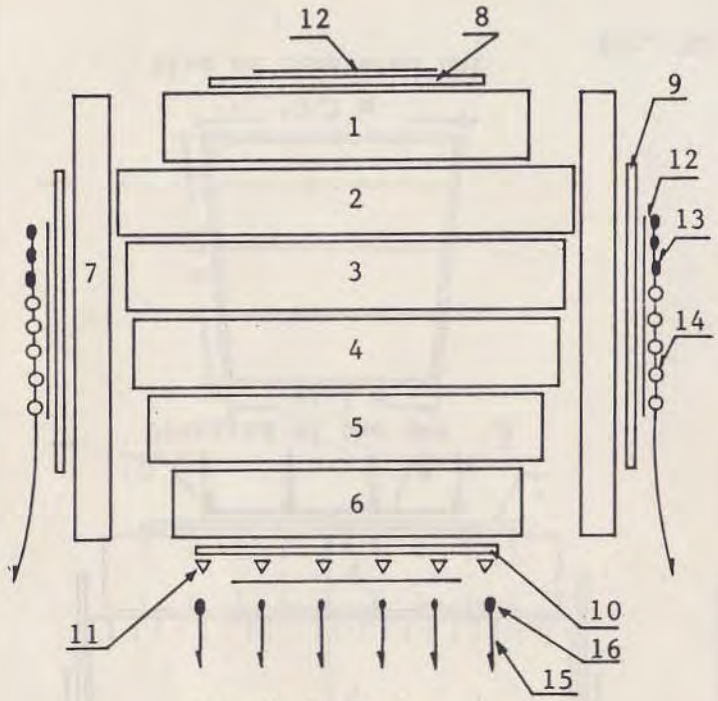
1) Lift line

The length of lift line should be 3 to 4 times the length of side rope (c)

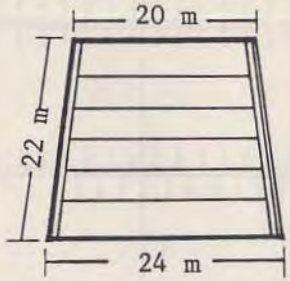
2) Sinker

The sinkers attached to the outer lift lines should be heavier (20 - 30 kg) than the others (10 - 15 kg). 100 - 150 pieces of small sinkers (100 - 150 g) are attached to the sinker line.

For reference, some specifications (Figs. 30-34) of stick-held lift nets are shown as follows:



Detailed of the net



View of the completed net

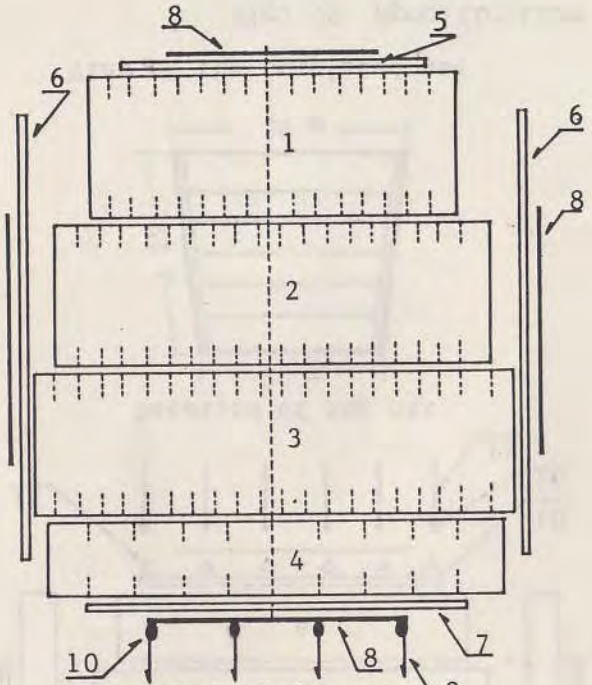
Scale : 10 m : 1.2 cm

Particulars

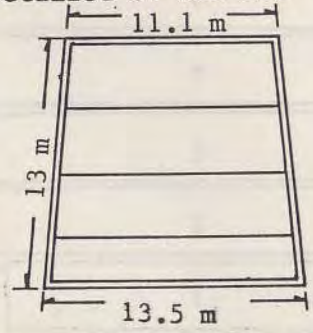
No.	Name	Twine	Size of mesh	No. of mesh	Length	No. of sheet
1	End (1)	SN/12	2.2 cm	100	7.5 m	18
2	End (2)	SN/12	2.2 cm	100	7.5 m	23
3	Main 3rd	SN/9	2.2 cm	100	7.5 m	22
4	Main 4th	SN/9	2.2 cm	100	7.5 m	21
5	Main 5th	SN/9	2.2 cm	100	7.5 m	20
6	Main 6th	SN/9	2.2 cm	100	7.5 m	19
7	Side net	SN/12	2.2 cm	100	3.7 m	20 x 2
8	Selvedge	SN/24	3.5 cm	10	30 m	1
9	Selvedge	SN/24	3.5 cm	10	34 m	1 x 2
10	Selvedge	SN/24	3.5 cm	10	31 m	1
11	Triangle	SN/45	5.0 cm	1 - 10		6
12	Side line	Vinylon 10 m/m dia S & Z				88 m
13	Float	Synthetic 7 x 2½" x 1½"				5 x 2
14	Ring	2" cir. 10 m/m dia				6 x 2
15	Lift net	Vinylon 12 m/m dia 60 m				6 lines
16	Sinker	Lead Big size 20 kg ... 2 P'cs Big size 15 kg ... 4 P'cs Small size 100 g ... 100 P'cs				

* SN ..... Saran nylon mixed twine

Fig. 30 Specification of stick-held lift net for small sized pelagic fishes I



Detailed of the net

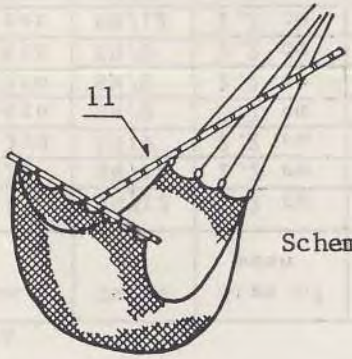


Size of completed net

Scale : none

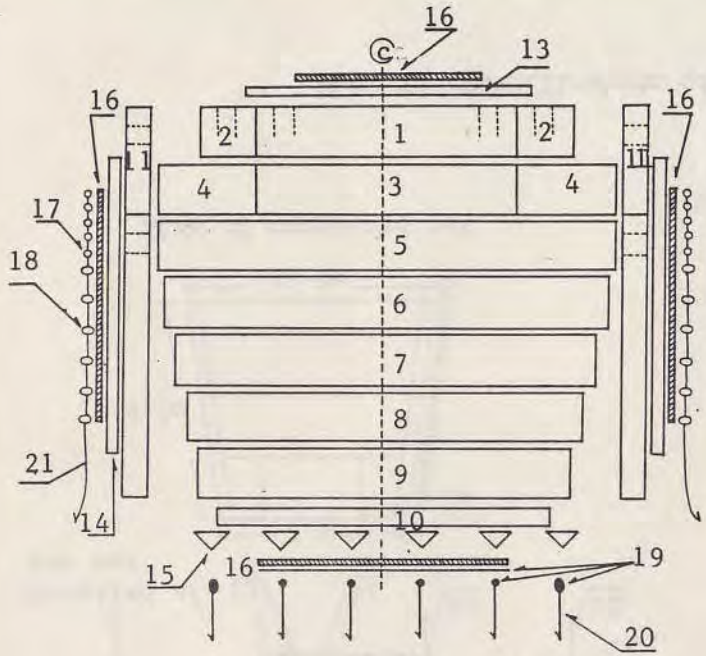
Particulars

No.	Name	Twine	Size of mesh	No. of mesh	Length	No. of sheet
1	End	Nylon 210d/4	1.2 cm	100	7.5 m	16
2	Main 1st	210d/4	1.2 cm	100	7.5 m	19
3	Main 2nd	210d/4	1.2 cm	100	7.5 m	21
4	Lower brim	210d/6	2.3 cm	100	3.8 m	10
5	Upper selvedge	210d/15	3.0 cm	6	15.0 m	1
6	Side selvedge	210d/15	3.0 cm	6	19.0 m	1 x 2
7	Lower selvedge	210d/15	3.0 cm	6	19.0 m	1
8	Side line	Vinylon 6 m/m dia S & Z				50.6 m
9	Lift net	Vinylon 9 m/m dia Z				40 m x 4
10	Sinker	Lead 7.5 kg/P'ce				4 P'cs
11	Pole	Bamboo 6 - 7 cm dia				13 m

