

FISHING ACTIVITIES IN RELATION TO COMMERCIAL AND SMALL-SCALE FISHERIES IN INDONESIA

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1. INTRODUCTION

As an archipelagic state with a vast area of marine waters, Indonesia has a great potential of fisheries resources. This fisheries has shown an important role in the economy for the country such as providing a source of income, employment, opportunity, protein-rich food supply and foreign exchange earning. According to Gulland (1983), fishing activities that has developed throughout the centuries until now are based on the wild living animal of the common property. Therefore the success of any fishermen in a certain area will invite and share other fishermen. On the other hand, the fishery resources which form a renewable resources has its own limit in response to human exploitation.

Fisheries resources within Indonesia are most densely concentrated in nearshore waters. The bulk of Indonesia's total marine fisheries landings is caught in coastal waters by small-scale fisheries. Most Indonesian fishermen exploit a number of different species depending on weather and seasonal availability. The fisheries statistics from Directorate General of Fisheries (DGF) report annual landings by quantity for about 45 finfish species or species groups, seven species or groups of both crustaceans and molluscs and four other species groups (seaweeds, turtles, sea cucumbers and jellyfish). To exploit this species of fishing grounds and commercially valuable species, a wide range of gear types and fishing vessels is in used. There are consist of 29 of the most important gear, ranging from simple "traditional" hand lines to more technically complex "modern" gear such as purse seiner and long-liner.

For planning purpose, Indonesia's marine fisheries sector is divided into small, medium and large-scale subsectors. A clear distinction based on investment cost separates the small-scale subsector from other two. Both medium and large-scale fisheries are distinguished from the small-scale fishery by use of boats powered by inboard engines. Nevertheless, large-scale fisheries are differentiated from medium-scale fisheries on the basis of investment levels and areas in which they are permitted to operate.

According to DGF, all boats powered by inboard engines (typically diesel) either are medium or large-scale. Small-scale fisheries, by far the most important in terms of employment, numbers of fishing units and quantity of landings, are distinguished from the other subsectors by type (or absence) of boat employed.

For purposing discussion in this paper, the fishing activities can be divided into two categories i.e. commercial fisheries or large-scale fisheries and artisanal or small-scale fisheries. The commercial fisheries (state enterprise and private fishing companies) are using BED-shrimp net for catching shrimp in the Arafura Sea, pole and line, long line and purse seine for skipjack, yellowfin tuna and bigeye tuna, etc.

The gears used by small-scale fishery are vertical line, payang (danish seine), mini purse seine, troll line, gill net, seine net, and traps; these are used in coastal waters for generally catching demersal and shrimps as well as small pelagic fishes.

2. HISTORICAL OF EFFORT

2.1 Commercial Fisheries

Commercial fisheries or large-scale fisheries include private Indonesian companies, joint venture corporation (primary with Japanese) and state-owned enterprises. Most of commercial fisheries are fishing for high valued commodities or export commodities, namely shrimp and tuna (including skipjack). Generally, shrimps are captured by otter-trawl (before 1982); tuna caught by longlines, and skipjack from pole and lines. The trawl fishery for shrimp in the Arafura Sea commenced in 1969 with 9 trawlers. The fleet size range from 90 to 600 gross tons and the horse power from 260 to 1,200 (Naamin, 1984). By the end of 1982 the number of shrimp trawler in those areas attained its peak, amounted to 188 units (DGF, 1984). Data from HPPI (1992) show that in 1991 the number of BED-shrimp net operated in those areas remain 87 fleets by 8 joint venture companies.

At present, after following the completion of UN Law of the Sea Convention 1982 with a Law on EEZ (Law No. 5/1983), a special arrangement was made to invite foreign fleets to exploit resources in EEZ for tuna, other pelagic and demersal fishes. The gear used in EEZ is long line, purse seine and gill net. The licensed foreign fleets are from Taiwan, Thailand, Philippines and Australia. In 1993, there were 946 foreign fleets and 2,127 Indonesian fleets operated in Indonesian waters (Sukirdjo, 1995).

About 80% of shrimp, tuna and skipjack landings came from eastern part of Indonesian waters, mainly in Irian Jaya, Molluccas, and North Sulawesi. Increasing demand for tuna and skipjack has encouraged the State Enterprise and Private Fishing Companies to expand their fishing activities to other type of fisheries such as long line and purse seine.

In 1994, a total of 2,152 units tuna long line and 2,616 units skipjack pole and liners were reported to be operating in Indonesia. Almost all of which were based in Bitung (North Sulawesi), Ambon and Labuha (Moluccas) (DGF, 1996).

The Indonesian pole and line fishery is mainly concentrated in the Eastern part of the country, Several state-owned, co-operatives and private fishing companies spread in Indonesia date from the beginning of the century, when probably Japanese fishermen introduced this gear in North Sulawesi an around 1918 for "katsubushi" production.

Later the fishery expanded all around East Indonesia, i.e. Moluccas, Irian Jaya, East Nusa Tenggara and all around Sulawesi.

The most important pole and line landing site in Sulawesi is Bitung. One of the state company has established in 1967 operating with 30 - 40 GT boats. In Irian Jaya one of the most profitable state fishing companies in operating since 1973 at Sorong ("PT. Usaha Mina Persero"). This company introduced of FAD's in Indonesia and expanded their use to industrial level in 1985. The Multi Transpeche Indonesia (MTI) company based in Biak - Irian Jaya has been using larger pole and liners. Four boats of 300 GT in sized have been used by this company since 1983.

The Indonesian tuna longline fishery started to develop during 1972. At that time, one state company began operations in Sabang (North Sumatera) and Benoa (Bali), although most of the boats shifted to Benoa very soon (Marcille *et al.*, 1984). The facilities available in Jakarta Fishing Port since 1984 have stimulated a major development of longline fishing. Benoa and Jakarta become the dominant landing sites for the Indonesian longline fleet.

2.2 Small-scale Fisheries

The small-scale fisheries is defined to include all fishing units which use boats powered by sail or outboard engines. Fishermen who operate gear without use of a boat also are classified as small-scale. Fishing operation is still labour intensive and the area of operation in the coastal waters. According to DGF the boats are divided into three categories, are as follows :

- a) Dug out boat ("jukung") one boat of hollowed-out logs, more than 77% of these boat were found in eastern part of Indonesia such a Molluccas and Irian Jaya, Sulawesi, and East Nusa Tenggara.
- b) Three types of non-powered plank built boats are divided : small (the largest boat is less than 7 m in length); medium (7-10 m), and large (more than 10 m). The total numbers of all boat categories was 118,686 or 30 % of all fishing boats in Indonesia (Table 1).
- c) Out board motor boat is a boat type which a motor is attached to the rear of the boat. Some of them are modified gasoline or diesel generator mounted along the side with along trailing propeller shaft and the engine from 2 to 15 HP. The total numbers of this boat category was 87,749 or 22.1% of all fishing boats in Indonesia (Table 1).

The type of gear commonly used in small-scale fishing are seine nets, gill nets, traps and other traditional gears such as shellfish collections, seaweed collections and cast nets. Total numbers of each gear type in 1994 are shown in Table 2. According to this Table, the dominant gear used by small-scale was hook and lines (about 44.5% of all gear units). The most numerous is the set long lines, and other pole and line, use of which are widespread throughout Indonesia. The most popular gear for catching

shrimps are trammel nets and shrimp-gill nets (monofilament gill net). This gear has been expanded rapidly in recent years along the South coast and North coast of Java, East coast of Sumatera and Malacca Straits. At present, most fishermen catch shrimp by trammel nets with in-board fishing boats (20 - 30 GT) and out-board fishing boats with 5 - 15 HP especially in south coast of Java (Sumiono *et al.*, 1996).

Table 1. Number of fishing boats by subsector and size in Indonesia, 1994.

Boat Type	Boat number	Percentage
1. Small-scale fishery :		
- dug out boat	126,800	32.01
- plank-built boat :		
* small	72,694	18.35
* medium	36,189	9.13
* large	9,803	2.47
- out board motor	87,749	22.15
Sub Total	<u>333,235</u>	<u>84.11</u>
2. Medium-scale fishery :		
- in-board powered boats :		
* less than 5 GT	45,331	11.44
* 5 - 10 GT	9,604	2.42
* 10 - 30 GT	3,376	0.85
* 20 - 30 GT	1,688	0.43
Sub Total	<u>59,999</u>	<u>15.14</u>
3. Large-scale fishery :		
- in-board powered boats :		
* 30 - 50 GT	1,869	0.48
* 50 - 100 GT	567	0.14
* 100 - 200 GT	340	0.09
* More than 200 GT	175	0.04
Sub Total	<u>2,951</u>	<u>0.75</u>
T o t a l	396,185	100.0

Table 2. Type of fishing and number of gear operated in Indonesia, 1994

Type of Fishing	Number of gear	Percentage
1. BED-Shrimp net	<u>894</u>	<u>0.14</u>
2. Seine nets	<u>32314</u>	<u>5.04</u>
- payang	18748	2.92
- danish seine	4750	0.74
- beach seine	8816	1.38
3. Purse Seine	<u>6,891</u>	<u>1.08</u>
4. Gill nets	<u>179,706</u>	<u>28.04</u>
- drift gill net	68283	10.66
- encircling gill net	11170	1.74
- shrimp gill net	24827	3.387
- set gill net	54474	8.50
- trammel net	20952	3.27
5. Lift net	<u>40,355</u>	<u>6.29</u>
- boat/raft net	9924	1.55
- stationary lift net	11426	1.78
- scoop net	7055	1.10
- other lift net	11950	1.86
6. Hook and line	<u>285,082</u>	<u>44.49</u>
- tuna long line	2152	0.34
- other draft long line	10976	1.71
- set long line	17100	2.67
- skipjack pole and line	2616	0.41
- other pole and line	198554	30.98
- troll line	53684	8.38
7. Traps	<u>45,096</u>	<u>44.49</u>
- sero guiding barrier	7283	1.14
- stow net	3604	0.56
- portable traos	13895	2.17
- other traps	20314	3.17
8. Other gear	<u>50,484</u>	<u>7.88</u>
- shell collection	11552	1.80
- sea weed collection	5944	0.93
- muroami	270	0.04
- cast net, harpoon and other	32718	5.11
Total	640,822	100.0

Source: DGF (1996)

3. FISHING GEAR, FISHING FLEET AND SPECIES COMPOSITION

3.1 Commercial Fisheries

3.1.1 BED - Shrimp Net

BED-shrimp net (to replace otter trawl, after 1982) is one of the fishing gear used for catching shrimp in the Arafura Sea and adjacent waters. Based on Presidential Decree No. 85/1982, this gear operated in the water of Arafura, Kai, Tanimbar, Aru and Irian Jaya which it has coordinate line 130°E to the East.

The development of BED-shrimp net aimed to reduce the unwanted capture and mortality of fishes in the shrimp trawl or to minimize of other fish or organism due to the fact by-catch of fish in the shrimp trawl is generally about 80% by-weight of the total catch. One among others has resulted in the development of the By-Catch Excluder Device (BED) which was originally aimed to exclude for reducing turtle captures in commercial shrimping in the Gulf of Mexico while maintaining shrimp catches, as a Turtle Excluder Device (TED) by the Southeast Fisheries Center's Mississippi Laboratories Harvesting Technology Branch, Pascagoula, Miss., USA in the mid 1982. More over the device showed potential capability to significantly reduce by-catch associated with shrimp trawling.

