SEAFDEC Training Department

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

TD/RES/32 February 1993

OBSERVATION REPORT ON TUNA PURSE SEINE FISHING OPERATIONS AROUND SEYCHELLES WATERS ONBOARD NIPPON-MARU 8 November 1992 to 7 January 1993

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I. Tuna is a group of oceanic fisheries resources. There are many varieties and they migrate worldwide. As they inhabit international waters (public sea), they can be caught by fishing boats from many countries, using different types of fishing gears, such as pole and line, drifting long-line, drift gill net, and purse seine. In 1990 an international decision was made to ban tuna drift gill net fishing. Although this decision will not be ratified by the FAO until 30 May 1993, many countries have already implemented the recommendation, and so there remain only a few active fishing gears for catching tuna; purse seine is the most active of these.

Although tuna migrate worldwide, there are species area limitations due to their preference for certain water temperatures. Yellowfin tuna (*Tunus albracores*) and skipjack (*Katsuwonus pelamis*) are most abundant in tropical waters from latitude 15°N to 15°S. For purse-seiners, the West Indian Ocean around the Seychelles is one of the best fishing grounds for these two species, and can be conducted throughout the year. There are about 60-70 purse seiners from various countries, Spain, France, USSR, Taiwan, Mauritius, and Japan, ranging from 500 GT to 1,500 GT in size, which fish in these waters; NIPPON-MARU, a 1,200 GT Japanese purse seiner, is one of them.

The SEAFDEC Training Department is part of an international group, with fisheries responsibilities in the Southeast Asian region. In early 1993, the Department acquired a new training vessel; its major fishing gear is tuna purse seine, and minor gear, tuna longline. In order to make full and efficient use of the vessel as quickly as possible, this observation program was arranged under the kind approval of the President of the Japan Marine Fisheries Resource Research Center (JAMARC).

For the success of this program, I would like to express my great thanks to the President of JAMARC who accepted our request for these observations to be made by SEAFDEC staff. Thanks to Mr. Tatsuhiko Iwasawa, the Director of the Development Department of JAMARC who arranged this schedule for the R.V. NIPPON-MARU, and also to Mr. Kohei Murosawa, General Manager of Japan Far Seas Purse Seine Fishing Co., Ltd. who allowed me onboard the company's vessel.

Thanks to Captain Itaru Yamamoto, Fishing Master; Mr. Takehiko Akiyama, officers and crew of NIPPON-MARU who showed me such warm hospitality while onboard the fishing vessel.

Thanks to Mr. Kazuo Inoue, Deputy Secretary-General of SEAFDEC who liaised with JAMARC, and special thanks to Dr. Thiraphan Bhukaswan, the Secretary-General of SEAFDEC who approved the budget for this programe.

II. NIPPON-MARU is a modern tuna purse-seine fishing vessel (American type). She is a 1,200 GT vessel, 78 meters in length, 14.0 meters breadth and 8.5 meters depth, with a draft of 5.5 meters, maximum speed 17 knots and normal speed 15 knots. There is one main engine, 3,800 PSI and two electric generators (900 PSI, 550 kw) with central air conditioning for accommodation; there is accommodation space for 21 people. On this cruise there were 20 persons on board: Captain Itaru Yamamoto, Fishing Master; Mr. Takehiko Akiyama; eight officers; nine Crew; and one researcher and one observer from SEAFDEC. NIPPON-MARU can stay out at sea for 60 days at a time.

NIPPON-MARU is fully equipped as follows:

1) Deck equipment (see Annex I)

- one skiff boat with 380 h.p. main engine
- two work boats with 100, 250 h.p. main engine, 10 kw. dynamo and echo-sounder with tele-transmitter
- one speed boat with 115 h.p. outboard engine
- one main mast with main boom

- two fishing booms and six accessory booms
- one crane
- one 5.5 tons hauling force power block
- one main purse winch with three drums
- one davit with three blocks and one ring stripper
- three capstan winches and two choke winches
- a skiff towing line drum and winch

2) Navigation Equipment

- Auto pilot wheeling gear with remote control console on upper deck
- Navigation radar 64 Nautical miles maximum range
- Satellite positioning, NNSS and GPS
- Navigation route plotter
- NOAA receiver and printer (wheather chart)

3) Communication Equipment

- SSB radio transmitter and receiver
- VHS radio system
- Emersatte communication system. Fax. and Telephone
- Telex communication
- Radio direction finder system

4) Fishing Equipment

- two Bird radars 96 nautical miles maximum range
- two Scanning sonar (short and long distance detection)
- VIDEO echo-sounder
- Paper echo-sounder
- two tele sounders
- Doppler sonar current indicator
- Net sonde (with echo-sounder)

5) Fishing Gear

- one set of tuna purse seine 1,500 meters in length and 290 meters depth (see Annex II)

6) Fish Preservation System

- Brine freezing system (16 brine fish holds, capacity 60 tons each)
- Dry freezing system (six dry freezing fish holds 30 tons each)

7) Power Supply System

- two electric generators (900 PSI, 550 Kw)
- seven hydraulic pumps

Others facilities include eight one bedroom units, seven double bedroom units, one dining room with TV & video set, one kichen, one bathroom, two washing machines and two toilets.

III. Sailing route of the cruise

During the 61 day cruise, NIPPON-MARU carried out searches around Seychelles waters and fished to the east and west side of the Seychelles Group. (Fig. 1) The programe for the cruise was as follows:

8 Nov. 1992 NIPPON-MARU left port Victoria, Mahe Is. and proceeded to the fishing ground on the west side of the Seychelles Group.