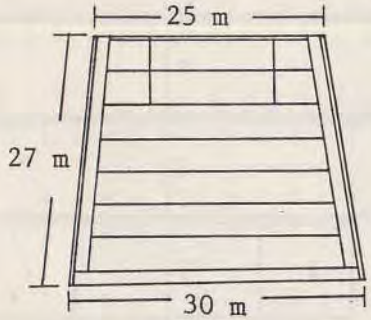


Schematic view of the net

Fig. 31 Specification of stick-held lift net for small sized pelagic fishes II



Detailed of the net



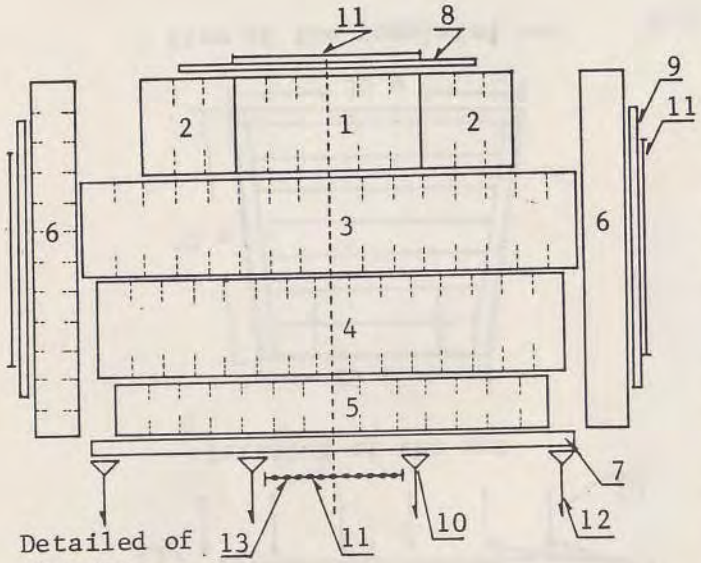
View of the completed net

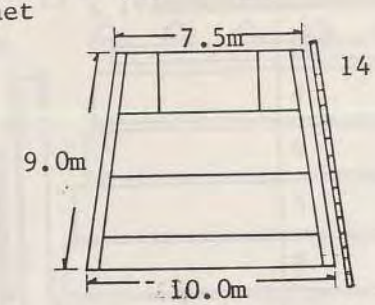
Particulars

No.	Name	Twine	Size of mesh	No. of mesh	Length	No. of sheet
1	End (1)	N210d/18	2.3 cm	100	7.5 m	14
2	Sub-end (1)	N210d/15	2.7 cm	100	7.5 m	3 x 2
3	End (2)	N210d/18	2.3 cm	100	7.5 m	14
4	Sub-end (2)	N210d/15	2.7 cm	100	7.5 m	6 x 2
5	Main 3rd	SN/12	2.3 cm	100	7.5 m	28
6	Main 4th	SN/12	2.3 cm	100	7.5 m	27
7	Main 5th	SN/12	3.3 cm	100	7.5 m	17
8	Main 6th	SN/12	3.3 cm	100	7.5 m	15
9	Main 7th	SN/12	4.3 cm	100	7.5 m	10
10	Main 8th	SN/24	6.0 cm	50	40 m	1
11	Side net	SN/15	2.7 cm	100	3.5 m	6 x 2
12	Side net	SN/12	3.3 cm	100	3.5 m	11 x 2
13	Selvedge	SN/45	4.3 cm	10	40 m	1
14	Selvedge	SN/45	4.3 cm	10	38 m	1 x 2
15	Triangle	SN/60	6.0 cm	1-12		6
16	Side line	Vinylon 10 m/m dia S & Z				110 meters
17	Float	7 x 2½" x 1½"				5 x 2
18	Ring	2½" Cir. 10 m/m dia.				6 x 2
19	Sinker	Lead 20 kg ..... 4 30 kg 2			100 g.	150 pcs.
20	Hauling line	Vinylon 16 m/m dia.		90 m.		6 lines
21	Hauling line	Vinylon 16 m/m dia.		120 m.		2 lines

Note: N ..... Nylon
SN ..... Saran nylon mixed twine

Fig. 32 Specification of saury stick-held lift net (medium boat type)



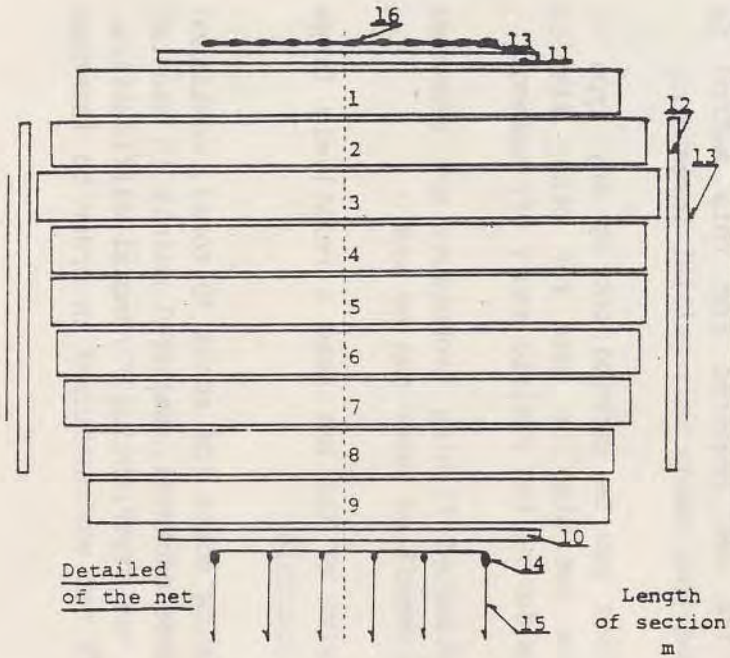


Size of completed net

Particulars

No.	Name	Twine	Size of mesh	No. of mesh	Length	No. of sheet
1	End	Vinylon 20's/15	2.3 cm	100	7.5 m	6
2	Sub-end	20's/12	2.3 cm	100	7.5 m	3 x 2
3	Main 2nd	20's/9	2.3 cm	100	7.5 m	16
4	Main 3rd	20's/9	2.3 cm	100	7.5 m	15
5	Main 4th	20's/9	2.3 cm	100	3.8 m	14
6	Side	20's/9	2.3 cm	100	3.8 m	12 x 2
7	Lower brim	20's/15	4.3 cm	15	40.0 m	1
8	Upper selvedge	20's/12	2.8 cm	6	20.0 m	1
9	Side selvedge	20's/12	2.8 cm	6	20.0 m	1 x 2
10	Triangle	20's/45	4.3 cm	1 - 15		4
11	Side line	Vinylon 6 m/m dia S & Z				35.5 m
12	Lift line	Vinylon 9 m/m dia				30 m x 4
13	Sinker	Lead 220 g/P'ce				100 P'cs
14	Pole	Bamboo 10 cm dia 11 m				2 P'cs

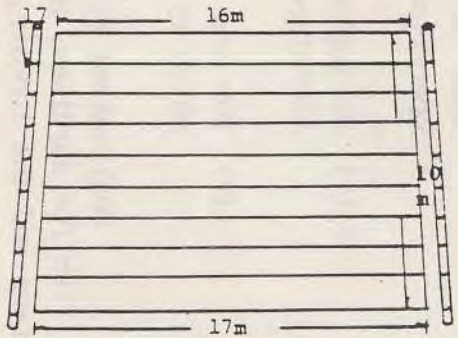
Fig. 33 Specification of saury stick-held lift net (small boat type)



Detailed of the net

Particulars

No.	Name	Twine	Size of mesh	No. of mesh	Length	No. of sheet
1	End (1)	210d/4	2.5 cm	100	35 m	1
2	End (2)	210d/4	2.5 cm	100	39 m	1
3	Main 3rd	210d/4	2.5 cm	100	40 m	1
4	Main 4th	210d/4	2.5 cm	100	39 m	1
5	Main 5th	210d/4	2.5 cm	100	38 m	1
6	Main 6th	210d/4	2.5 cm	100	37 m	1
7	Main 7th	210d/4	2.5 cm	100	36 m	1
8	Main 8th	210d/4	2.5 cm	100	34 m	1
9	Main 9th	210d/4	2.5 cm	100	33 m	1
10	Selvedge	210d/6	3 cm	6	25 m	1
11	Selvedge	210d/6	3 cm	6	26 m	1
12	Selvedge	210d/6	3 cm	6	16 m	2
13	Side line	Vinylon 6 m/m dia			90 m 1 line	
14	Sinkers	Lead 3 kg x 4 pcs; 4 kg x 2 pcs				
15	Lift line	Vinylon 10 mm dia		6 pcs		
16	Floats	7" x 2" dia (round)		90 pcs		
17	Pole	Bamboo 10 m		2 pcs		



Size of completed net
Scale 1 : 180

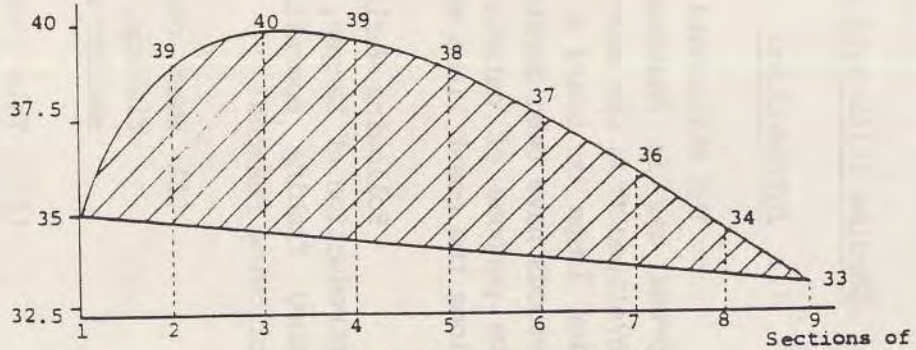


Figure of the net under water
Scale 1 : 170

Fig. 34 Specification of Squid Stick-held lift net used by SEAFDEC Training Boat "PLATOO"

IV. TYPICAL FISHING GEAR AND METHODS

1. Sardine stick-held lift net fishing operation

1.1 Introduction

The stick-held lift nets which, at present, are in widespread use in Southeast Asia and the South Pacific are all developed from the saury stick-held lift net. Using fish attraction lamps on board a 10 to 20 ton fishing boat, the fishing methods have been developed over the last sixty years, mainly for the purpose of catching sardines, horse mackerel and mackerel along the coast lines and offshore for saury.