One of the BED-shrimp net operated in the Arafura Sea consist of 1.0 x 0.9 x 0.9 meters frame, constructed of 1/2" dia. (varies) aluminum pipes with aluminum rod (smaller dia) bars slanting at 15 cm (varies) apart and a detachable door of 87.5 x 87.5 cm (varies) in the top. This device is placed at the intersection of the trawl's body (belly's edge) and the bag (cod-end) (Fig.1). The slightly bigger front frame is fixed and fitted to the belly and the rear frame to the cod-end.

All objects leave the body and enter the bag through the device. As unwanted large object leaves the body, it strikes and slanted bars and is forced and slipped away towards the door. The door opens on hinges allowing the object to pass out of the trawl (excluder), and closes as the object is excluded. On the other hand, small objects, shrimps, etc., pass through the bars into the bag.

Catch rate data were collected from the Arafura Sea by commercial vessel (150 GT) shows that the BED possessed higher percentage of smaller size finfish (65%) as compared to 54% of the control. There is no significant difference (0.05%) between the shrimp catch rates of BED-shrimp net (33.2 + 13.4 kg/hr) and that the control (33.8 + 13.6 kg/hr). Meanwhile, there is a significant difference (0.05) between the average of catch rates of the by-catch of the BED-shrimp net (16.9 + 14.4 kg/hr) and that the control (28.0 + 27.9 kg/hr) (Sumiono and Sadhotomo, 1985).

The average of shrimp catch rates by BED-shrimp net in the Bintuni Bay was 31.0 kg/hr, dominated by endeavour shrimp (*Metapenaeus ensis*) and banana shrimp (*Penaeus merguensis*) (Sadhotomo and Sumiono, 1986).

3.1.2 Pole and line

Pole and line fishery is only developing in the eastern part of Indonesia. There are two types of pole and line fisheries, i.e. (1) the large-scale pole and line fishery run by the state enterprise and private fishing companies based in Biak, Sorong, Ambon, Bitung, Kendari and Maumere; and (2) the artisanal pole and line fishery based in Biak, Sorong, Ambon, Ternate, Labia, Bitung, Gorontalo, Luwuk, Kendari, Kolaka, and Maumere (Naamin and Bahar, 1991).

The size of pole and line boats are small-scale fisheries range from 8 to 30 GT or 20 to 150 HP with 10 - 20 fishermen per boats. The boat owned by the State Enterprise are mostly of 30 GT, 100 GT and 300 GT. The small-scale pole and line fishery is capturing mainly skipjack (Fig. 2). A 100 GT and 300 GT were used as freezing vessels. Since 1985, these vessels have been used for collecting skipjack and tuna which it caught by the artisanal fishermen and private companies based on the Nucleus Estate for Small holders System (NES).

Due to the problem of availability of live bait, since 1985 those pole and line fishery had been using payaos as fish aggregating device (FAD's). The use of payaos make the fishery more efficient i.e. reduce the amount of live bait used as well as fuel consumption (Naamin and Chong, 1987).

The species composition in pole and line fishery are dominated by skipjack-yellowfin and probably bigeye may occur regularly, and frigate, bullet, kawakawa, and longtail are considered incidental catch. Since the FAD's or "rumpon" were deployed at industrial level, different tuna school are mixed and different species proportions are fished.

3.1.3 Long line

Tuna long line fishery has rapidly developed since 1985 due to the higher demand for fresh tuna especially in Japan. This can be seen from remarkably increased of longliner from 17 boats in 1975 to 136 boats in 1989. The size of boats range from 33 to 300 GT. Long liner as it used in Indonesia is shown on Fig. 3.

The boat used for large or deep long line based in Bena, Ujung Pandang, Kendari, Bitung, Ambon and Biak ranges from 90 to 400 GT with 16 - 30 fishermen. Their trip duration ranges from 14 to 140 days. On the other hand, the conventional or monofilament longline based in Bena, Bitung and Biak used boats of 30 - 100 GT with 10 - 16 fishermen with trip duration is around 10 to 15 days. The size of boats used for mini longline based in Bena

and Maumere ranges from 3 to 30 GT with 10 fishermen and trip duration around 7 days (Naamin and Bahar, 1991).

Catch rates in term of hook rate (number of fish caught per 100 hooks) in the area of fishing grounds are differentiated by various factors. It might be caused by difference of : (1) the bait used; (2) the condition of the fishing gear and it accessories; and (3) the experiences of the fishing master and the skill of the crews.

Three type of boats operate in the longline fishery based on Bena : mini-longline, regular (Taiwanese) longline and deep longline. Mini-longline boats are less than 20 GT have 6-8 crews, and day at sea about 10 - 14 days per trip. The boats are not equipped with electronic navigational aids. They use monofilament main lines 27 - 33 km length, and 4 - 6 branch lines with 400 - 600 hooks, which fish at depths of 50 - 180 m. Regular longline boats have 20 - 50 GT with 10 - 12 crews, fishing 10 - 20 days per trip. They use monofilament main lines of 37 - 40 km length and 4 - 6 branch lines with 700 - 1200 hooks, which fish at depths of 50 - 220 m. Deep longline boats are generally larger than 50 GT, have 15 - 18 crews with multifilament main lines of about 50 km in length, and 9 - 11 branch lines with 1500 - 2000 hooks.

In 1993, yellowfin tuna was the dominant species landed in Bena (Bali) with 57.2% of total landings by weight, followed by bigeye tuna (31.3%), albacore (3.8%), billfish (3.6%), southern bluefin tuna (3.1%) and others (0.9%) (Davis et al., 1995).

The study on influence of the utilization of baitfishes on longline catches in the waters to south of Java, Bali and Nusa Tenggara in the depth around 50 m to 70 m showed that total hook-rate was 3.93, where yellowfin tuna was the dominant species with hook-rate of 1.13. The catch rate of tuna species increase with increasing depth by using saury (*Cololabis saira*) baitfish as well as lemuru (*Sardinella lemuru*) baitfish. Highly significant difference between saury and lemuru baitfishes were found for mean catches of the tuna species, but not for the non-tuna species (Uktolseja, 1992).

3.1.4 Purse seine

Purse seines are commonly used all around Indonesia to catch small tunas as well as small pelagic fish, but they are particularly developed in West Indonesia. Excluding the big purse-seiners operating from Biak in the Indonesian Pacific rim, most of the Indonesian purse seiners are multipurpose boats. Three large purse-seiners (ranging from 632 to 765 GT) have been used by joint venture company in Biak.

3.2 Small-scale Fisheries

3.2.1 Purse seine

Since the ban on trawlers in 1980's, purse seiners have come to dominate medium and small-scale landings. Excluding industrial (commercial) purse seiners (> 600 GT) developed in Eastern Indonesia, we can identify major types of seine gears catching small tunas and small pelagic fish i.e. (1) small purse seines (< 40 GT), mainly operating in the Indian Ocean of Sumatera (Banda Aceh and Sibolga) and Prigi (South Java); (2) a type of danish seines or "payang" (10 - 20 GT), mainly developed in Pelabuhan Ratu. Apart from these places, there are other important small-scale purse-seiners landings sites in Pekalongan, Tegal and Juwana (North Java), Nusa Tenggara and Ujung Pandang (Sulawesi).

Generally purse seine fisheries in the Java Sea use wooden vessels with a capacity ranging from 20 to 50 GT, without any electronic or mechanical device such as sonar, depth sounder, radar, direction finder, power block, etc. In general one to three hauls were carried out per vessel per night. Nets extended from 300 to 400 m in length and 50 to 70 m in depth with a bunt of 15 mm mesh size (Fig. 4).

According to Potier and Sadhotomo (1994) there are three kinds of purse seiner operated in the Java Sea. Mini seiners fisheries are wooden vessels with semi dugout and planked vessels. The fishing area is located along the coast around 30 miles away from the shore. They stay from 1 to 3 days at sea. The medium seiners is a wooden vessel fitted with an inboard engine of 35 to 100 HP. The length is between 15 and 20 m and the hold capacity is between 20 and 25 tons. They stay at sea between 8 and 15 days. The large seiners are flat bottomed vessels with shallow draught and inboard engine of at least 160 HP. Most vessels of this type have a fish hold capacity of 50 to 80 tons, and 30 to 40 crews. The catch composition of the seiners are dominated by scads (*Decapterus macrosoma*) followed by mackerels (*Rastrelliger kanagurta*).

3.2.2 Seines

One is seine known in the along Java's north coast was payang. This net is used for the capture of scads and mackerels in conjunction with an anchorage lure used to aggregate schools of fish. The payang seines is a traditional Danish seine and its specially design for catching fishes associated with rumpon, they are gradually being replaced by purse seines (Fig. 5). Purse seines are operate to capture fishes attracted to fish lamps at night and also schooling fishes, without any gathering fish technique in daytime.

Payang nets for catching tuna is only operated in Pelabuhan Ratu (South coast of West Java). The size boats range from 4 to 7 GT using outboard motor of 40 HP with vessels speed 4 to 5 knot, and 3 - 4 crews. One piece of net is 60 m length and 14 m depth with mesh size in the wing 30 cm and in the bunt 2 to 13.5 cm. Fishing are done daily trip from 6 p.m. to 6 a.m (Wijopriyono *et al.*, 1985).

Beach seines are widely distributed throughout of Indonesia with the Malacca Straits and Northern Sulawesi as a major concentration of this gear. All beach seines have same basic design, i.e. with one bag, long wings and warps which function as scare lines (Fig. 6). They are operated from non-mechanized boats along the sandy beach without any hauling device to capture mostly sardines, anchovies, and shrimps.

3.2.3 Gill nets

Gill nets are single-walled nets found in various mesh sizes. Fish of different body sizes get gilled or tangled into the netting when they try to pass through it. Trammel nets are included in this group. These are passive gears, but fish can also be driven into gill nets. The most numerous of the drifting gill net use of which is widespread throughout Indonesia. The netting material is monofilament for small scale gill nets, and multifilament for large-scale gill nets. Drifting gill nets hang on floats just below the surface and are used to capture various pelagic species (Fig. 7). Most set gill nets are anchored or weighted to the bottom to catch demersal species. This gear increasingly are being displaced by trammel nets. Trammel nets consist of three layers of different mesh size (Fig. 8). The primary target species of this gear are shrimp.

3.2.4 Lift nets

The most important type of lift net found in Indonesia is a stationary platform built on pilings in shallow water and used at night to capture anchovies or other small schooling pelagic fish which are attracted over the net with light from powerful kerosene pressure lamps. Though lift nets, when not equipped with other fishing devices are regarded as passive and inefficient gear.

Lift nets are commercially important and very common in Indonesia. The most important one is *bagan*. It is a box-shaped net hung from a platform of bamboo poles, gradually sunk to the seabed, and is frequently operated at night using fish lamps. When enough fish have been attracted by the lamps (kerosene lamps), set above the center of the net, the net is then lifted by hauling the hanging lines by means of rollers. Three types of *bagan* are common in Indonesia, i.e. set lift net (*bagan tancap*), and boat lift net (*bagan perahu*) (Fig. 9).

Set lift nets are widely distributed throughout Indonesia, very common in bays and calm shore waters. Fishermen use two or three pressured kerosene lamps at once to attract fishes. The second important gear of this type is boat lift net. This gear became popular in the 1970's as the use of outboard engines became more common. These engines are less frequently used with the less maneuverable raft lift nets.

3.2.5 Hook and lines

The simplest form of fishing requires only a line and a baited hook. The line is cast into the water where the fish supposedly are, the fish take the bait and are hauled in. Attached to lines are hooks which may be single or multiple, big or small, depending on the species desired. Line fishing method is one of the most common used in Indonesia. This includes haul line, pole and line, troll line, longline and jigs. Skipjack pole and line and tuna long line, were described in the previous section on commercial fishery.