10 Nov. 1992 Set six FADs (PAYAO) at the fishing ground (lat. 04°-10' to 05°-00'S and long. 48°-30' to 49°-50').

11-17 Nov. 1992 Searches carried out from the west through to the north until arrival at the east of the Seychelles Group.

18-20 Nov. 1992 Conducted fishing operations on drifting objects near east fishing ground (lat. 04°-00' to 05°-40'S long. 58°-00' to 59°-30'E).

21 Nov. 1992 Searched on the way to the far east fishing ground.

22-25 Nov. 1992	Conducted fishing operation at fish schooling at far east fishing ground (lat. 04°-00' to 05°-30'S long. 62°-30' to 63°-30'E).
26 Nov. 1992	Back to near east fishing ground.
26-30 Nov. 1992	Fished on drifting objects at near east fishing ground of Seychelles group.
1-2 Dec. 1992	Searched on the way to the far east fishing ground again.
3-6 Dec. 1992	Fished on drifting objects at far east fishing ground.
7-10 Dec. 1992	Searched on the way to the near east fishing ground and on fishing ground.
11-12 Dec. 1992	Proceeded to fishing ground on west side of Seychelles (FADs or PAYAO location). One had drifted 60 miles south and the other five FADs 180-200 miles west near to the EEZ boundary of Somalia and Kenya).
13-14 Dec. 1992	One fishing operation on FADs conducted and eight other FADs set at the fishing ground (lat. 05°-10' to 05°-50'S, long. 49°-00' to 50°-00'E).
15 Dec. 1992 to 5 Jan. 1993	Fished on FADs at west fishing ground.
6 Jan. 1993	Set six FADs on the northwest fishing ground of the Seychelles and returned to Mahe Island.
7 Jan. 1993	Arrived at Port Victoria, Mahe Is., Seychelles.

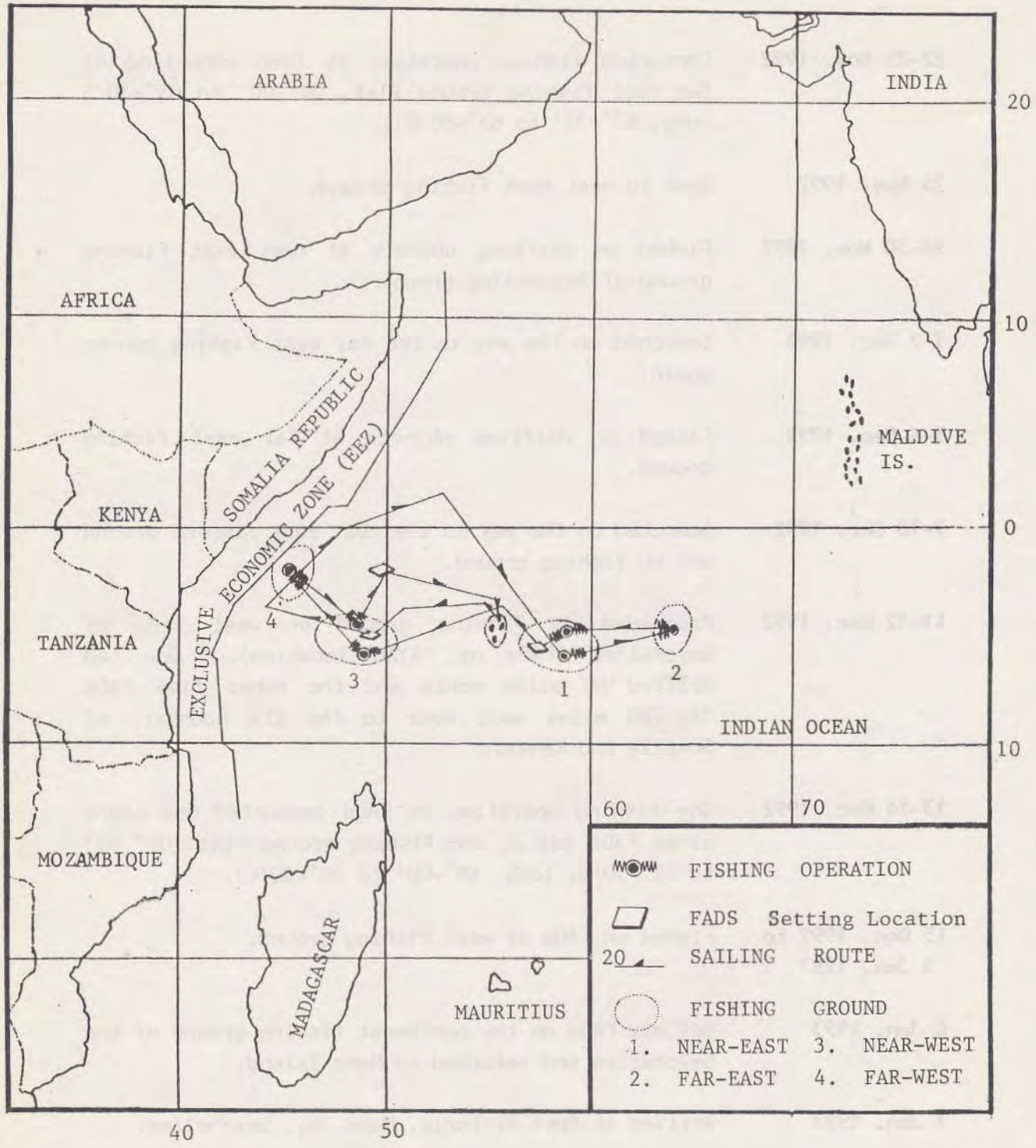


Fig. 1 Sailing route and fishing ground of NIPPON-MARU around Seychelles waters. (8/11/92 to 7/1/93)