Following World War II, rapid development came with the introduction of larger, more powerful fishing boats, and offshore saury fishing operations made remarkable advances for the following reasons:

(i) When compared with drift net or purse seine fishing, the net required for this method is smaller and thus needs less initial investment.

(ii) This fishing can be carried out by any type of boat which can also be used for other fishing operations during the Pacific saury off season.

(iii) No sophisticated fishing techniques are demanded therefore unskilled labor can be used.

(iv) For the size of the net used a relatively large catch is possible.

Small-sized fishing boats (of about 10 tons), continued to fish for sardines, horse mackerel, mackerel mainly in coastal waters and the industry was experiencing financial difficulties. A sardine stick-held lift net was developed in order to increase the catch.

In addition to the advantages mentioned for the saury stick-held lift net, this new lift net also has the following favourable characteristics:

(i) The net may now be as large as that used for a middle- or a large-sized fishing boat.

(ii) The introduction of purse winch and net hauler allows as few as 4 or 5 men to operate the net.

1.2 Rationale

In the Southeast Asia and South Pacific waters the saury stick-held lift net is used to supply the demand for live bait for the skipjack pole-and-line fishing industry in Indonesia and the South Pacific region. This method is also applied to the fishing of sardines, horse mackerel, mackerel and squid in the Philippines, Malaysia and in Thailand, where it is used by small boats (of 2-3 tons) to fish exclusively for squid. The way to increase the efficiency of this method depends not on the scale of the boat, but on the size of a net and the introduction of modern equipment. Although the length of the stick varies according to the size of a boat and net used, in general a straight and strong bamboo (a species of thick-stemmed bamboo: *Phylostachys pubescens*) is needed. This bamboo is not only difficult to obtain in the tropics but it also has a short life due to exposure.

The advantage of the sardine stick-held lift net are as follows:

(i) A large-scale sardine stick-held lift net has a purse line to prevent fish from escaping, making the operation much more efficient.

(ii) Because a long stick is not required, the bamboo used for this kind of a net can be found in these regions.

1.3 The construction of sardine stick-held lift net (Figs. 35 and 36)

The sardine stick-held lift net can be either square, rectangular or trapezoid. In appearance, the lift net rather like a sleeveless cape because of its specially designed bag net. It also has float line and sinker line, and the edge of the net on sinker side is closed into the shape of a purse, as in a purse seine.

The sardine stick-held lift net consists of three parts: a bag net; a body/main net; and an apron net. (floats are attached to the edge of the bag net and body net, and sinkers to the edge of the apron net).

When the net is cast, the float line extends to about 120 m, the sinker line 65 m and the center of the extended float line is about 40 m from the boat. The maximum depth of the net is about 40 m at the center of the sinker line and approximately 20 m at the center of body net when a purse line is wound up.

In general, the bag net and apron net are made of nylon netting, and the body/main net of polyester (Tetoron) netting. However, in TD's work shop, polyethylene netting is used for selvage net on both float and sinker side. The use of Tetoron netting for body/main net has an advantage in that the specific gravity of the heavier Tetoron (1.38) with the three sinker lines attached add to the sinking speed, allowing the net to maintain an optimum shape in tidal currents.

1.4 Fishing Operation (Fig. 37)

After casting, the shape of the net is dependent on the speed and direction of the current. Therefore, the movement of the current should be studied carefully.

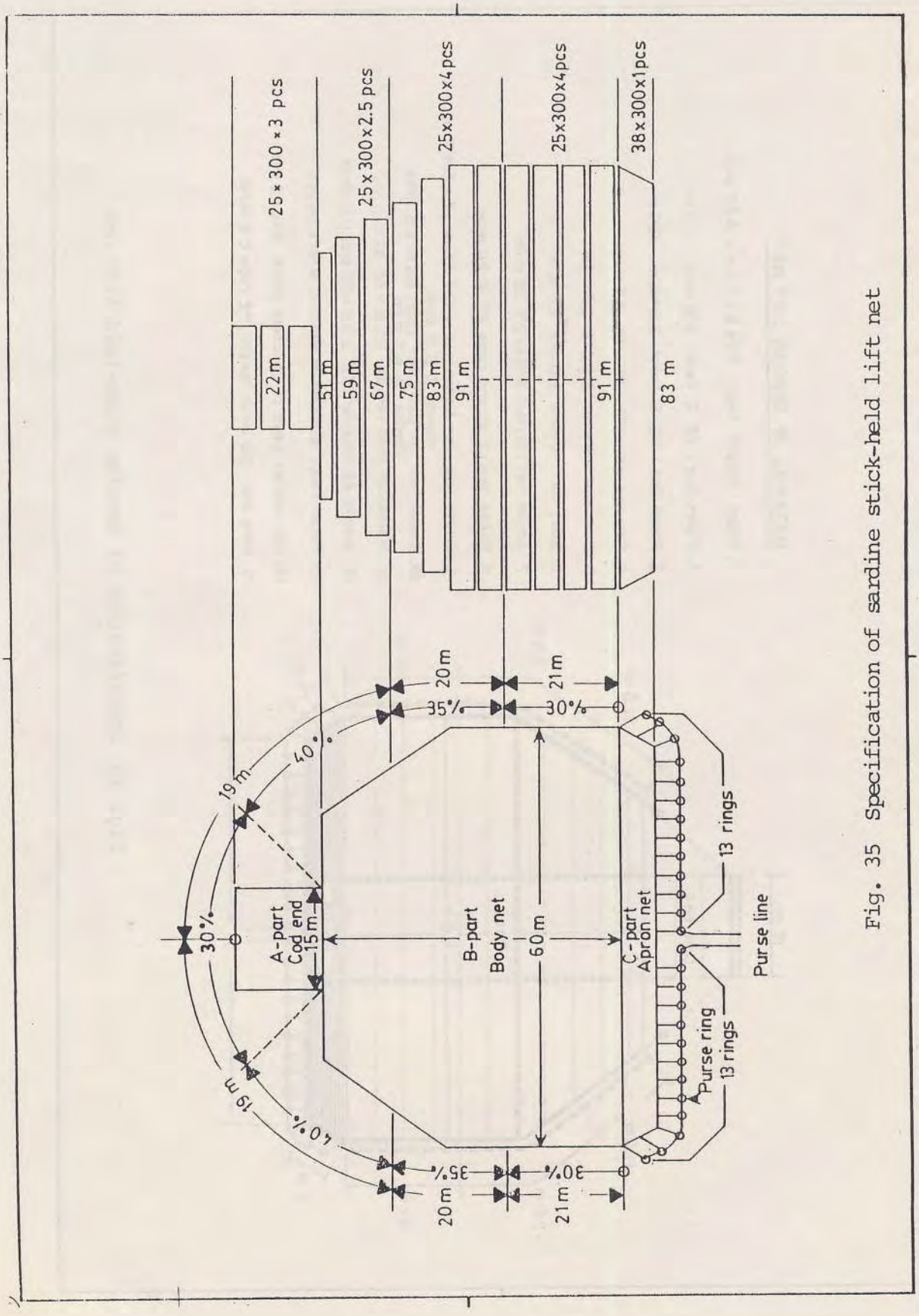
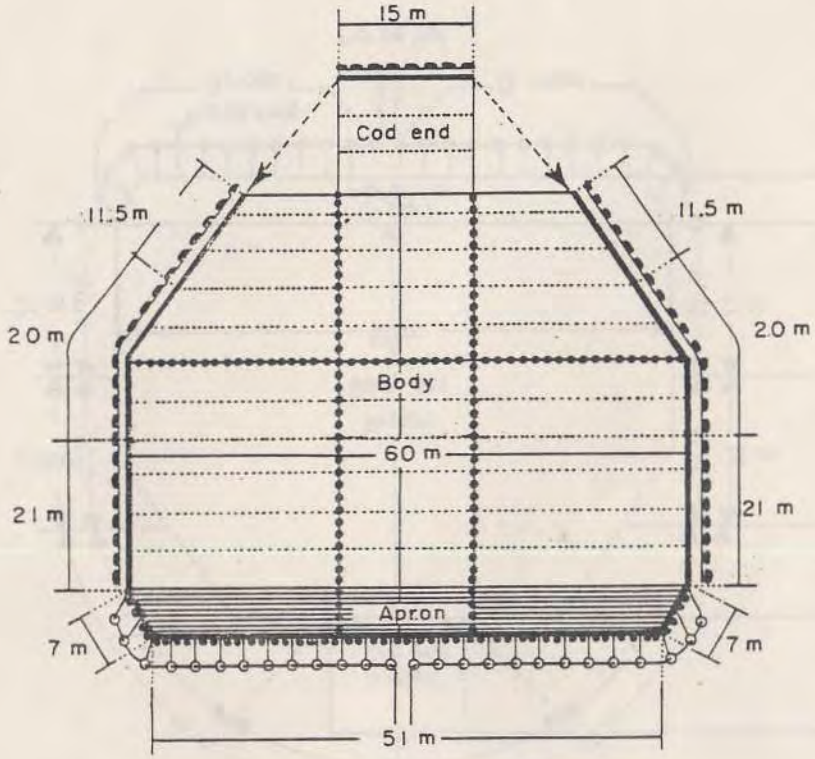