Hand line is used on a very small-scale and it is operated from non mechanized boats but mostly from small sailboats with double riggers, which typically are located close to shore. There are several varieties of handlines. A hand line carries a single hook for bait fishing or several hooks for lure fishing. Lure fishing is restricted only to daytime. Before the nighttime operation of hand line in the north coast of Java, fishermen capture anchovy or sardine attracted to kerosene lamps with a scoop net for the bait. The hand line also used as an alternative gears during off seasons for fishermen whose main involvement is with a different gear or those who are engaged in fishing as a part time activity.

Some of fishermen who are fishing for snapper and their related species in the waters of West Nusa Tenggara, Bali and East Nusa Tenggara used hand line and mini bottom long line (Budihardjo et al., 1993; Marzuki and Djamal, 1993). Meanwhile, bottom long line by 600 to 1,000 hooks per unit vessels with 20 GT used to catch demersal and coral fish in the waters of South Sulawesi (Djamil and Marzuki, 1993).

Both vertical and horizontal long lines of wide varieties, size and construction, are operated in the waters of North Java, Riau, South Sulawesi, West Sumatera and Moluccas. The biggest one in scale is the tuna long line or *rawai tuna*, and the most primitive one in scale is *pancing prawe* which is a line set horizontally between two fixed poles. Set long lines use baited hooks but are suspended just above the seabed. Relatively few gears of this type are operated in the waters of Moluccas, South Sulawesi, Kalimantan and Java (Fig. 10) Troll lines are operated primarily by sail powered boats though in some areas. In the West coast of Sumatera this gear operated by motorized boats. The largest concentration of troll lines is the coastal area embracing the Moluccas and Irian Jaya, and Northern Sulawesi (Fig. 11).

3.2.6 Traps

This gear category includes both large stationary gear (guiding barriers and stow nets) and various small traps. Guiding barriers consist of a long stationary barrier set perpendicular to the current. Generally, the fish coral *sero* are operated along the coast of Java and Madura, Malacca Straits, South Kalimantan and East Kalimantan (Fig. 12). This typical gear consists of a series of four enclosures of chamber, flanked by two wings, and prolonged leader. The set up is made of bamboo poles and slabs of split bamboo. This

gear is regarded as traditional gear, is used primary to capture demersal finfish and shrimp, and require shallow protected waters.

Stow nets or filter bag nets could be set or towed againsts current. Usually they have wings of netting, bamboo matting or leaves and branches in other areas. *Jermal* has wings of bamboo poles in the waters of Malacca Straits, East Sumatera and West Kalimantan (Fig. 13). This gear is fixed with the mouth open to bamboo poles and set semi-permanently in relatively deep waters. Similar type of filter bagnet togo, toros, and tadah (Fig. 14, 15) are operated in the shallow waters or in the deeper portion of the rivers. Bamboo basket is attached to the end of the bagnet to facilitate small fishes and shrimps harvest. This gear concentrated in East coast of Sumatera and North coast of Java.

Portable fish traps or fish pot(Fig. 16) are made from the bamboo or woven rattan and are used to capture demersal fish species in both open waters and coral reefs. A single fishing unit typically will operate several such traps. *Pakkaja* (drifting fish pots) is used to catch torani (*Cypsilurus* spp.) in the waters of South Sulawesi (Fig. 17).

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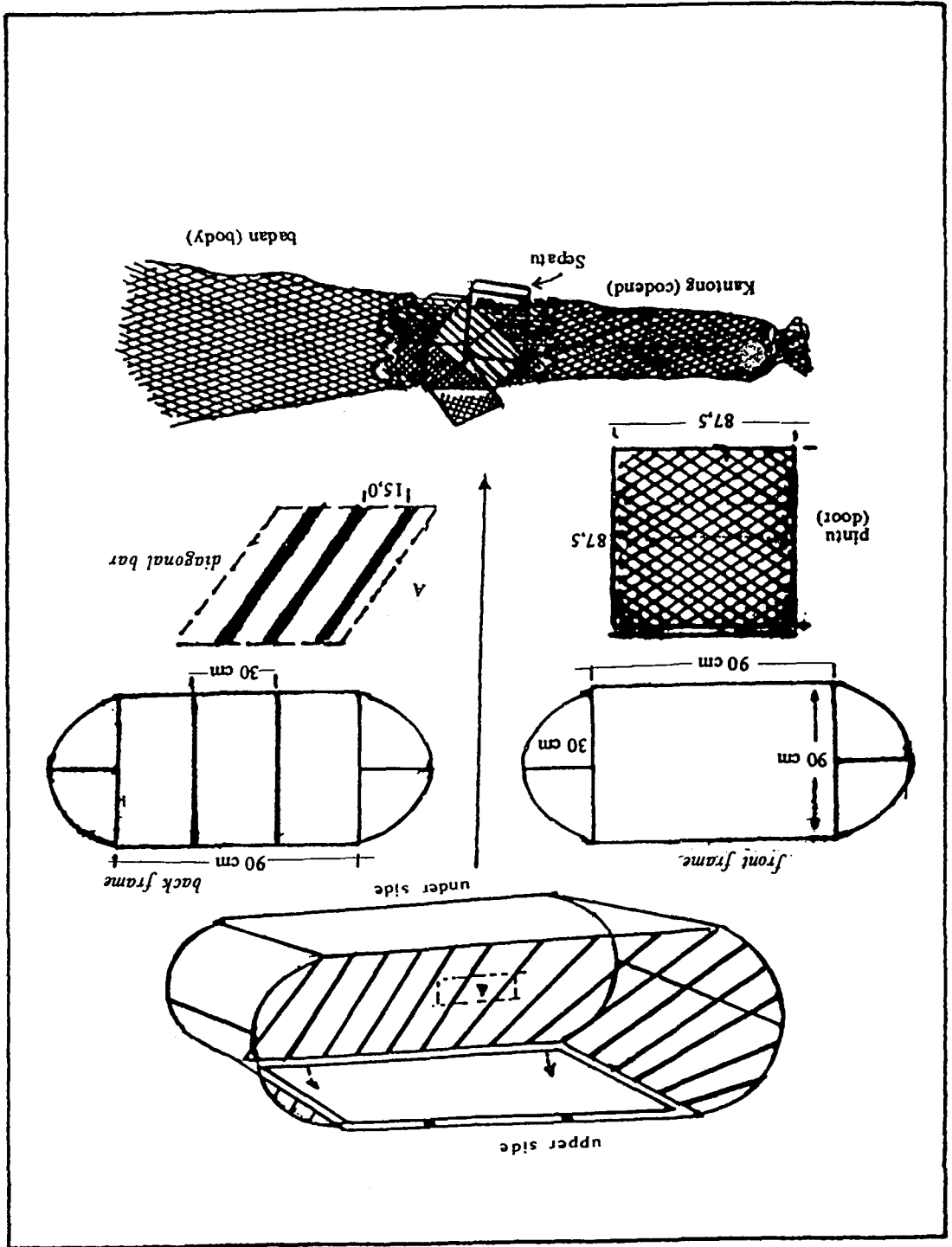


Fig. 1. One of the design of BED-shrimp net operated in the Arafura Sea (Sumiono and Sadhotomo, 1985)

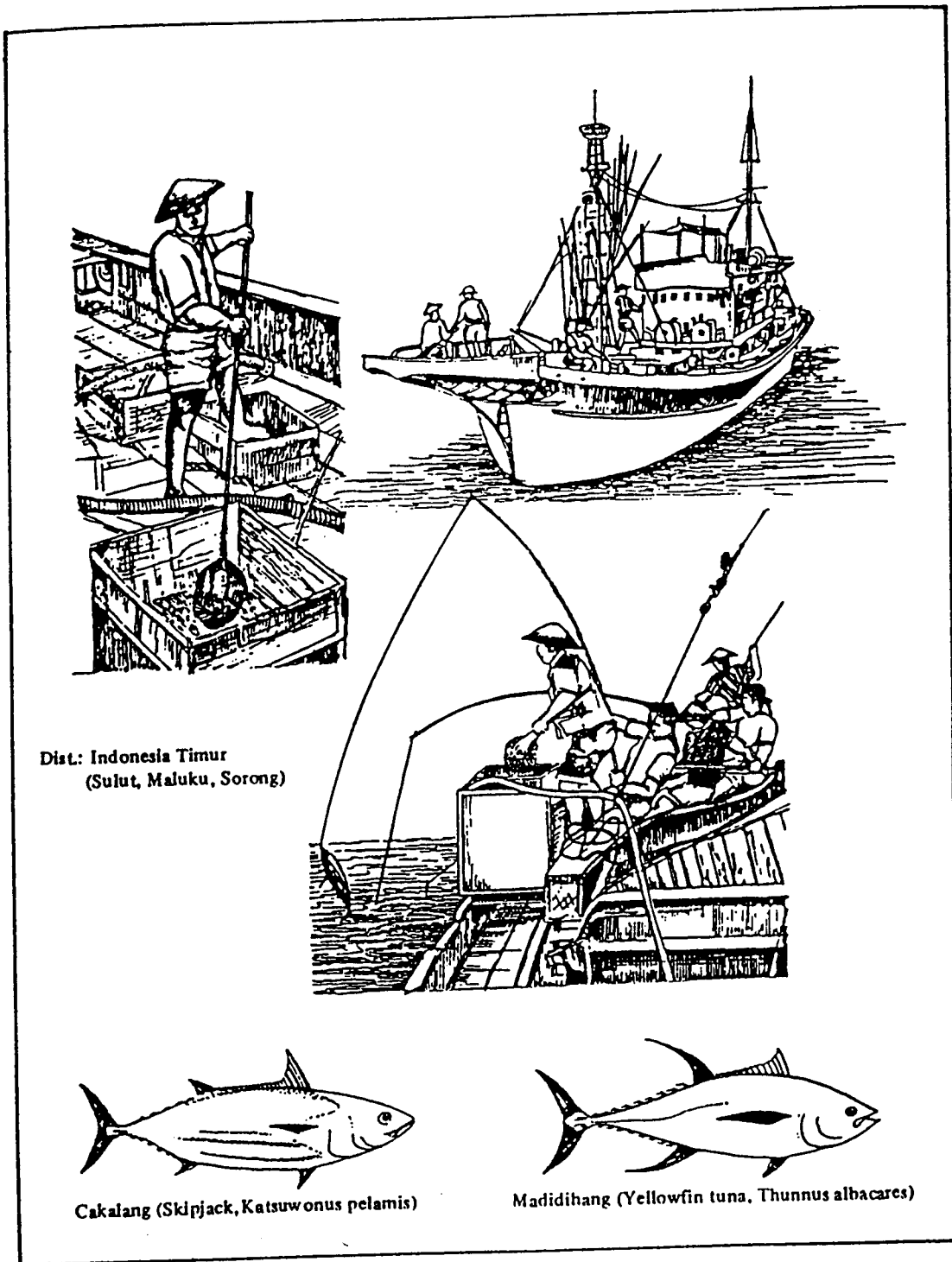


Fig. 2. Pole and line in operation (*Subani and Barus, 1989*)