IV. Activities onboard during the cruise

Cruise activities onboard NIPPON-MARU were the same as other tuna purse seine cruises except for the additional tuna research program. All activities could be divided into seven items. Before starting the cruise, however, the designation of the fishing ground was an important item to be taken into the consideration. So, these will be described one by one as follows:

1) Fishing ground designation

Fishing masters designate fishing grounds according to their own experience, former fishing recorded, up-to-date information by radio communication from other vessels at the same fishing ground, and from their own equipment onboard such as fishing ground detector (satellite system NOAA). The fishing master on NIPPON-MARU designated the fishing ground not only in accordance with this information but also taking the research program into consideration. According to five-years-plus experience in the west Indian ocean area, the fishing season for tuna purse seine around Seychelles waters is as follows:

January - March	: Southern area of Seychelles group (lat. 7°-00' to 10°-00'S and long. 50°-00' to 60°-00'E).
February - April	: Southwest area of Seychelles group up to the EEZ boundary line of Kenya, Somalia, and northern Madagascar (lat. 7°-00' to 12°-00'S and long. 40°-00' to 50°-00'E).
April - June	: Western area of Seychelles group and along EEZ boundary line of Somalia (lat. 0°-00' to 07°-00'S and long. 44°-00' to 52°-00'E).

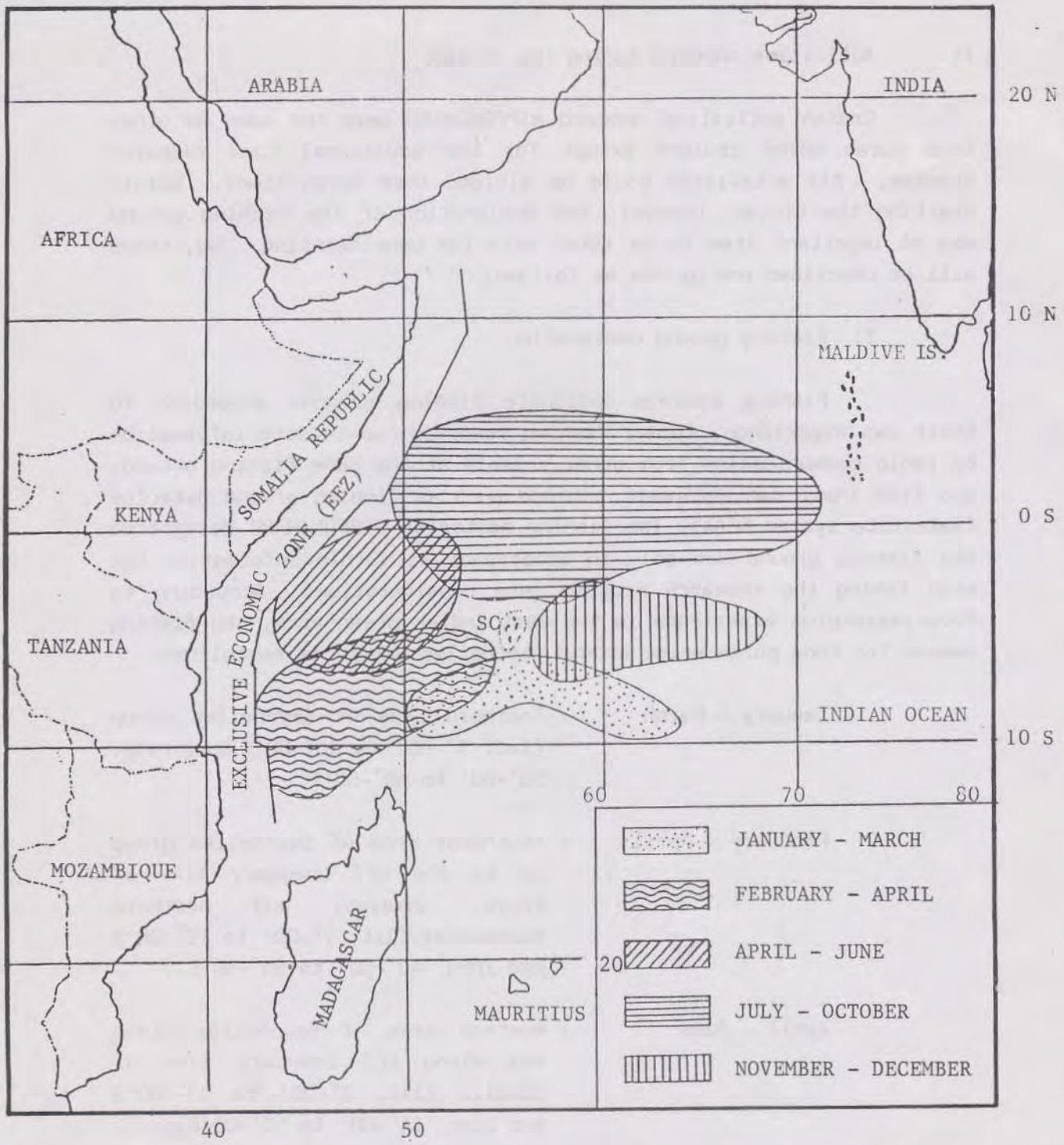


Fig. 2 Tuna fishing ground and fishing season around Seychelles waters.