Fig. 35 Specification of sardine stick-held lift net



MATERIAL OF SARDINE LIFT NET

1. Float : Plastic foam 20x6x4 cm x 480 pcs
2. Float line : PE Z twist Ø 8 m/m 120 m
3. Float line : PE S twist Ø 8 m/m 120 m
4. Selvage net : PE 380/12 35 m/m
5. Cod end : Nylon 210d/9 25 m/m
6. Body net : Nylon 210d/6 25 m/m
7. Apron net : Nylon 210d/28 38 m/m
8. Purse line : 8 strand rope PE Ø 20 m/m
9. Sinker line for Apron net (SA) 65 m (7+51+7 m) Vinylon Ø 6.5 m/m
10. Sinker line for Body net (SB) 60 m x 3 lines Vinylon Ø 6.5 m/m
11. Weight of lead for SA 20 g x 65 pcs.
12. Weight of lead for SB 20 g x 60 pcs x 3 lines
13. Purse ring : Ø 100 m/m width 12 m/m x 26 pcs
14. Big weight : Lead or Concrete brock 5 kg x 2 pcs
15. Ring line : 30 cm in length, PE rope Ø 8 m/m

Fig. 36 Specification of sardine stick-held lift net

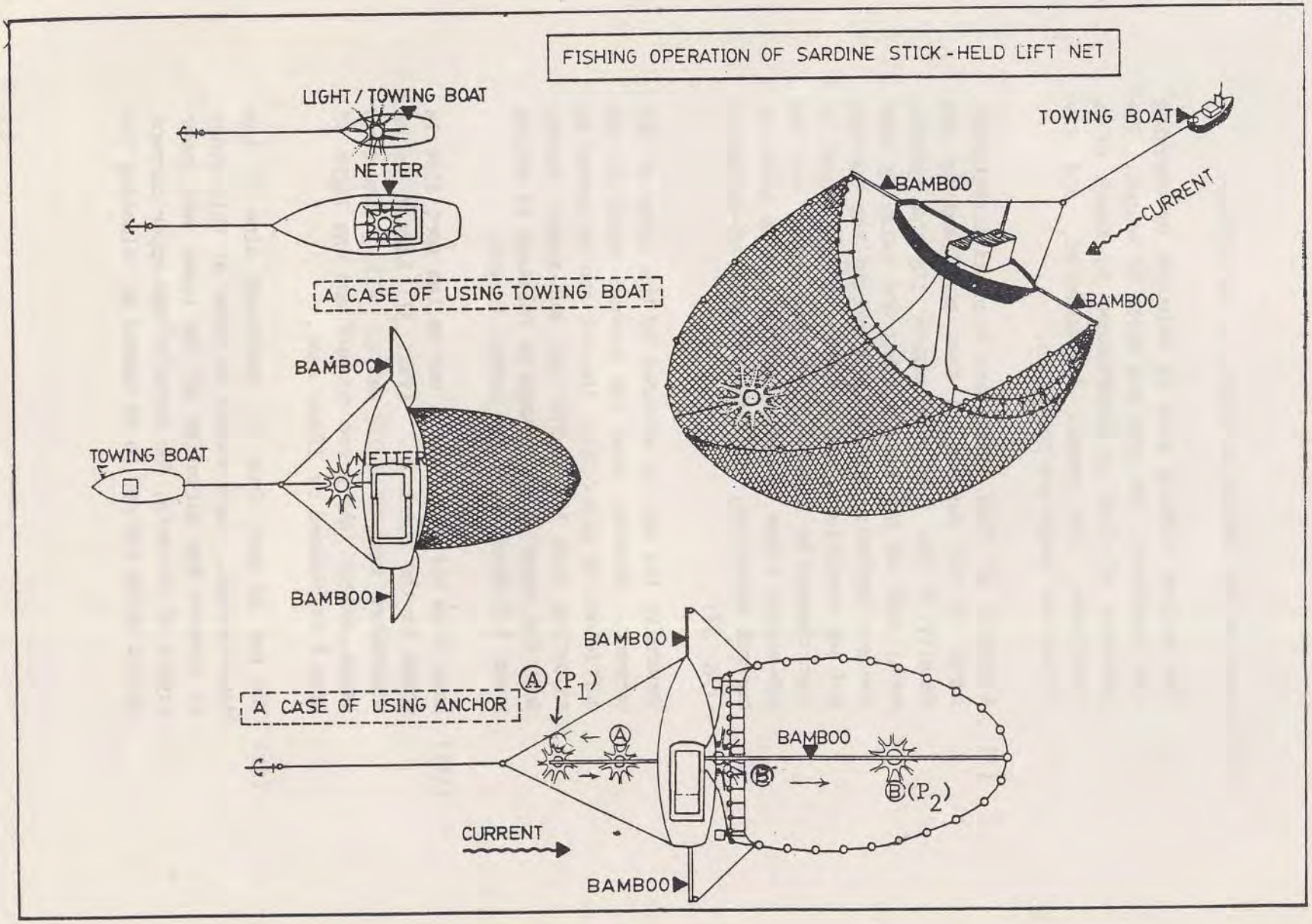


Fig. 37 Fishing operation of sardine stick-held lift net

The procedure for fishing at night, is as follows:

(i) The desired fishing area is selected by checking the topography, the type and depth of seabed. The presence of fish is ascertained by means of a fishfinder, the vessel is anchored, and the attraction lamps are turned on.

(ii) A school of fish which has been satisfactorily lured to the surface is then confirmed by the density of the fish echo and/or physical phenomena; such as bubbles, jumping and swimming near the sea surface. Taking into account the current and sea conditions, the direction of the vessel is then changed by adjusting both the anchor and the sub-anchor ropes to allow the boat to be abeam of current direction, with its port side up-current. (Fig. 37)

Generally the net is extended by the force of the current. However, when the current speed is not sufficient to allow this, the net can be opened by adjusting both the anchor and sub-anchor ropes. Both the ropes should always be released by adding about 1.5 shackles to the normal length.

(iii) Lamp A on the 10 m lamp's bar on the port side is moved to the point P_1. (Fig. 37) Lamp A is an underwater lamp of 2,000 watts. All of the fish lamps, except lamp A are cut off and the light of lamp A is reduced by 20 per cent.

(iv) The net is shot from the starboard side of the down-current. Care should be taken at this stage to observe the direction of the upper and lower layers of currents. The force of the upper current should allow the net to be opened by releasing the

float line gradually into the water. When the upper current is not sufficient the net can be spread by using the under-current to open parts of net. In this case, the float line is released with as little tension as possible. In the absence of either flow of current both ropes are wound out gradually and equally so that the vessel does not lean over the school.

(v) When the net is fully extended, the purse line is released to completely open the mouth.

(vi) Lamp A is slowly pulled to the port side of the vessel.

(vii) Lamp B is switched on at the starboard side of the vessel. The intensity of lamp B (2,000 watts) is reduced by 40 per cent. And the light of lamp A, on the port side, is gradually reduced before being cut off completely.

A few minutes later the light of lamp B is reduced by a further 20 per cent.

When a long lamp-bar to hold lamp B is not provided, a light-boat or light-raft is used.

(viii) When lamp B is reduced by 60 per cent from the original 2,000 watts the fish gather to the surface around the vessel and lamp B is moved to the point P_2, further away from the boat, to lead the fish school into the net. (Fig. 37) It is essential in this fishing operation to keep the lamp B's position carefully fixed. If the position is lost the fish school may escape through the mouth of net if the light of the lamp allows the fish to see the net clearly.

(ix) After confirming movement of the fish school either visually or by using a fishfinder or sonar the purse line is immediately hauled up.

(x) The sinker line and the body net are then hauled by turns. When the hauled net approaches the bag net, the net is spread so as not to injure the fish and the catch is transferred from the bunt to the fish hold of the vessel.

1.5 Notes

(i) The entire fishing operation takes between 30-60 minutes, depending on the current, the ability of the crew and the quality and type of fishing gear.

(ii) It is essential to check the flow of the current, topography and type of seabed, the depth of water, the ability of the crew and fishing gear before making the decision to fish.

(iii) When turning off and/or reducing the lights, the actions should take place gradually to lure the fish school to the surface. It is essential that the fish luring lights should be less than 20 m in depth, to take into account the depth of net.

(iv) The method of reducing the lights for inducement, surfacing and concentration of the fish school is one of the most important acts in this fishing operation. The reduction of the intensity of the lights is dependent on the fish species, size and composition of the school. A standard rate is as follows:

- For small-sized pelagic fishes such as small-sized sardines, anchovy, horse mackerel and mackerel, reduction ranges from 20% to 70%.

o For rather bigger-sized pelagic fishes such as large sardines, mackerel and small bonitos, the lights are dimmed from 20% to 25-30% maximum.