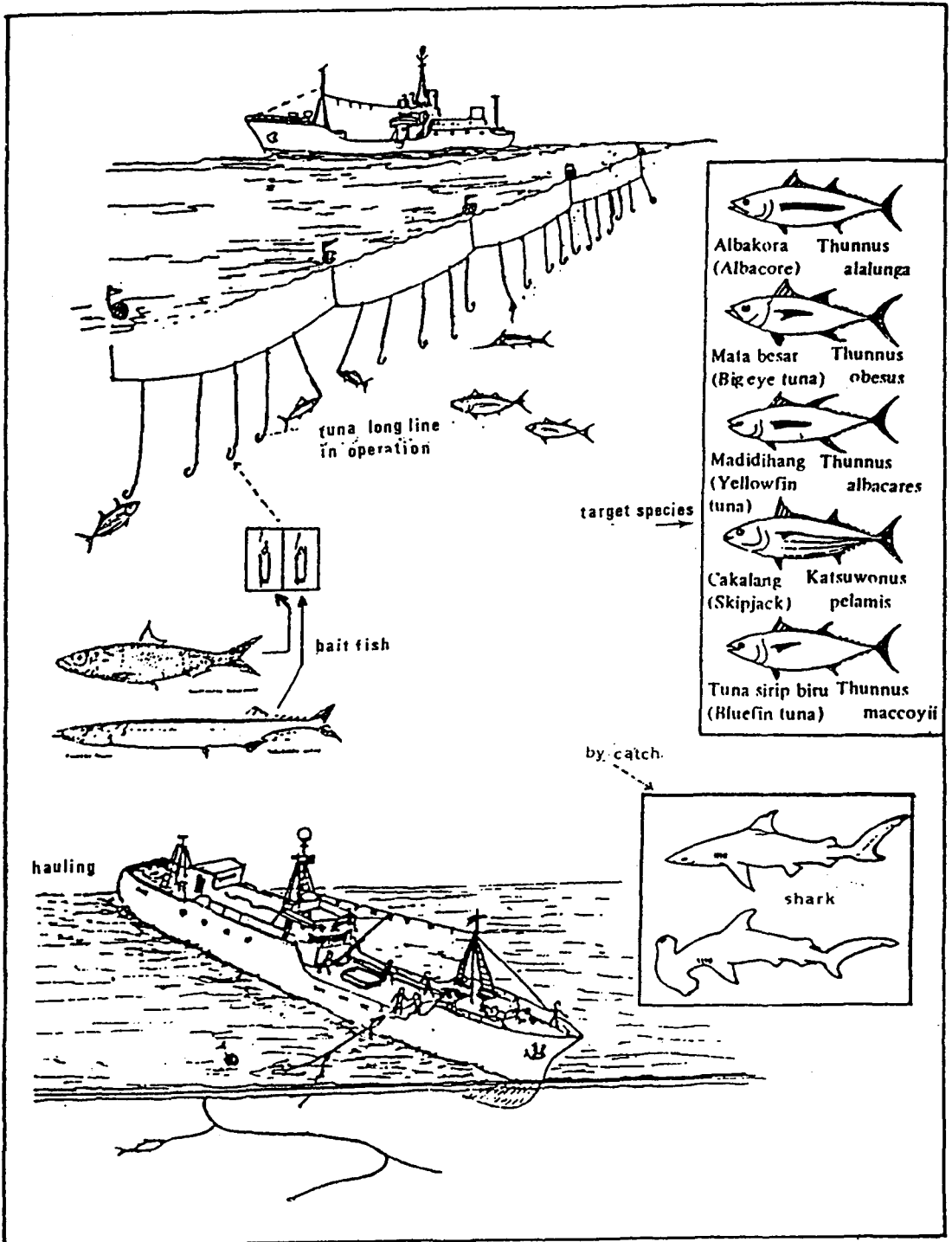


Fig. 3. Tuna longline in operation (Subani and Barus, 1989)

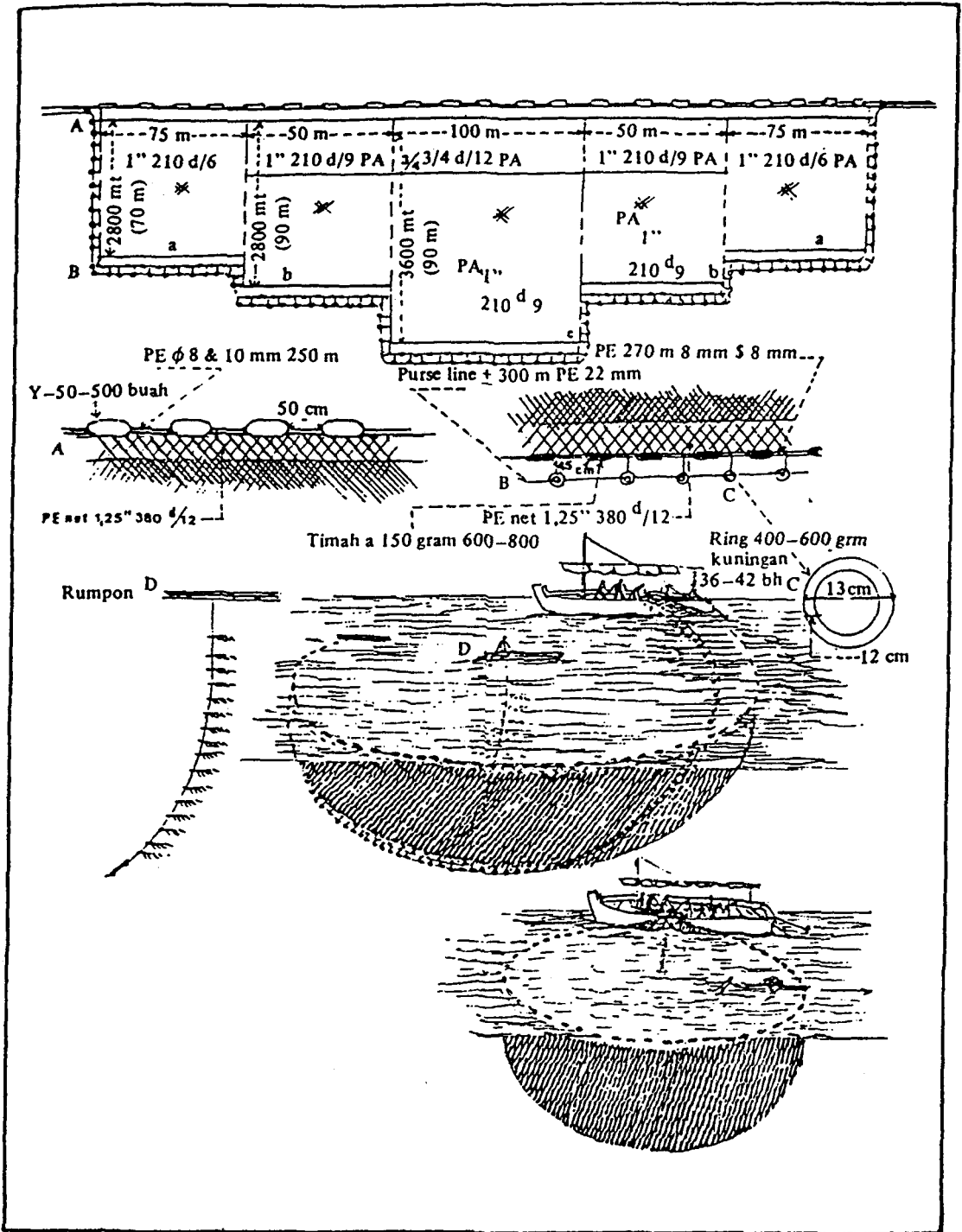


Fig. 4. The design of mini purse-seine and its fishing methods by using rumpon (Subani and Barus, 1989)

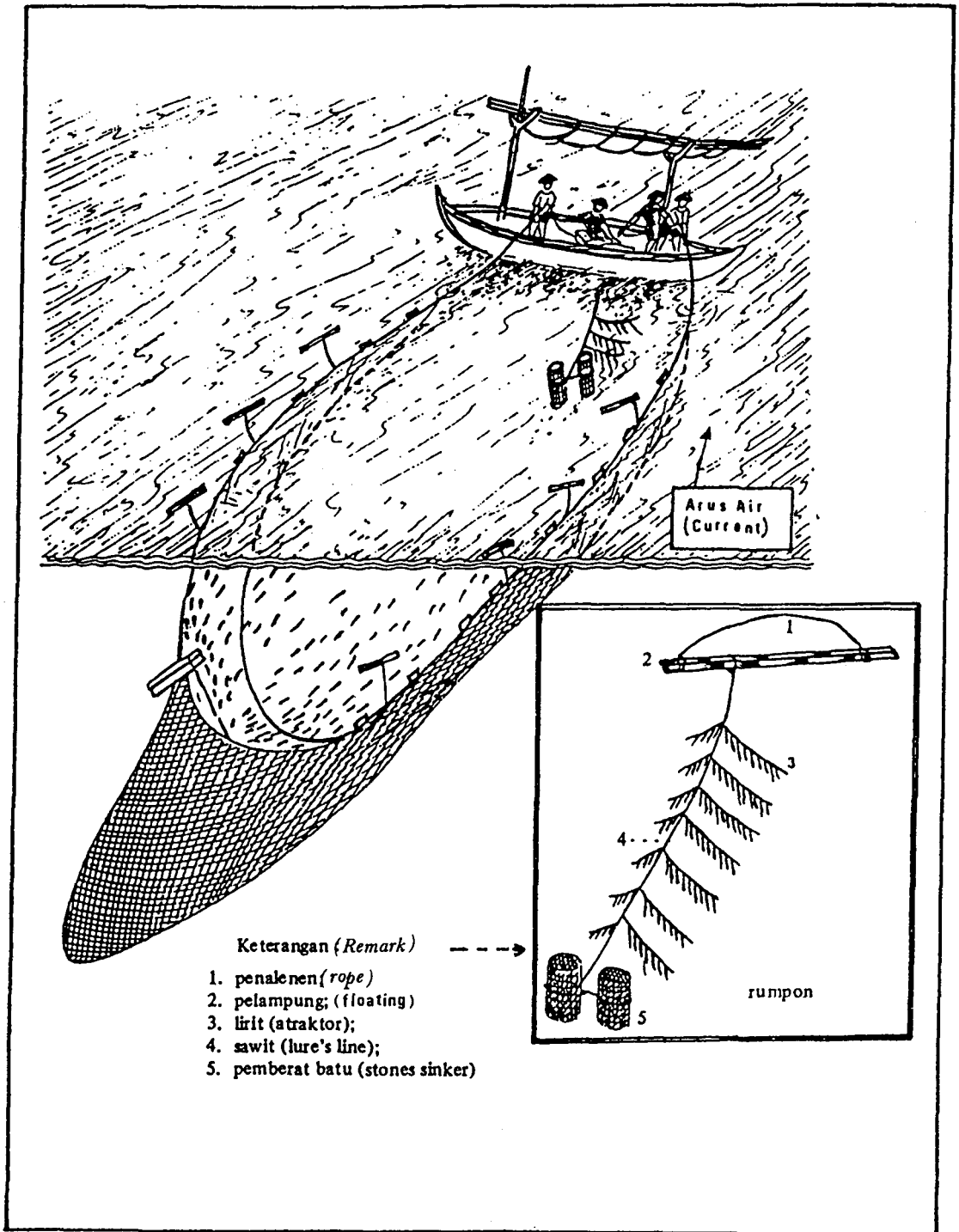


Fig. 5. One of the types of payang by using stationary lure
(Subani and Barus, 1989)