July - October : Northern area of Seychelles up to Maldive waters (lat. 3°-00' to 5°-00'N and long. 50°-00' to 70°-00'E)

November - December : Eastern area of the Seychelles group (lat. 3°-00' to 7°-00'S and long. 57°-00' to 68°-00'E).

Spanish and French purse seiners conduct fishing by searching for schools and following seasonal variations, but Japanese purse seiners are different. They prefer *Payao* fishing, so their fishing season depends upon the oceanic currents. When the current is too strong and its average direction is to the east, fishing is not good. The northern and southern areas of the Seychelles do not have such strong currents. Japanese purse seiners decide on fishing grounds by the current conditions.

So although the NIPPON-MARU sailed around the waters of the Seychelles for this fishing trip, the main catch was in the eastern area.

2) Searching

While the vessel sails to the fishing ground during the day, bird radar is operated at a range of 6 and 12 nautical miles, to find far distant flocks of birds. When found, the vessel proceeds in that direction. Throughout the day, the fishing master, captain, officers and crew also search through binoculars from the high basket on the main mast, and high bridge deck, (14x70°-4°) to find a flock of birds, jumping fish, drifting objects or other signs related to fish schools. When the vessel is close to the area or object, careful observation is made through binoculars, and by sonar and echo-sounder, to confirm the fish school's condition. After this is confirmed the fishing master orders the net operation, or the luring method, and waits for a suitable time for a net operation. Searching is one of the important steps of tuna purse seine fishing. After searching, however, if a fish school is not found or the fish school is not suitable for net operations (scattered or not big enough), aggregating methods will be used.

3) Aggregrating

A long time ago, fishermen learned by experience that fish aggregate around a drifting object in the sea. So, they made floating objects and put them into the sea; the Philippine fishermen make a bamboo raft under which coconut fronds are attached, and set it in the sea fixed with an anchor. This is called a "PAYAO". This is well-known among the purse seiner fishermen, especially tuna purse seiners. There are many types, designs and styles in various parts of the world, but they play the same role as "Fish Aggregating Devices" (FADs). There are two different settings. For certain fishing grounds (not a wide area), anchorage FADs or PAYAO are set, but on wider and oceanic waters, drifting FADs are used. Fishing grounds around the Seychelles are very wide, so drifting FADs (PAYAO) are popular among Japanese purse seiners. Spanish, French and Russian purse seiners prefer searching for fish schools rather than using FADs or PAYAO fishing.

The FADs of the NIPPON-MARU were quite specially designed, made of used materials, iron frames, bamboo, net rope, plastic sheet and others. (see Annex III)

Setting the FADs will depend on the condition of the fish at the fishing ground. The fishing master will decide to set FADs when he finds a lot of bait at the fishing ground but few fish, or when the location has yielded good catches in previous years, or when some small drifting object is found with a good number of fish around it. So about 6-10 FADs are set near the drifting object with a radio buoy attached and a distance of about 15-30 nautical miles between each. Usually, fishing conditions around FADs will be good enough for net operations about two weeks after setting. At the fishing grounds in Seychelles waters it is sometimes quite difficult to use this method because there are a lot of fishing vessels after the same target but all using different methods, so a lot of FADs and radio buoys are lost.

4) Fishing operation

After a school or drifting objects are found, the condition of the school is confirmed by binoculars, sonar and echo-sounder, then net operations will be designated. The fishing operation is carried out on three different fishing conditions - fish schooling, fish aggregating at a drifting object and fish gathering around FADs, all of which require different fishing techniques.

a) Fish schooling

This type of fishing condition is the most difficult method, because fish schools usually move very fast in the day time. There is only a very short time, about 30-50 seconds, to use the surrounding net while the fish feed on bait on the surface. The fishing master has to control the following of the school until the position of the vessel, direction of fish school movement, and direction of current and wind are fit to start surrounding with the net. If all these factors are not ready at the same time, the fish escape from the surrounding or the net operation is in trouble. (Fig. 3)

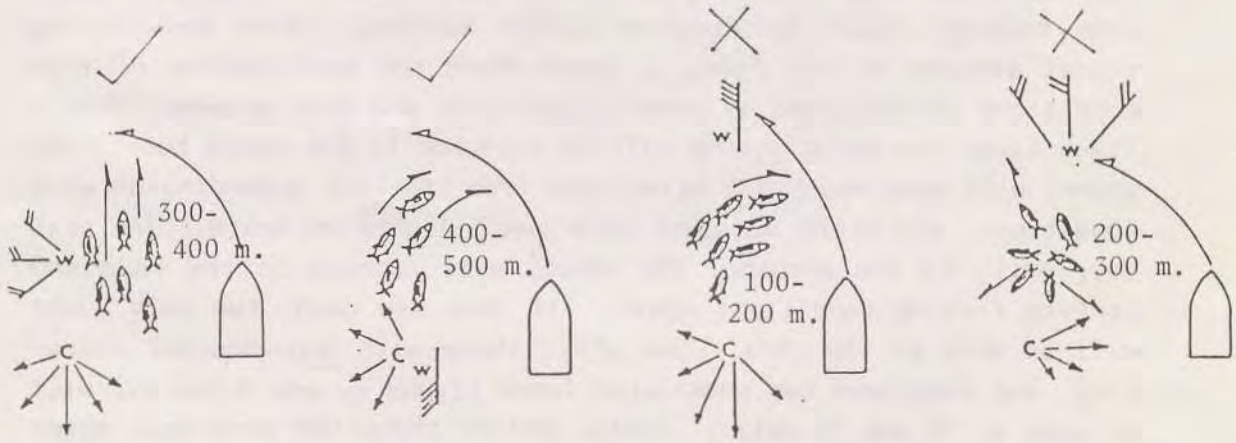


Fig. 3 Net conditions for shooting

After the surrounding by the net is complete, work boats must be released quickly to chase the fish into the net opening until it is closed, at the purse line too. Then the other steps of net operation continue until the operation is finished.