As it is more difficult to concentrate large fishes around the lights of lamp B because of their wider swimming range. And, as fishes of this size can see and stir the net easily the purse line should be hauled up immediately after lamp B has passed the center of the net to prevent the fish escaping.

2. Saury stick-held lift net fishing operation

2.1 Arrangement of fish lamps:

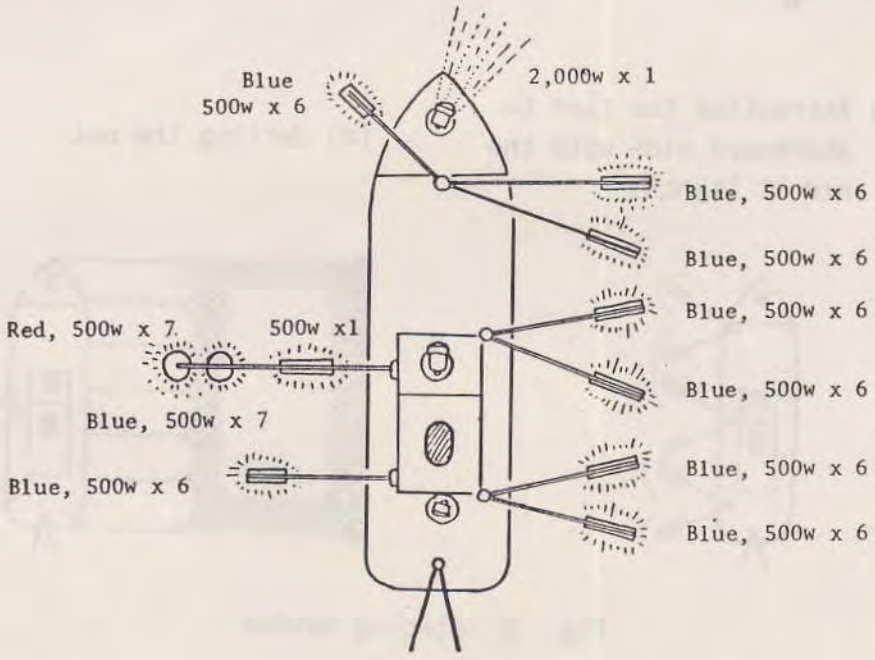
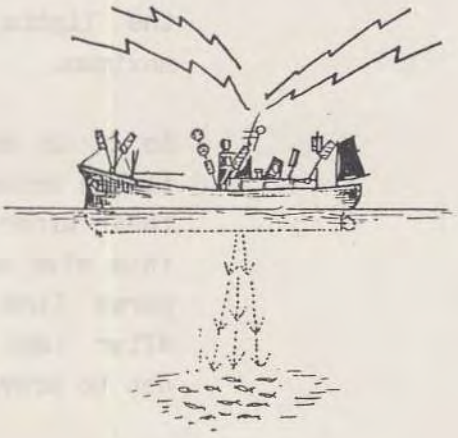
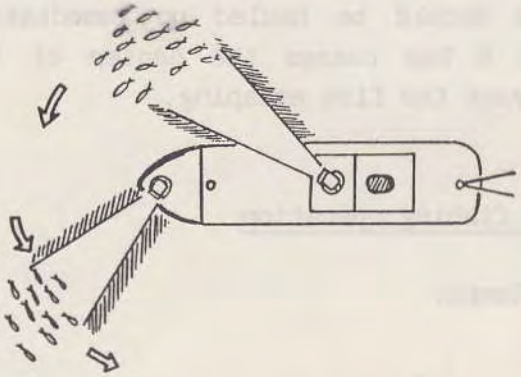


Fig. 38 Arrangement of fish lamps of saury stick-held lift net gear

2.2 Fishing method:

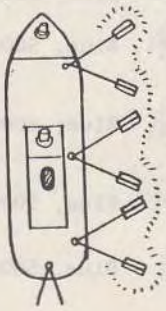
(a) Detection and attraction of fish schools





(b) Use of searchlights

(c) Attracting the fish to starboard side with the aid of lights.



(d) Setting the net

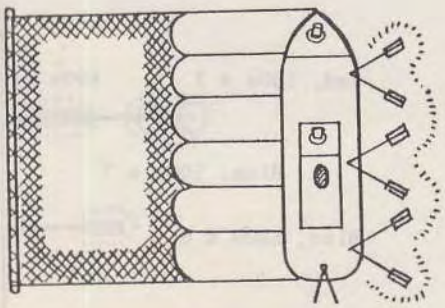
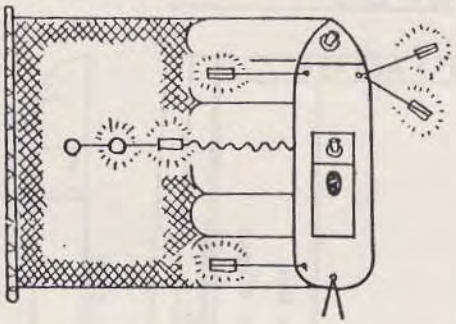
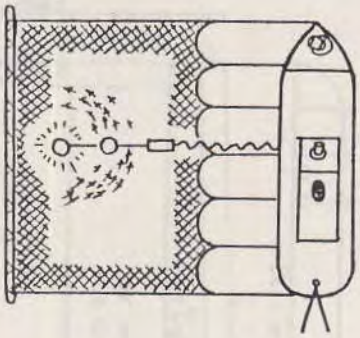


Fig. 39 Fishing method

(e) Leading fishes over the net. Lamps fitted to the starboard side are switched off in succession from stern to stem.

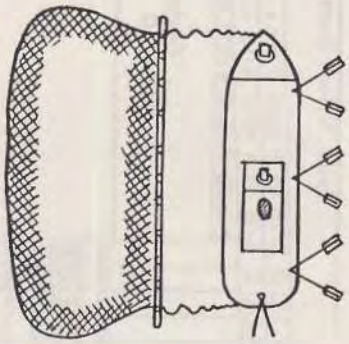


(f) When all blue lamps are turned off, only a red lamp is kept alight.



to attract the fish over the net.

(g) Hauling the net.



(h) A second operation is started.

Fig. 39 (Cont.)