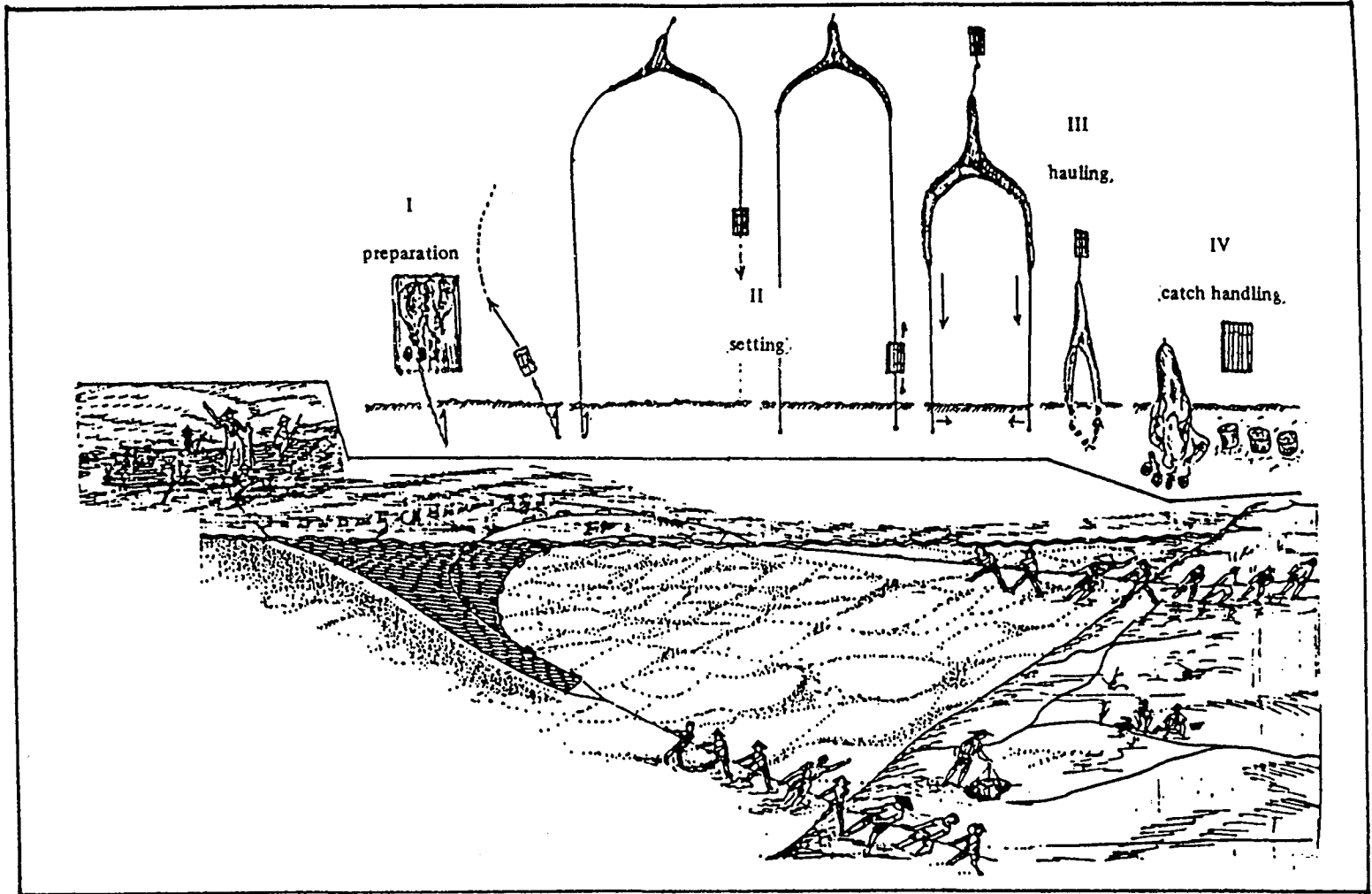


Fig. 6. One of the types of beach seine in operation (Subani and Barus, 1989)

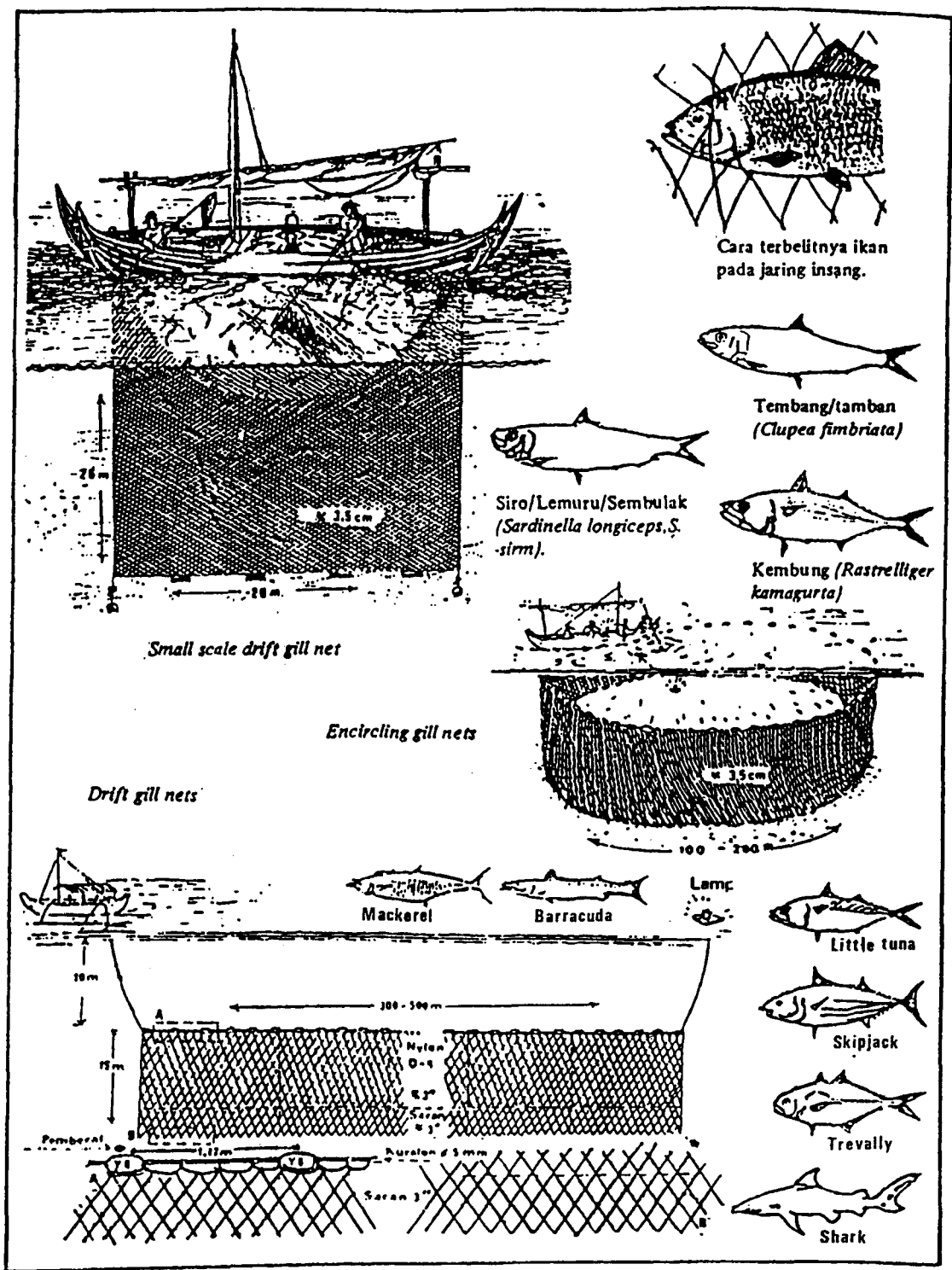


Fig. 7. Three types of gill net (Subani and Barus, 1989)

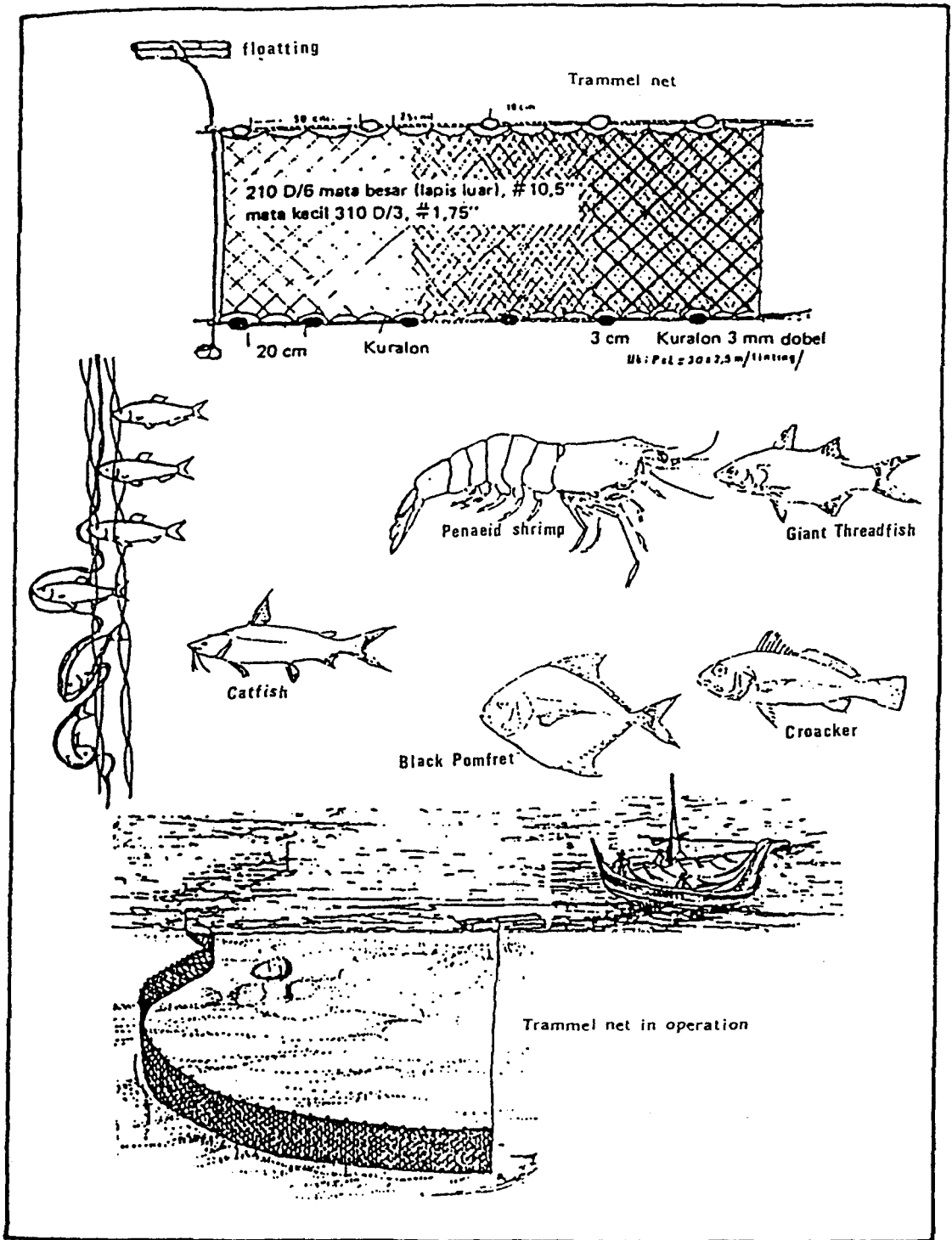


Fig. 8. Trammel net commonly used in Indonesia (Subani and Barus, 1989)