b) Fish school aggregated with a drifting object

When it is confirmed that fish are under the object or nearby and not moving much, net operations are started, usually around noon time. If the school is still moving around and is far from the object, a radio buoy with a light will be attached to the object for net operations early the next morning. If the object is small, FADs will be set to accompany it. In the case of immediate net operation, two work boats are released to stay at and around the object with echo-sounder operating, in order to confirm the fish school condition by tele-sounder on the net boat. Then net surrounding is started and continues until the operation is completed. (Fig. 4).

c) Fish school gathering around FADs (PAYAO)

Usually, fishing on FADs or PAYAO is designated for the early morning, starting before sunrise (0430-0530 am.). Purse line hauling should be finished before sunrise. When the fishing vessel arrives at the FADs, a rough check and confirmation of fish conditions is conducted by sonar, binoculars and echo-sounder. Then a flash light sun value system will be attached to the radio buoy. The vessel will keep about 3-5 miles away from the FADs depending on wind conditions, and drift at night with small lights on board. The next day, early in the morning, the vessel will proceed to the FADs and confirm fishing conditions again. If they are good, two work boats will be sent to the FADs. One stays there with echo-sounder operating, and sometimes two underwater lamps (2,000 w. and 3,000 w.) will be used at 10 and 20 meters depths, whilst the other work boat moves slowly around the FADs. The fishing master will make a last confirmation by tele-sounder from the two work boats. After everything is confirmed, net operations will start. (Figs. 5 and 6)