2.3 Construction:

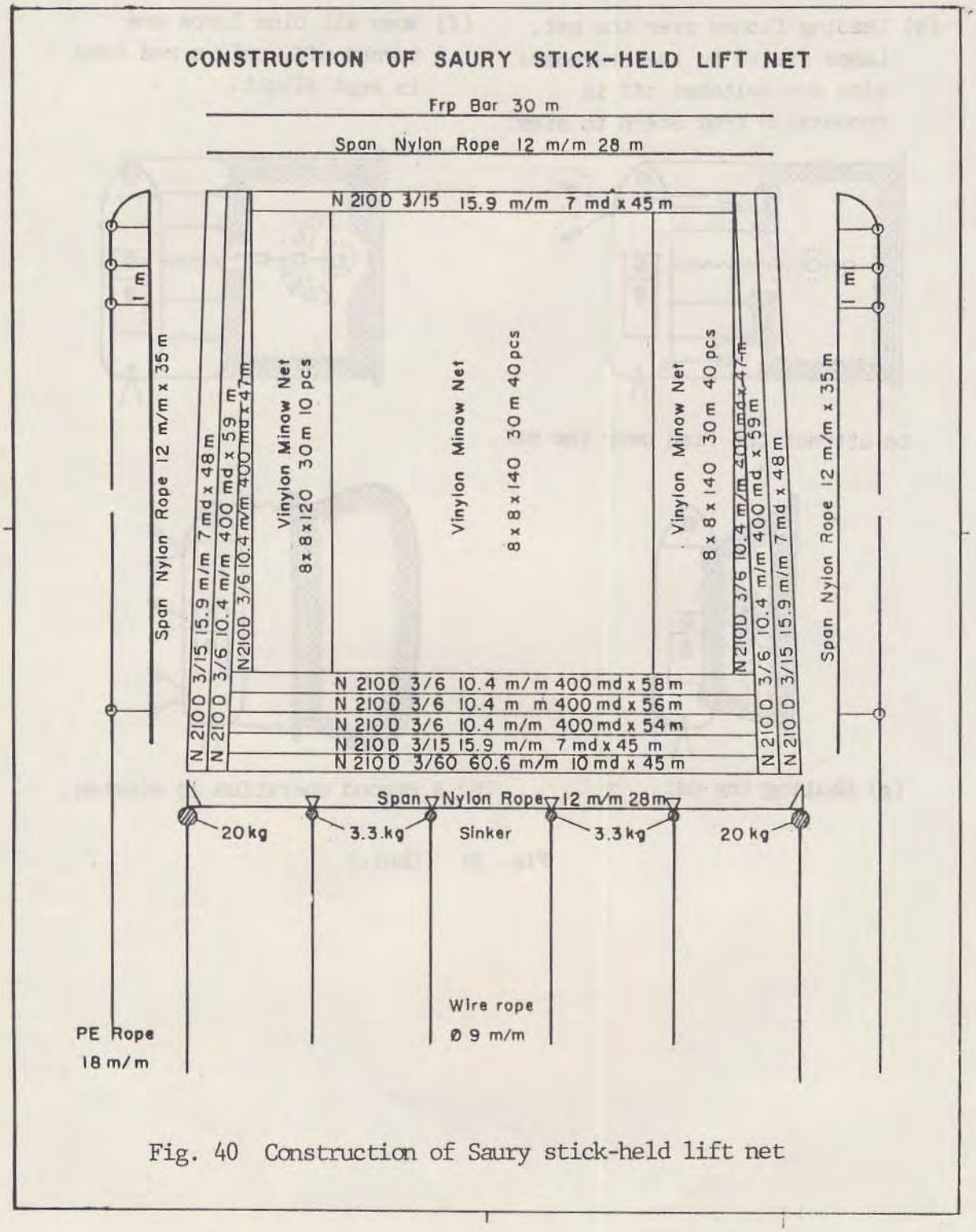


Fig. 40 Construction of Saury stick-held lift net

2.4 Fishing boat and equipment

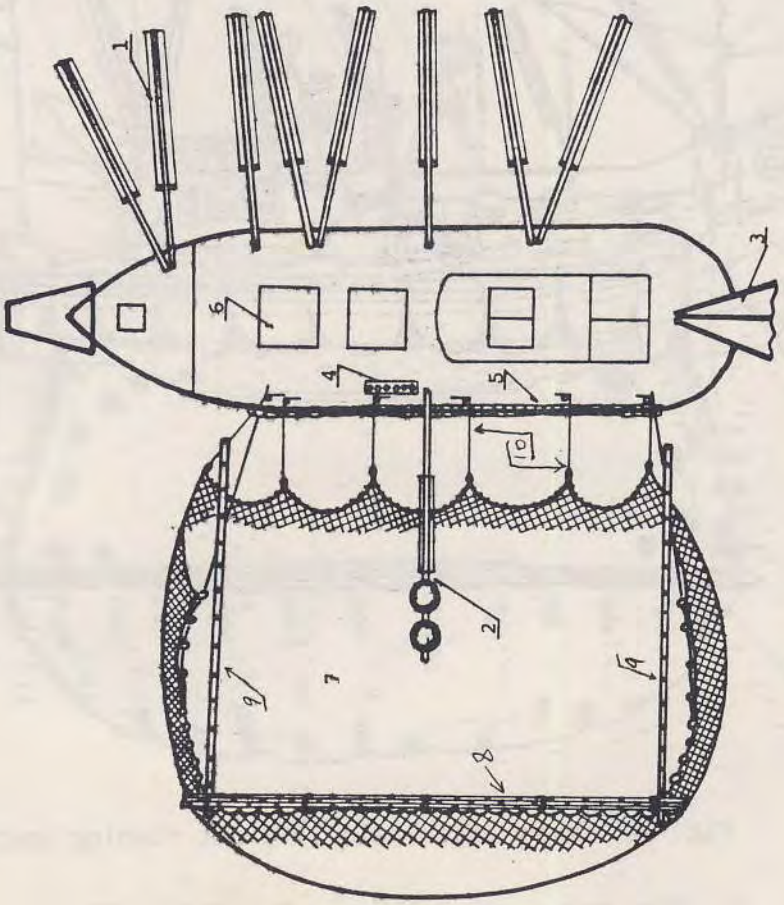


Fig. 41 Fishing boat for a stick-held lift net

1. Fish attraction/luring lamp
2. Fish leading/luring lamp fishing operation
3. Spanker
4. 6 reel winch
5. Side roller
6. Fish hold
7. Net
8. Bamboo float, bundled bamboos (A) for making net hold and open
9. Push pole, long big bamboos (B) for pushing and/or pulling bamboo (A)
10. Fore rope for hauling net

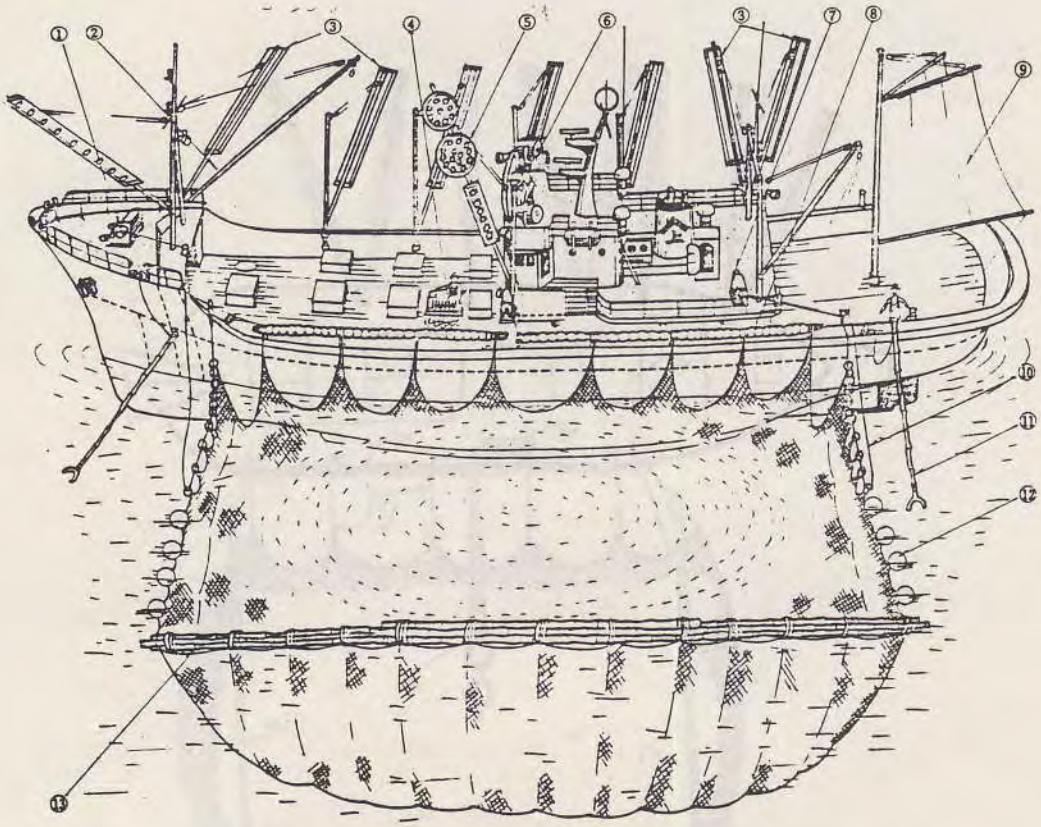


Fig. 42 Saury stick-held lift net fishing boats

1. Windlass
2. Spoon net boom
3. Fish lamp (S. size)
4. Reel winch
5. Fish lamp (P. size)
6. Search light
7. Winch
8. Side roller
9. Spanker
10. Quarter rope
11. Push pole
12. Float
13. Bamboo float

Fishing equipment: Ideally the fishing boat should have the following equipment installed on board:

1) Fish luring lamp

The success or failure of this fishing method depends on the effectiveness of the fish luring lamps. The power of illumination should be large, but within the allowed regulation limits of kw size per boat. In general, the fish luring lamps are connected to between 5 to 9 booms which are positioned from 1.5 to 2.0 meters above the sea surface.

2) Winch and roller (Fig. 45)

A six-reel winch for hauling the net towards the boat and two auxiliary winches are set on either side of the boat stern. To land the net on deck, rubber rod-shaped side rollers, or power rollers, are provided on the bulwark top.

3) Processing equipment

Although no processing equipment is provided in small or medium size boats, because the fish caught are preserved in ice and marketed as fresh fish. Some larger vessels, however, are equipped with quick freezing plants, to allow extended trips.

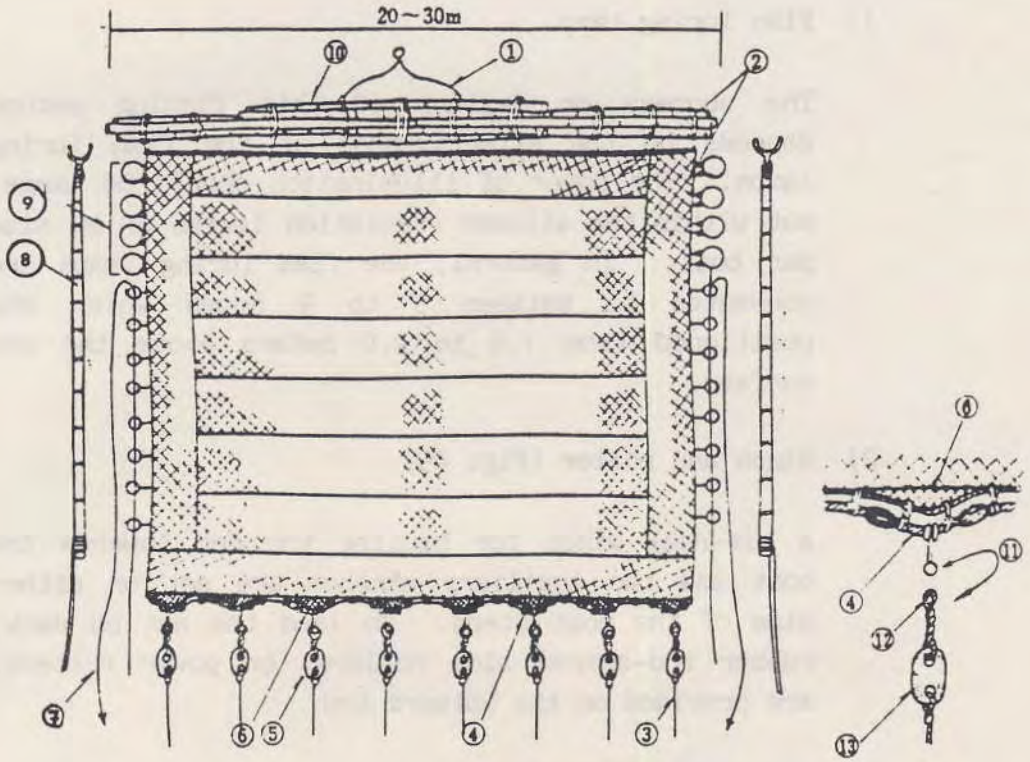


Fig. 43 Saury stick-held lift net

1. Landing wire
2. Selvage trip
3. Fore rope
4. Foot rope
5. Bullet
6. Border
7. Quarter rope
8. Push pole
9. Float
10. Bamboo ford
11. Knot
12. Rope ring
13. Bullet (lead)