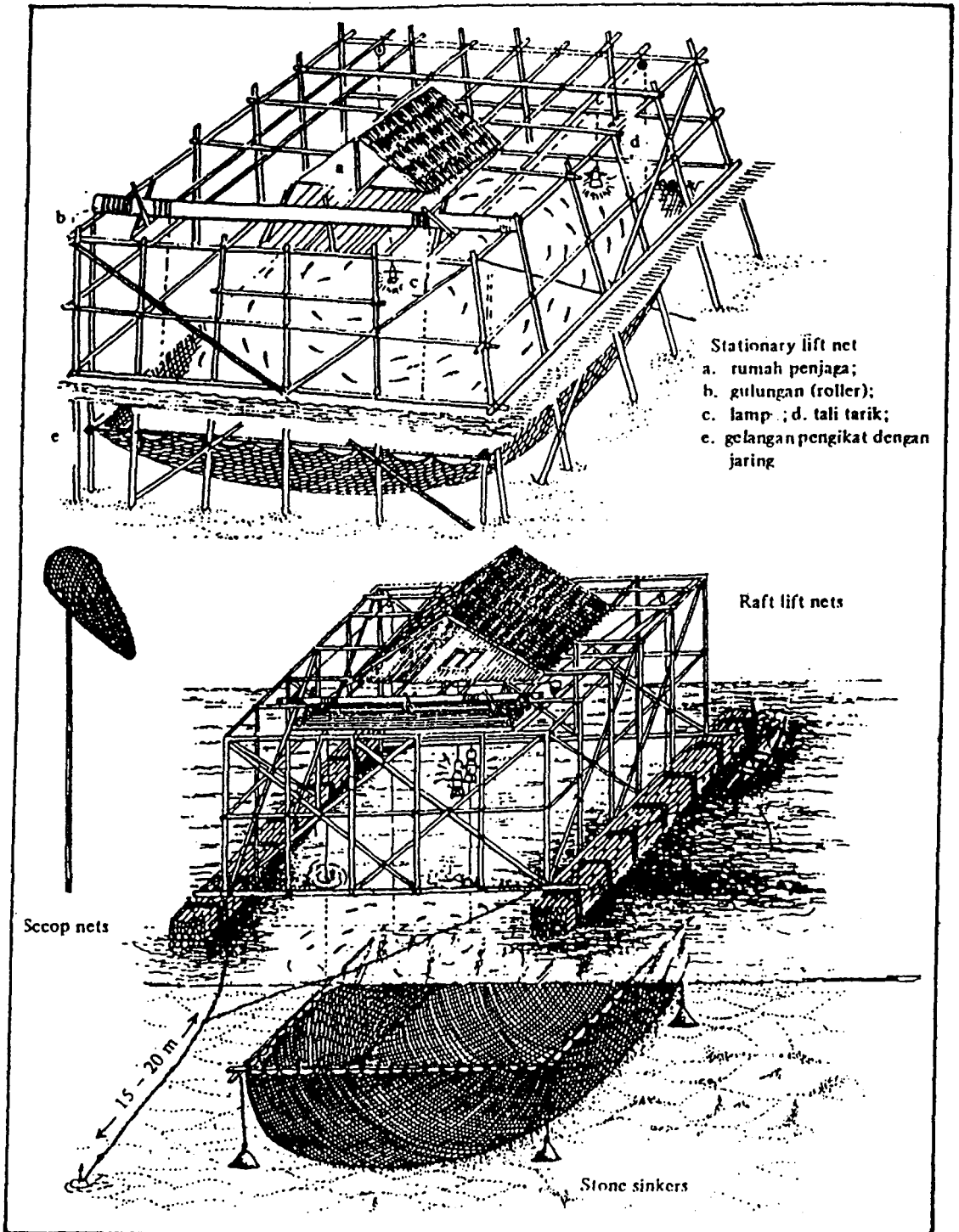


Fig. 9. A type of the stationary and raft lift net (Subani and Barus, 1989)

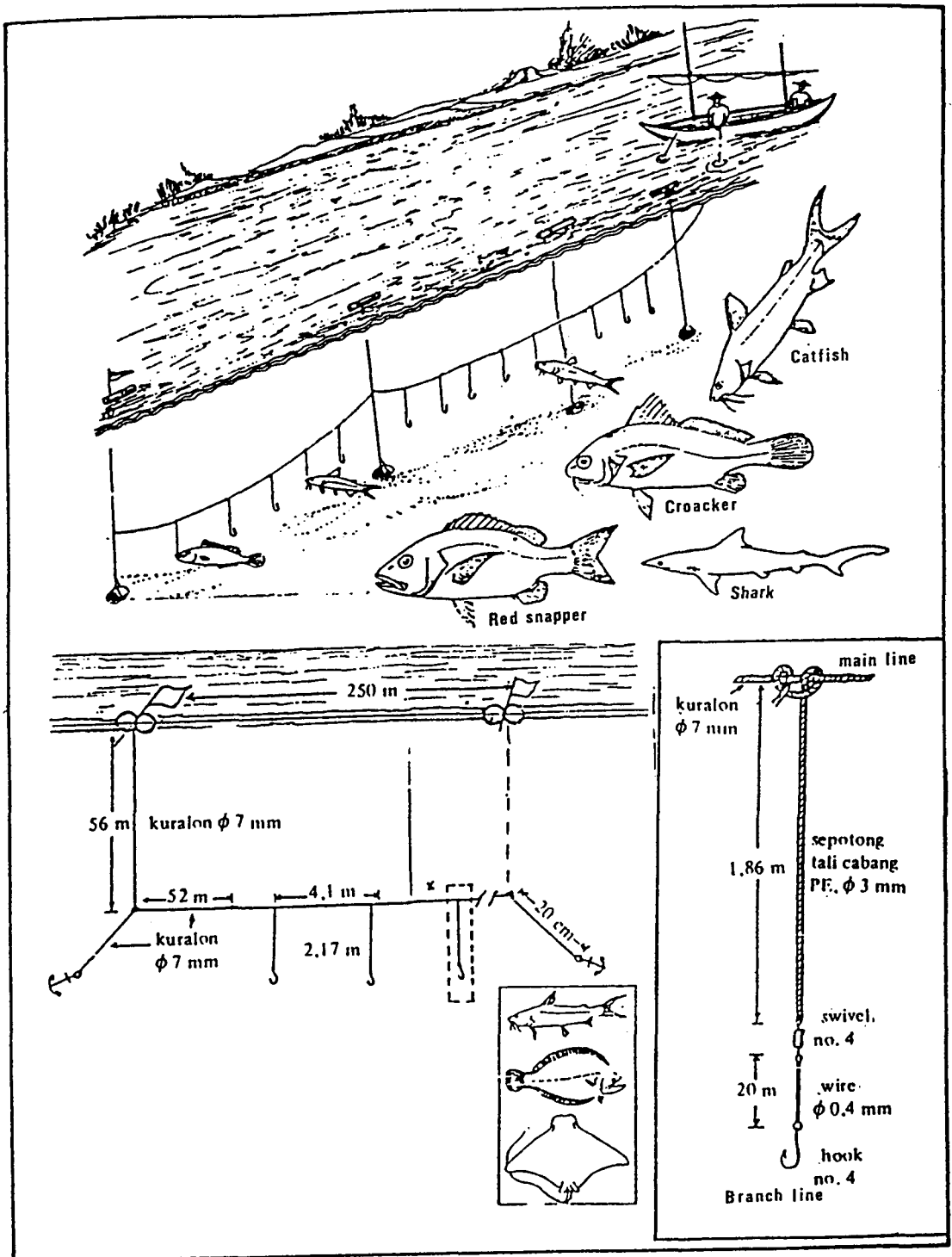


Fig. 10. Two types of traditional bottom longline (Subani and Barus, 1989)

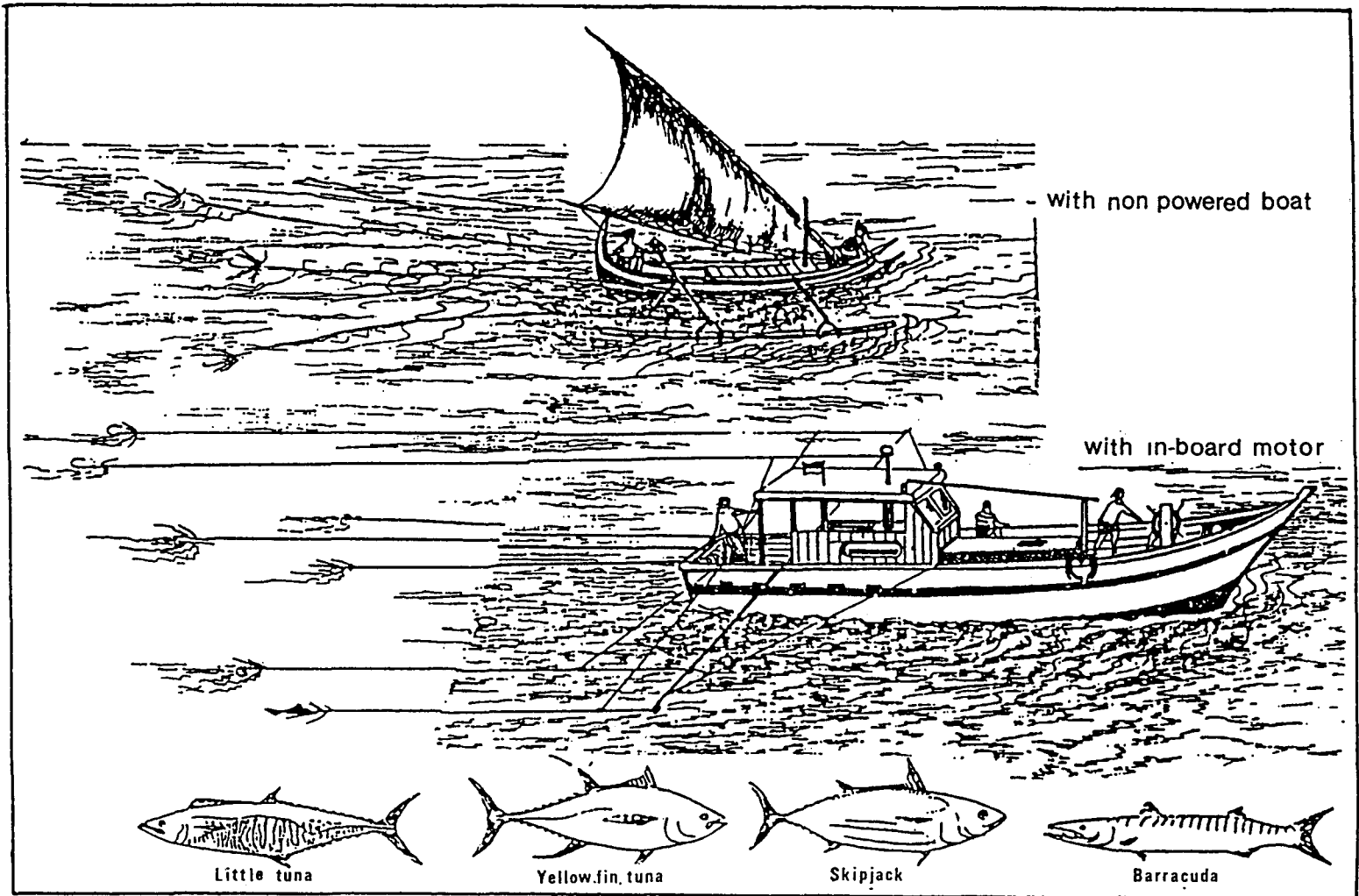


Fig. 11. Troll line in operation (*Subani and Barus, 1989*)