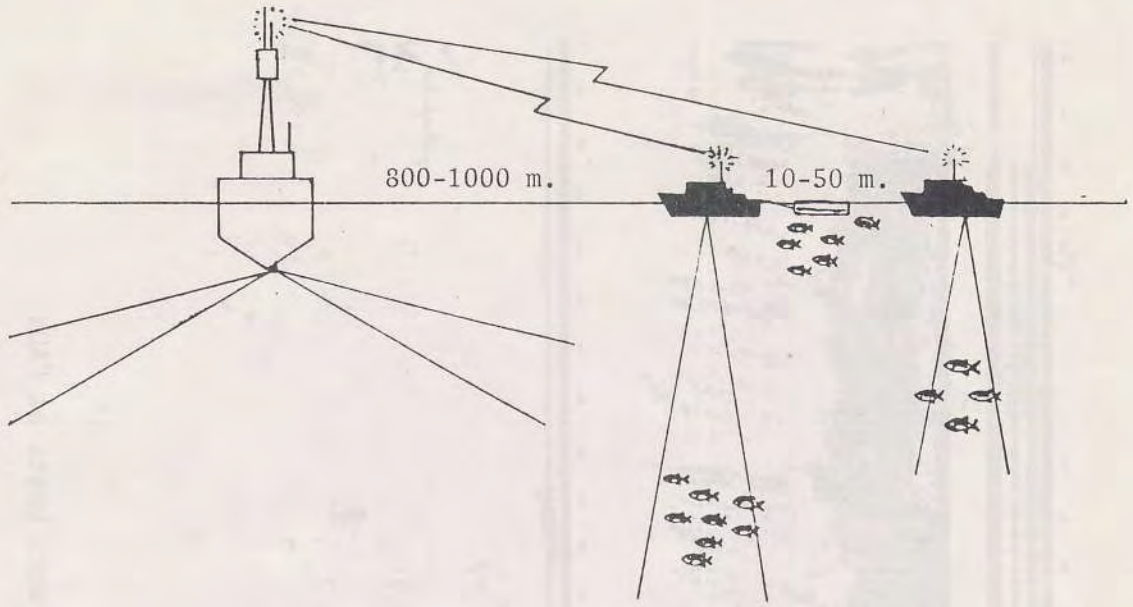


Fig. 4 Fish confirmation at drifting object by tele-sounder

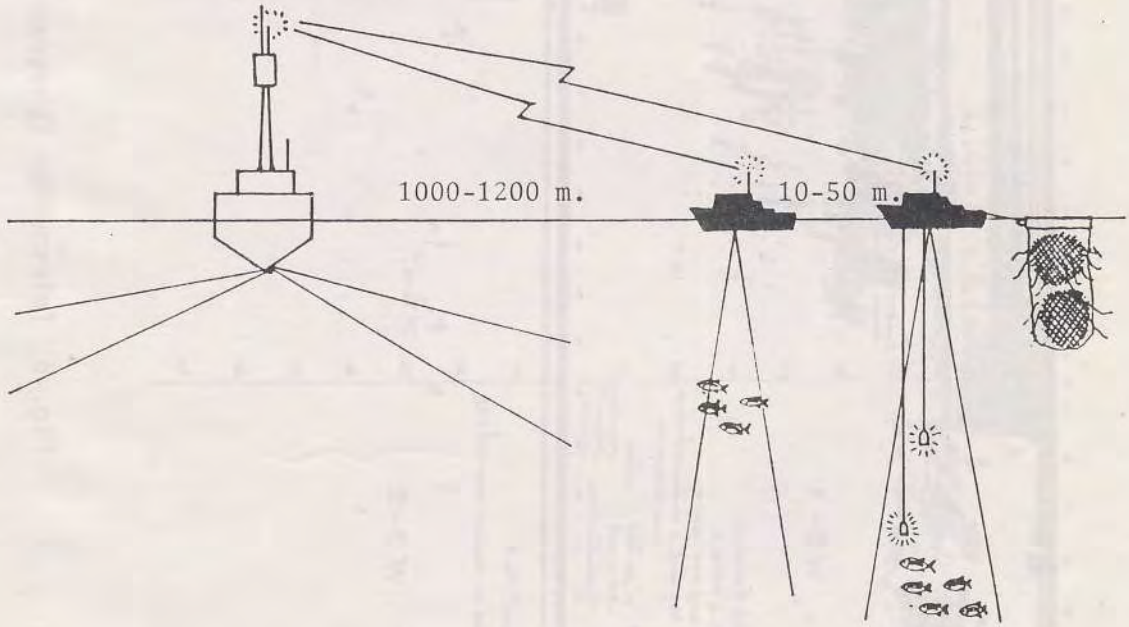


Fig. 5 Fish confirmation at PAYAO or FADs by tele-sounder

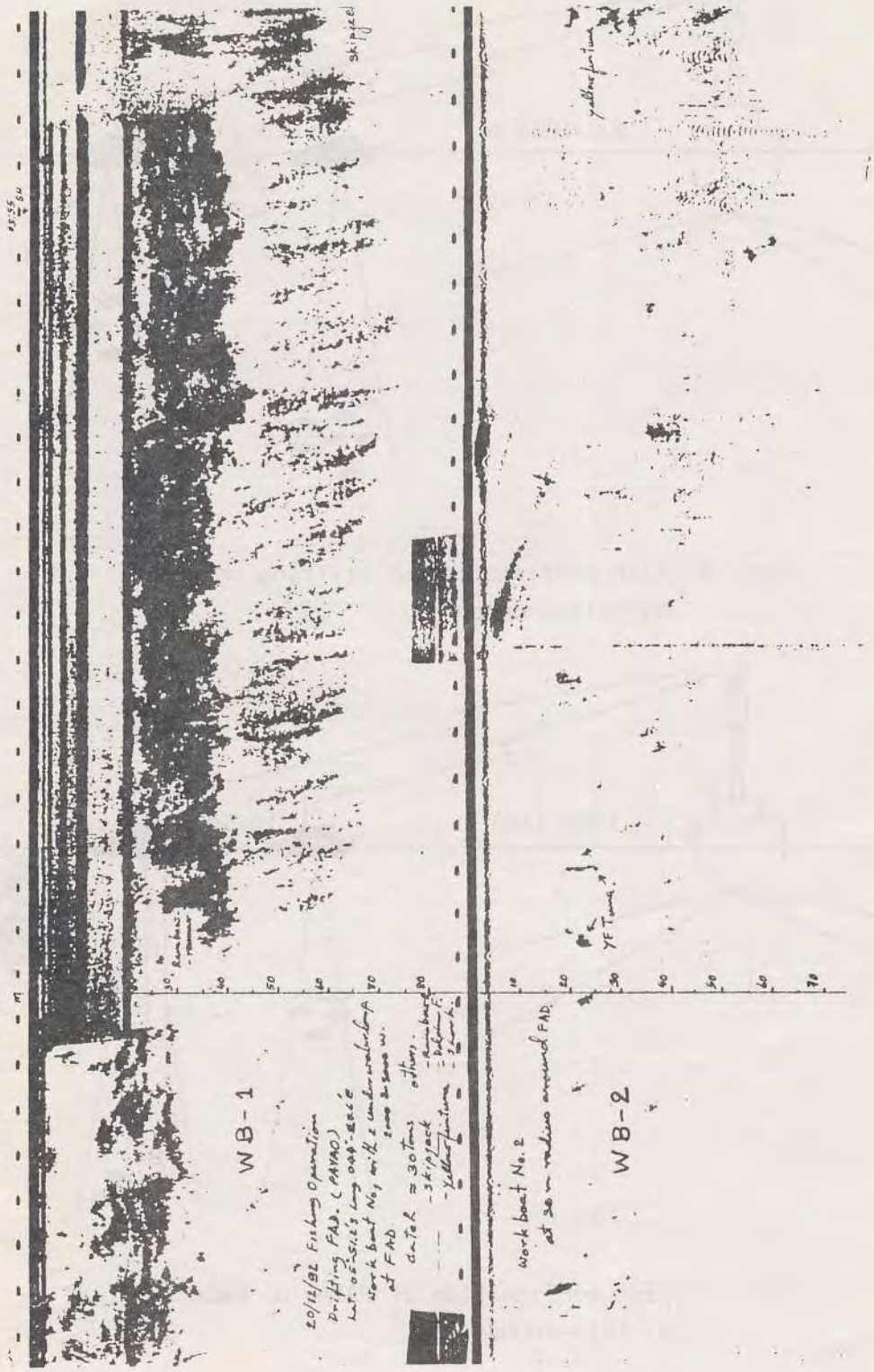
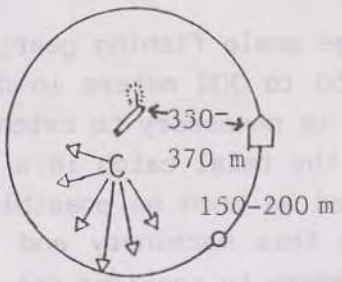