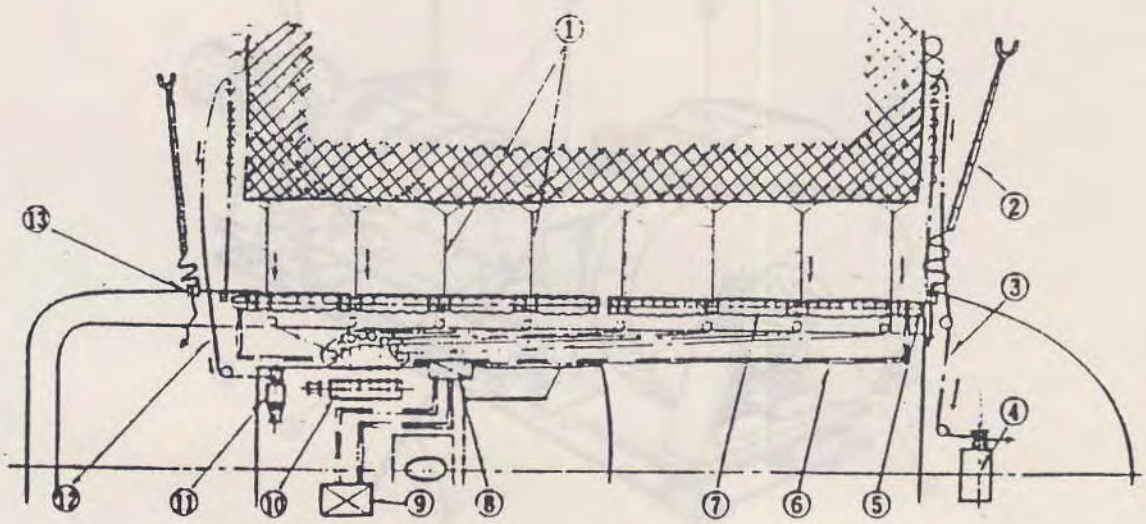


Fig. 44 Fishing equipment arrangement

1. Fore rope
2. Push pole
3. Quarter rope
4. Windlass
5. Side roller hydraulic motor
6. Hydraulic pipe
7. Side roller
8. Hydraulic control stand
9. Hydraulic
10. 8 or 6 reel winch
11. Winch
12. Quarter rope
13. Push pole

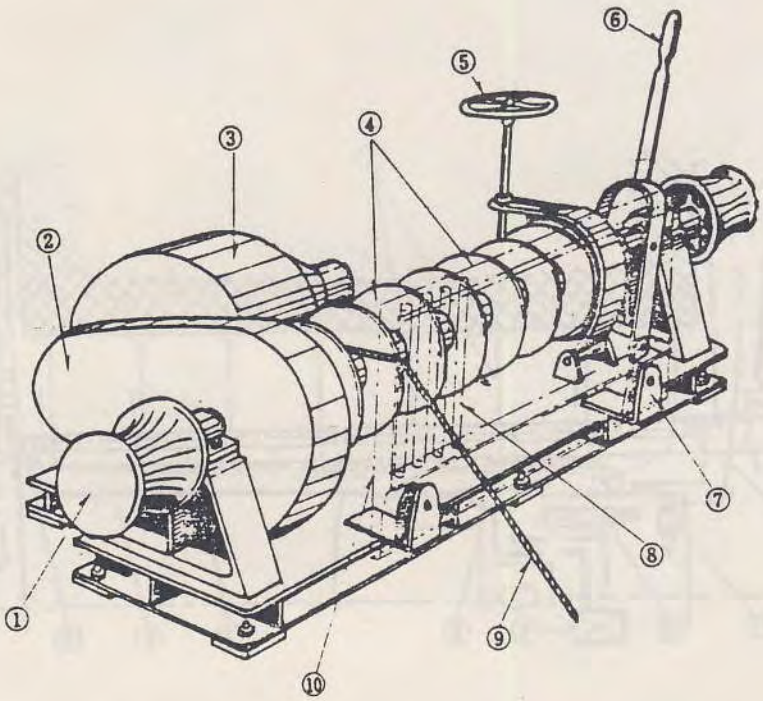


Fig. 45 Rell winch "Rokudan maki winch"

1. Warping drum
2. Reduction gear
3. Hydraulic motor
4. 6 reel
5. Break handle
6. Clutch lever
7. Wire shifter socket
8. Wire shifter
9. Pulling the fore
10. Shifter rim

3. Live bait fishing using the stick-held lift net

3.1 The operation sequence of live bait fishing using the stick-held lift net is as follows:

a) Drop the anchor and the 'yamazuna' (a Sub anchor rope - 12 mm diameter by 100 m.). Fix the anchor rope, 'yamazuna' and buoy (Fig. 46). N.B. the length of anchor rope should be over twice the depth of water at which anchor is laid).

b) Two underwater lamps, one at the bow head and the other under the stern are illuminated to attract the fish (See Fig. 47).

c) After scattering bait, the vessel should be positioned to keep abeam of the tide by adjusting the anchor rope and 'yamazuna'. They should be kept well balanced.

d) When the vessel is correctly positioned, the horizontal bamboo pole 'A' should be pushed out by slowly extending the bamboo poles 'B' and 'C'.

e) The bamboo pole 'A' is then secured by 'Tottari' ropes (Fig. 48). The poles 'B' and 'C' are also tied to the vessel.

f) The bow underwater lamp is mored very slowly and cautiously, by pulling the cord, so that it passes to the side of the vessel to which the net is fixed.

g) The power of the mored lamp is now reduced gradually and finally put out to attract the fish towards the stern underwater lamp. (The power of the underwater lamp is reduced by means of a slide regulator).

h) The stern underwater lamp is hauled up from the collecting depth (around 5-10 meters) to the shifting depth (around 5 meters).

i) When the presence of fish is confirmed, a small boat slowly tows the stern underwater lamp towards the centre of the net and the 'Tottari' ropes (about 3 - 5 minutes). During this period, the light is gradually pulled up from 5 m. depth to an 0.5 m. operating depth.

j) The intensity of the stern lamp is reduced by slide regulator.

k) To lift the net, the sinker wire rope is hauled in by the winch.

l) Finally, the bamboo poles 'B' and 'C' are pulled to a suitable distance towards the vessel and the fish are scooped carefully out of the water into baskets, before being transferred into the fish holds.

Note 1: The time taken to complete one operation is about 3-5 hours. Four hours to attract the fish around lamps, and between 30 minutes to one hour to haul the net onboard.

2: The number of fishermen required for this operation ranges between 18 - 25.