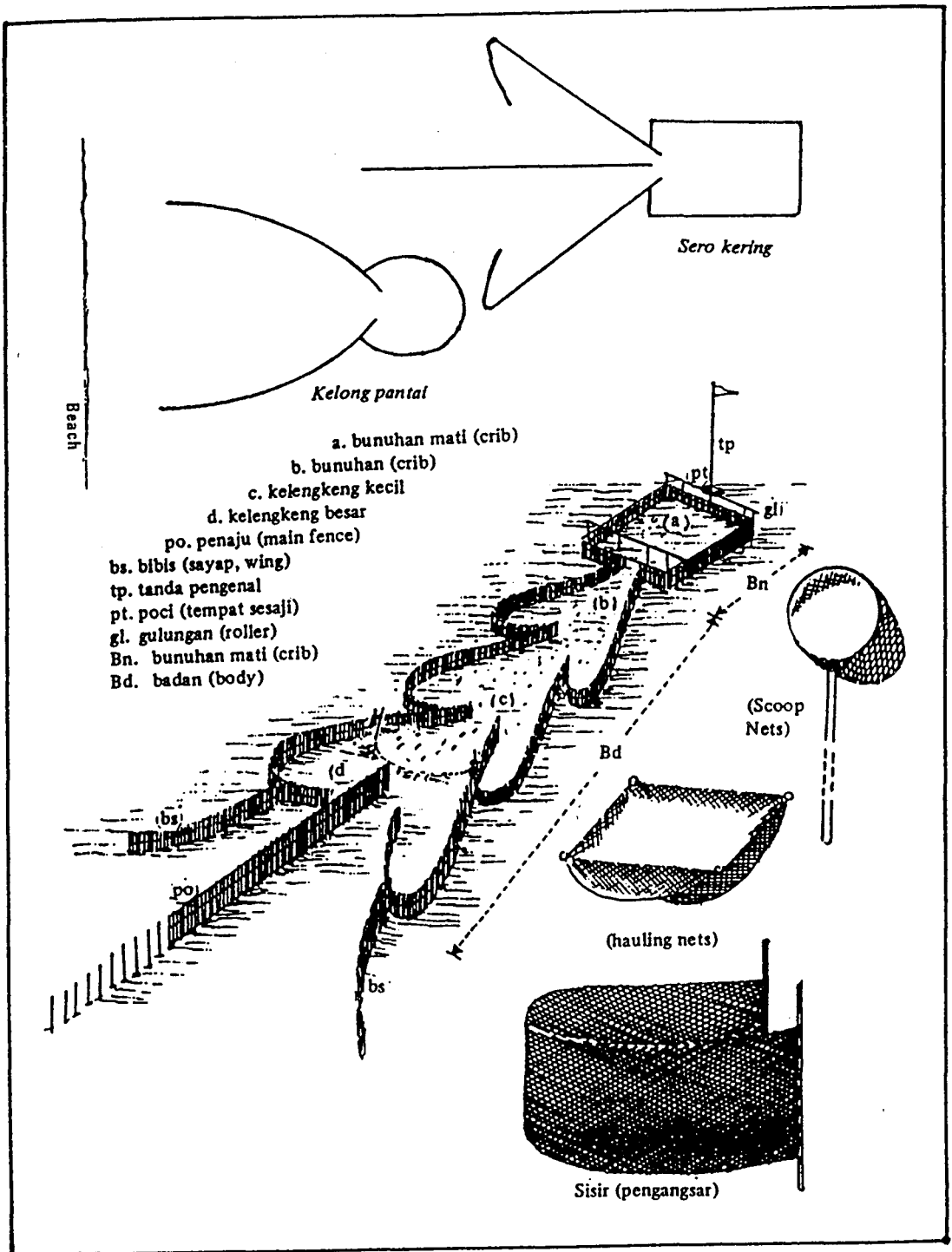


Fig. 12. Typical big-and mini of stake traps (guiding barrier)
 (Subani and Barus, 1989)

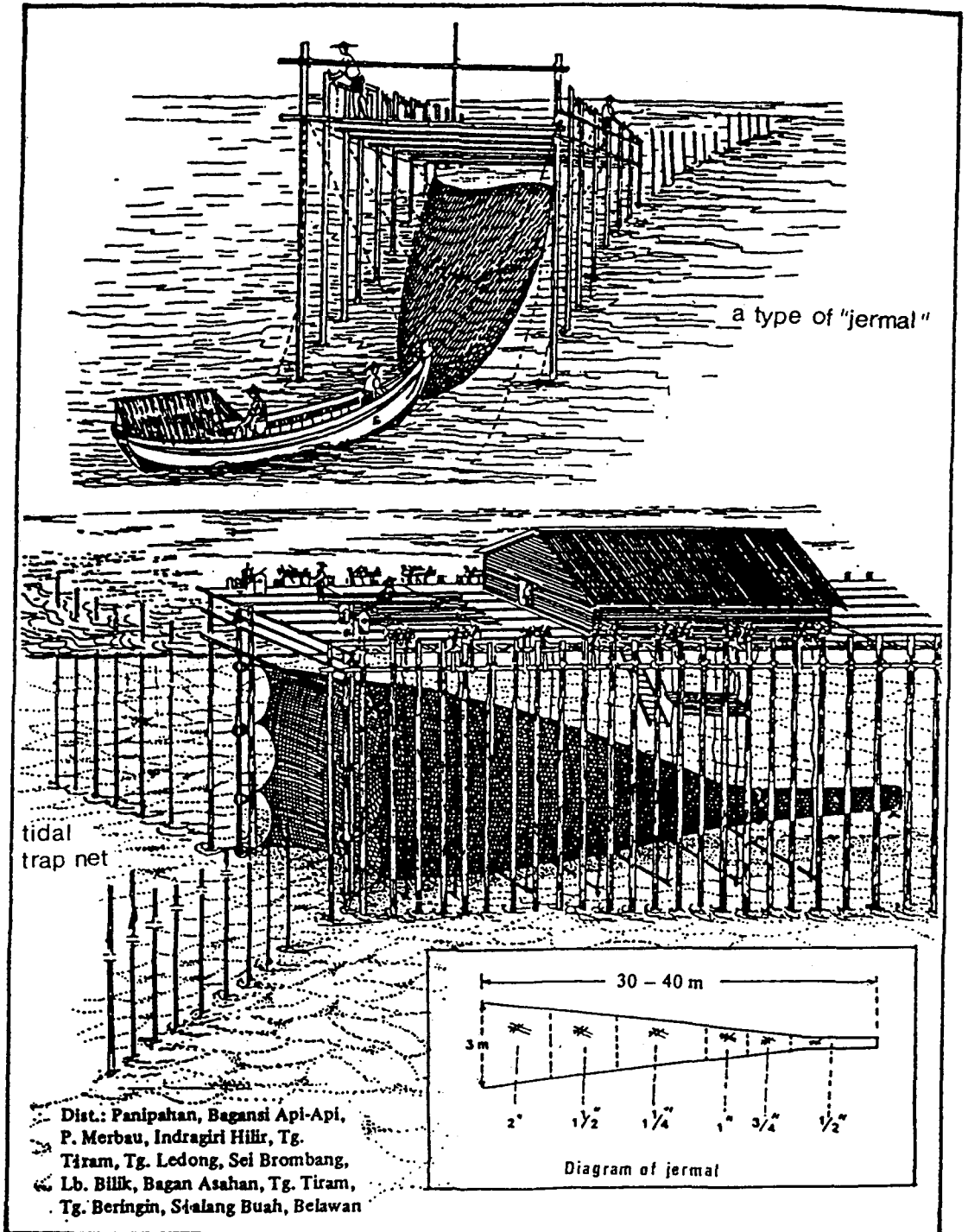


Fig. 13. Several types of *jermal* (stow net) in Indonesia (*Subani and Barus, 1989*)

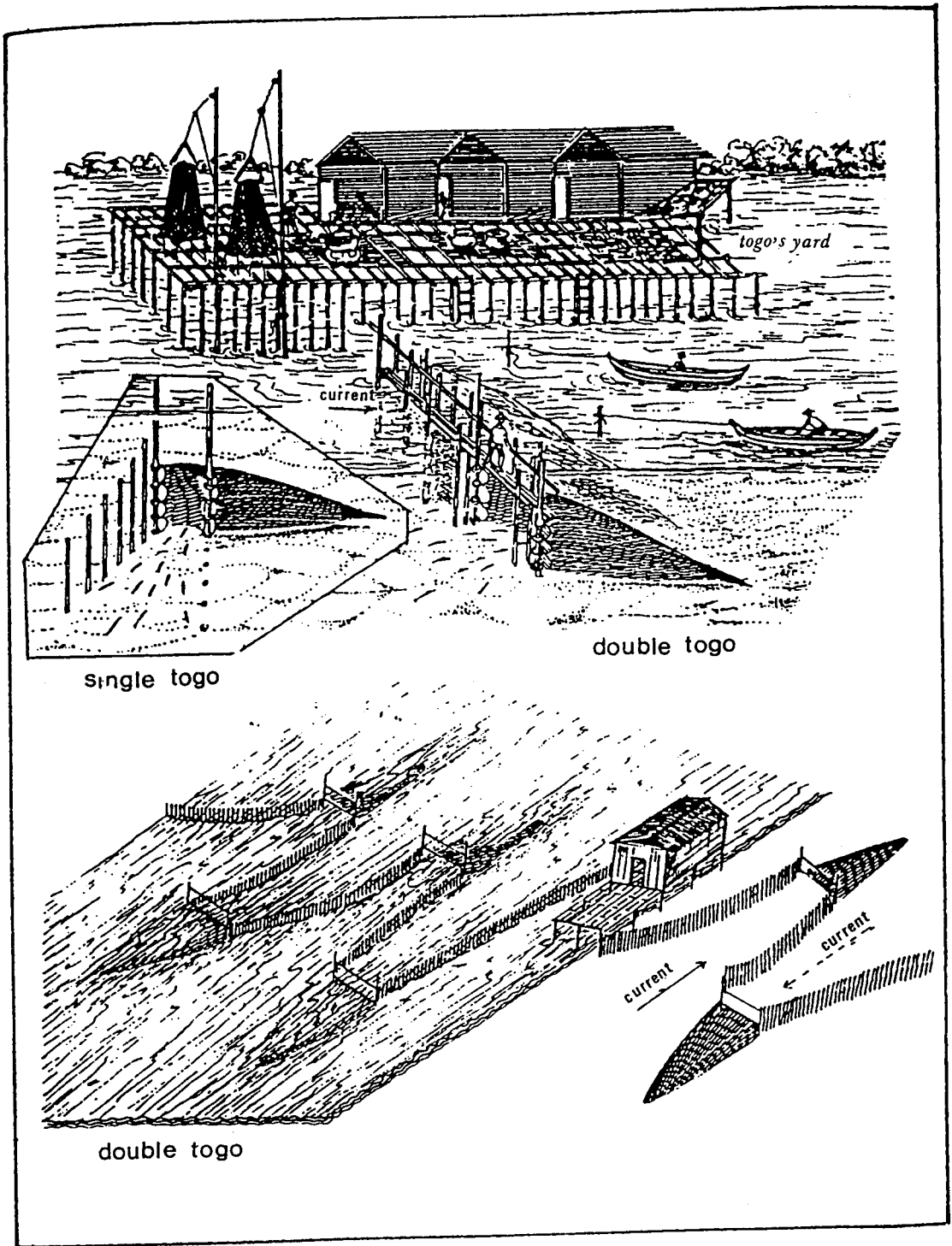


Fig. 14. Several types of *togo* (stow net) and their fishing methods (Subani and Barus, 1989)