Fig. 6 Telesounder Echogram from two work boats at FADs

5) Net operations

Tuna purse seine is quite a large scale fishing gear, the net is very big, about 1,500 meters long, 250 to 300 meters in depth and total weight of about 30-40 tons. This is necessary to catch big fish like tuna, in large schools; sometimes the total catch in a haul is over 100 tons. Mechanical help is needed as much as possible in these operations. Of course, working with this machinery and with such big loads, is dangerous, and it is necessary to consider not only catch efficiency but also crew safety while working on deck. Net operation will be smooth if it is started from the correct position, with efficiency, and at the correct time. The most important factors which the fishing master must take into consideration together with fish conditions, are current and wind to avoid net trouble during operations. The current should not be too strong (more than 1 knot) and directed away from the vessel at the stern when the surrounding is finished. If the wind is strong (more than 10 knots) the direction of starting shooting must follow the wind direction. (Fig. 7)

The net of NIPPON-MARU is 1,500 meters long and 250 meters deep, with a total weight of about 40 tons. When operating its net, the vessel proceeds to the point of shooting slow ahead and increases to half ahead (8-9 knots) before starting to shoot. Usually the fishing master keeps about 350-370 meters distance between the start of the shooting point and the fish school. The fishing master of NIPPON-MARU never made a complete circle within the length of the net; he always kept a gap between the net ends of about 100-200 meters. This is to avoid net trouble when purse line hauling. Then, after transferring all the wire end to the net boat, the skiff boat comes to the stern of the net boat and pulls her to make closing of the net faster. When both ends of the net are onboard, the skiff will tow the towing line on the opposite side of the net to open the net, and adjust the net boat for more convenient net hauling after the purse line hauling is finished. Net operations will go on step by step.

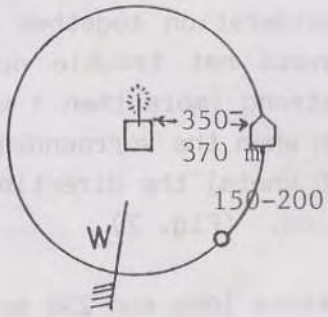


A

A. Target moving within small area (fish at drifting object such as log or FADs)

- distance between starting point to target (fish school) 350-370 m
- net end gap should be about 150 to 200 meters

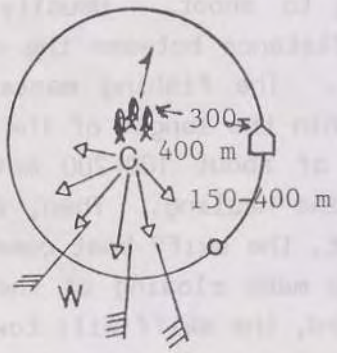
Wind not so strong, current should be considered as Fig. A. (should not be over 1 knot)



B

B. Same target and object conditions as above, but

- the wind is very strong (more than 10 knots), shooting should be with wind direction



C

C. Object is fish schooling at surface.

Shooting direction; should be along fish school direction; current and wind must be taken into consideration too, as Fig. C.

Fig. 7 The conclusion of net shooting

Net operations consist of fish surrounding, net enclosing, purse line hauling, ring transferring, net hauling, bunt taking, catch transferring, net and purse line rearranging, work boats and skiff boat taking up, so that net operation is complete and ready for the next operation. (Fig. 8) The crew stations while net operations are conducted are as shown on Fig. 9.

6) Fish preservation onboard

Usually, the catch of each tuna purse seine operation is quite big and is onboard all at the same time. The general dry freezing system could not preserve such a large amount of fish. So a brine freezing system is applied for the first stage and the dry freezing system used later to keep the catch in good condition. Before the fishing operation, brine water is made and stocked in the fish hold at a temperature of -15°C to -18°C. Large volumes of brine are made by dissolving salt in seawater at a ratio of about 1:4 (salt 1 ton; seawater 4 m^3). This is then mixed up by using a submersible pump to circulate the mixture in the fish hold. While mixing the solution, the specific gravity must be checked by hydrometer until it is up to 23.5. The solution is then transferred to another fish hold where it is brought to a temperature of -15°C to -18°c and kept at that level. The brine water preparation and brine stock is kept on standby for the catch. (Fig. 10) The remaining salt will be used again until it is all finished.

Catch preservation onboard starts from the time the net operation is carried out. Brine solution is transferred to the standby fish hold, to about 1/3 - 1/2 of its volume. After the catch has been put into the fish hold, brine is added until full. In order to preserve the quality of the fish, the hold should not be filled to full capacity, 10% should be saved. The fish are kept in brine over night, and then their condition is checked the next day; fish should stay in the brine for one more day to make sure they are frozen through. They should not be kept in brine for too long. After that, the brine is transferred and kept as stock in another standby fish hold. The fish are then dry frozen and kept at a temperature of -30°C to -33°C until unloading time.