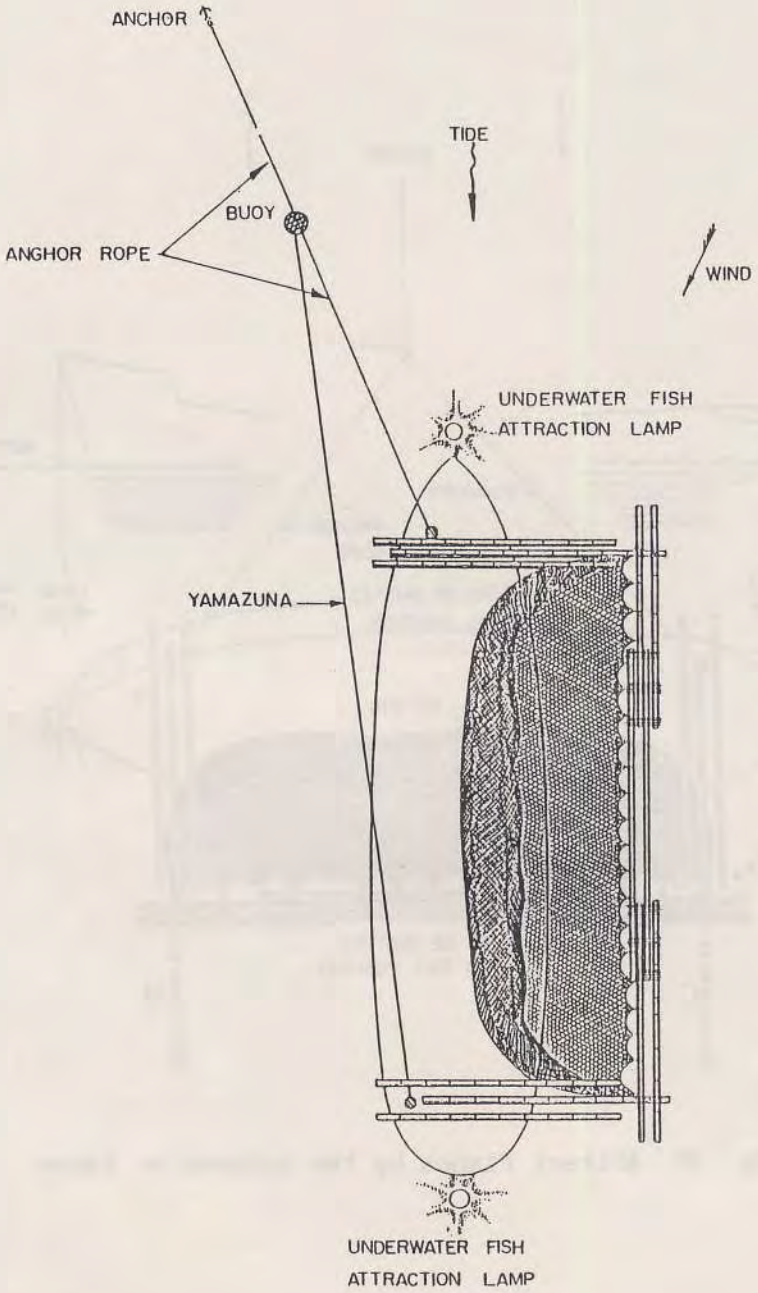


Fig. 46 Fix anchor rope

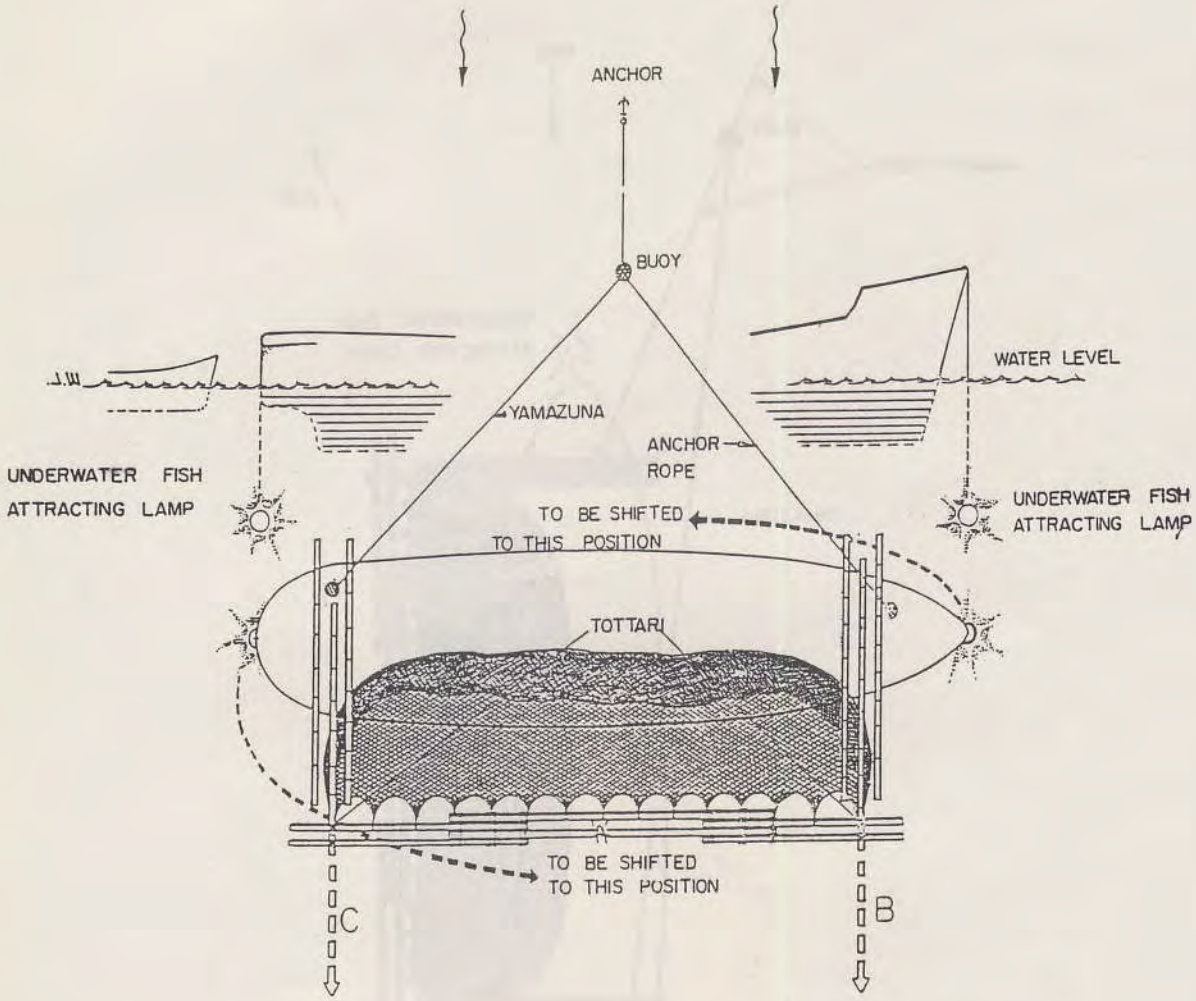


Fig. 47 Attract fishes by two underwater lamps

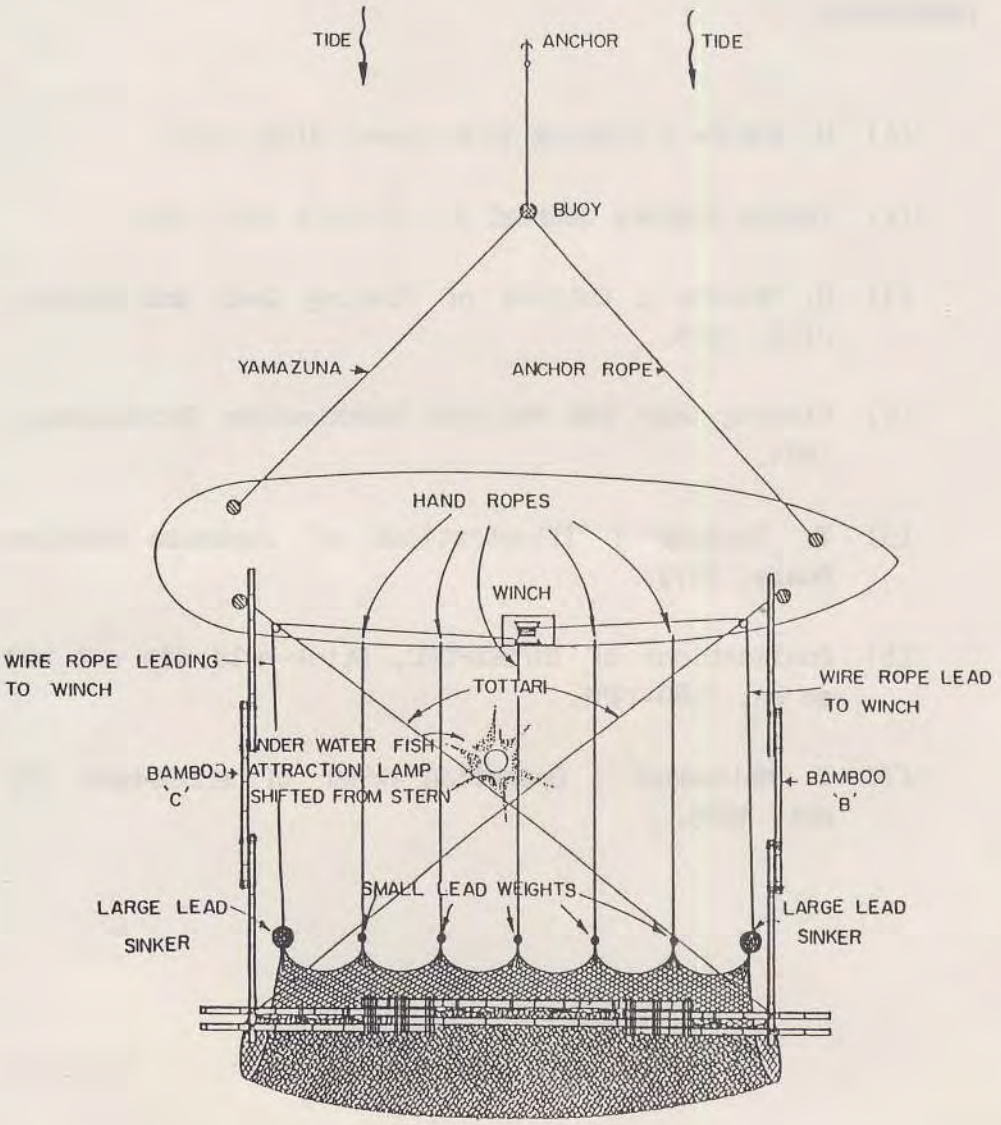


Fig. 48 Shooting the net

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