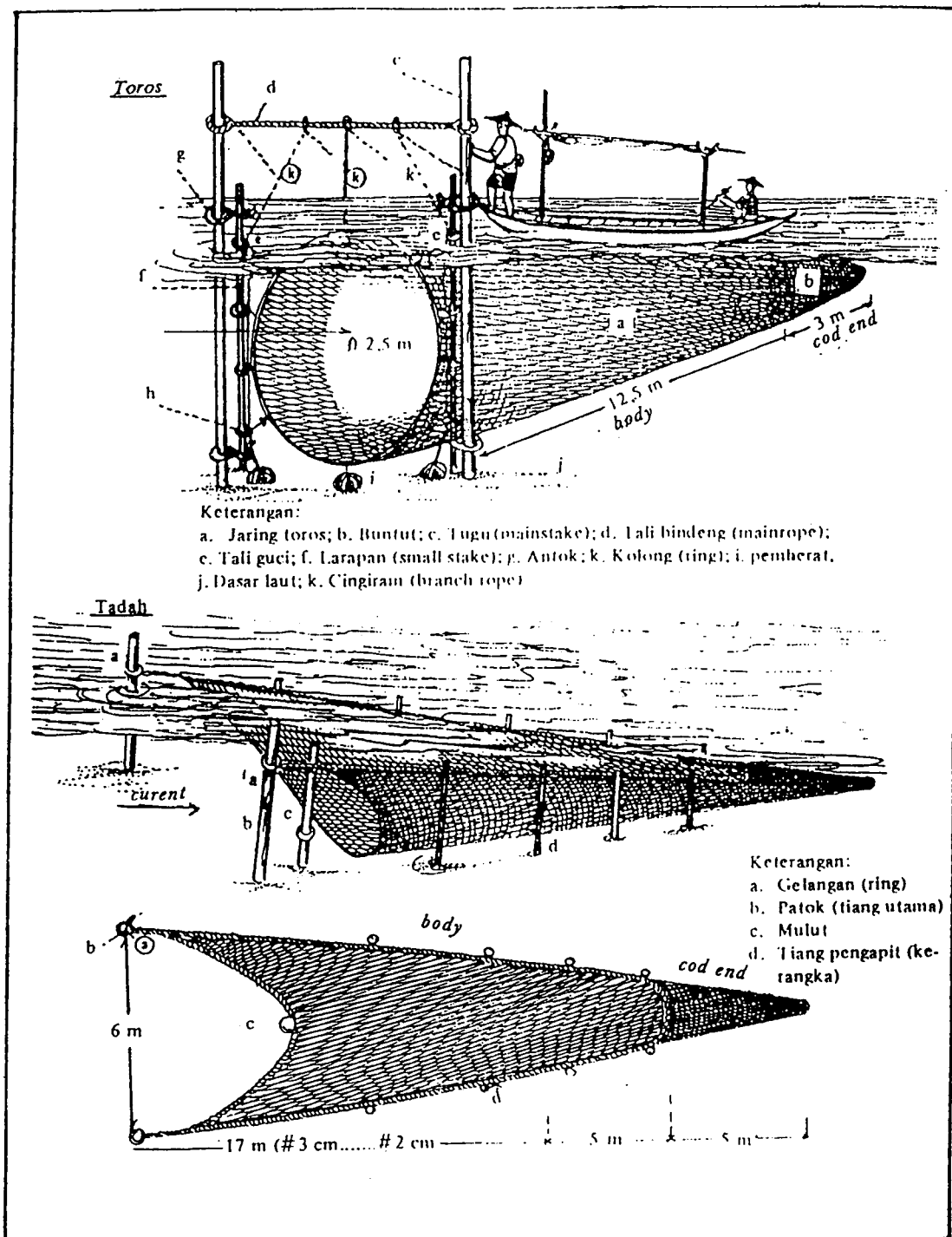


Fig. 15. Two typical filter nets ("toros" and "tadah") in operations (Subani and Barus, 1989)

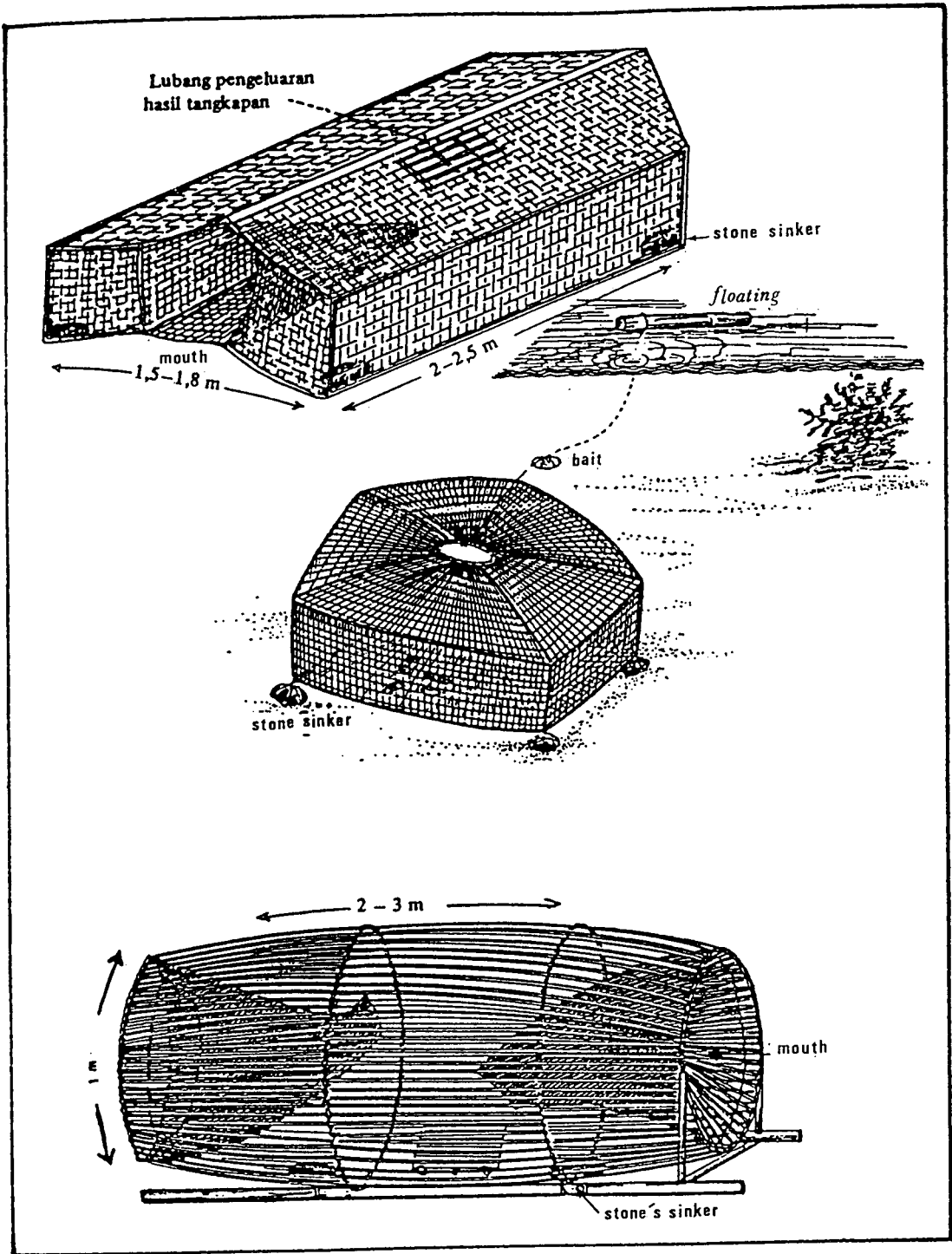


Fig. 16. Three types of fish pot (Subani and Barus, 1989)

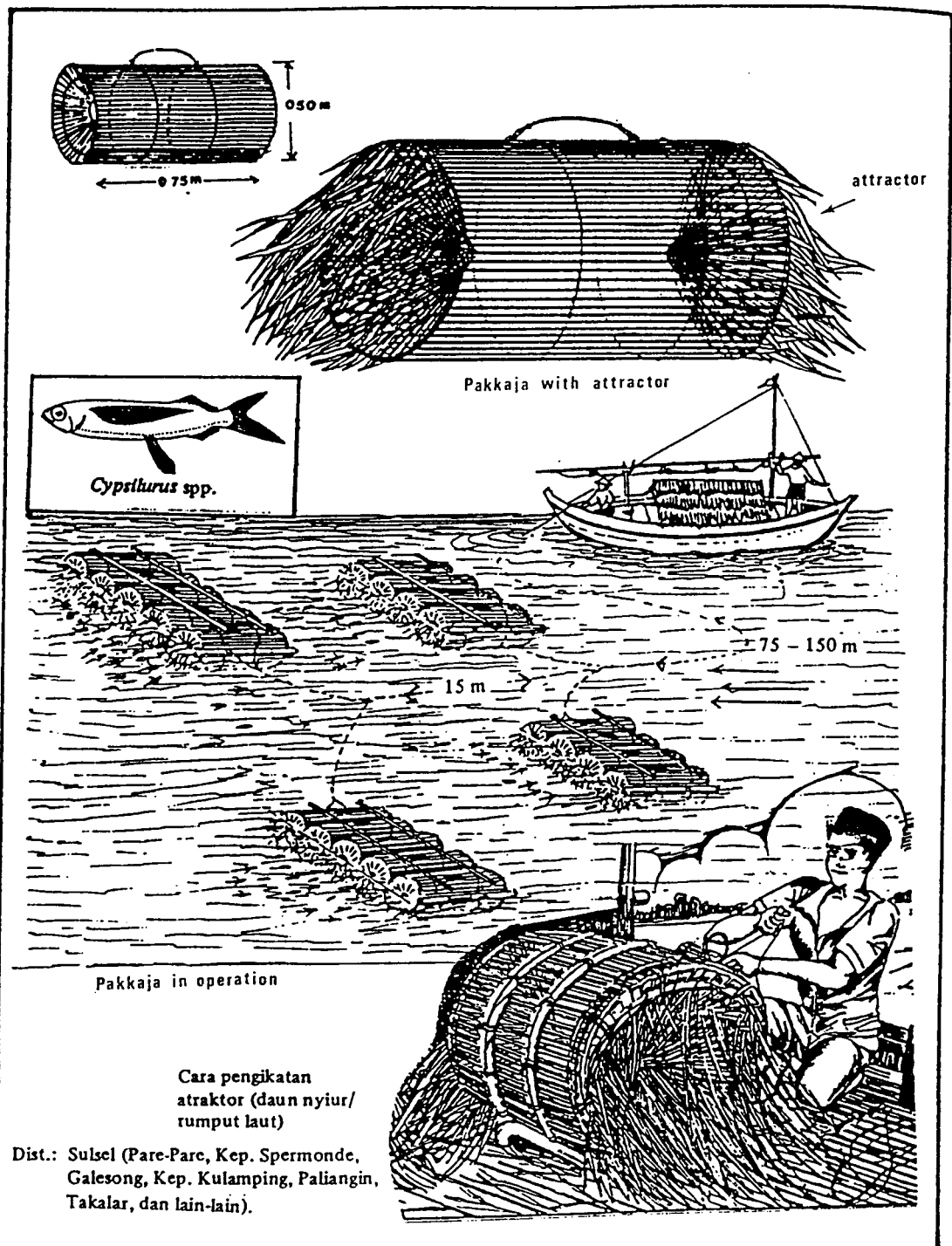


Fig. 17. Drifting fish pot (*pakkaja*) and its fishing method (Subani and Barus, 1989)