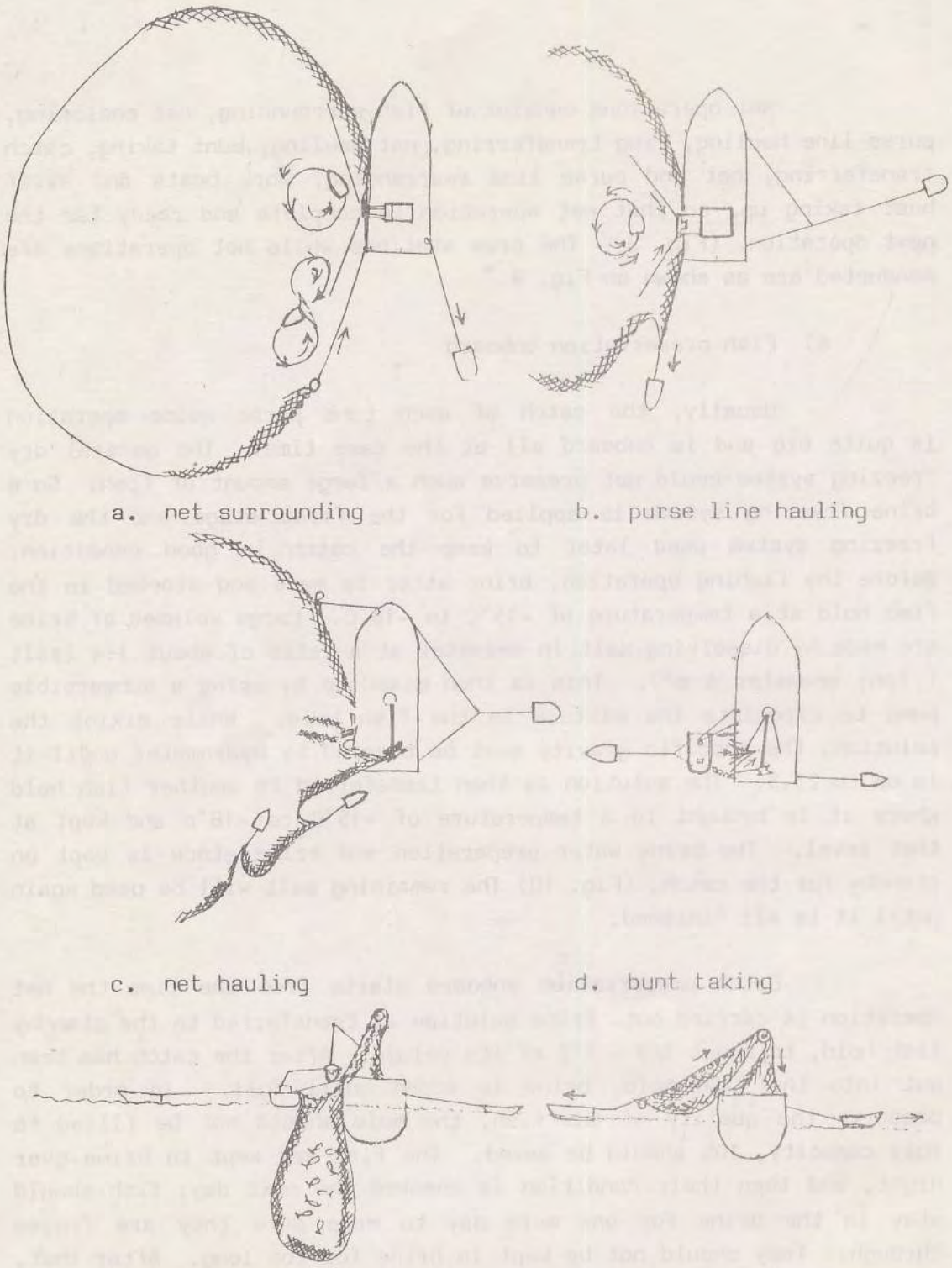
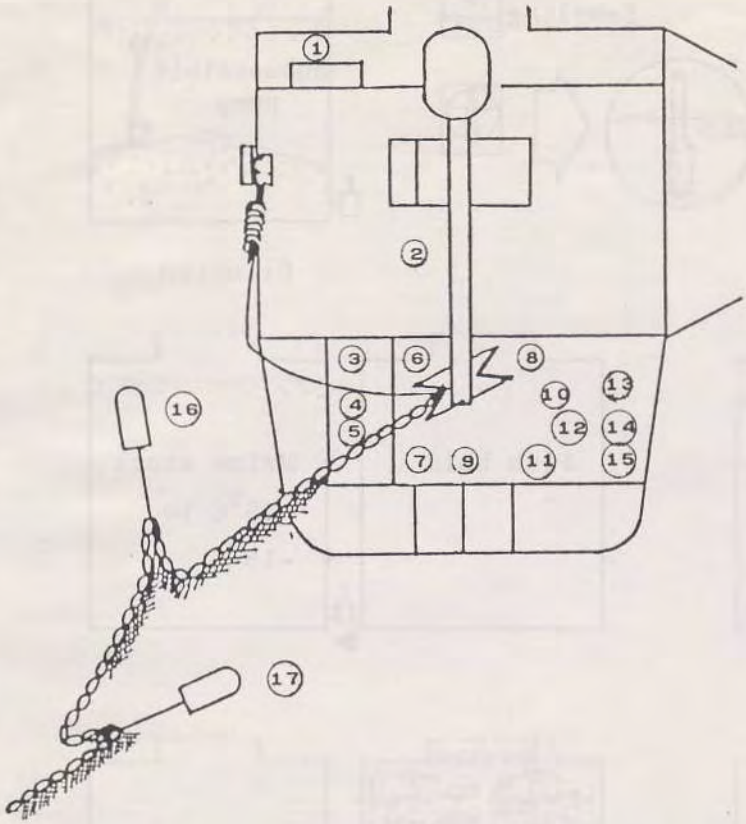


Fig. 8 Net operation of tuna purse seine fisheries



① - blocks & booms controller
② - deck boy
③-⑤ - sinker arranging
⑥-⑫ - net arranging
⑬-⑮ - float arranging
⑯ - work boat No. 1
⑰ - work boat No. 2
⑱ - skiff boat

Fig. 9 Crew stations while conducting net operation

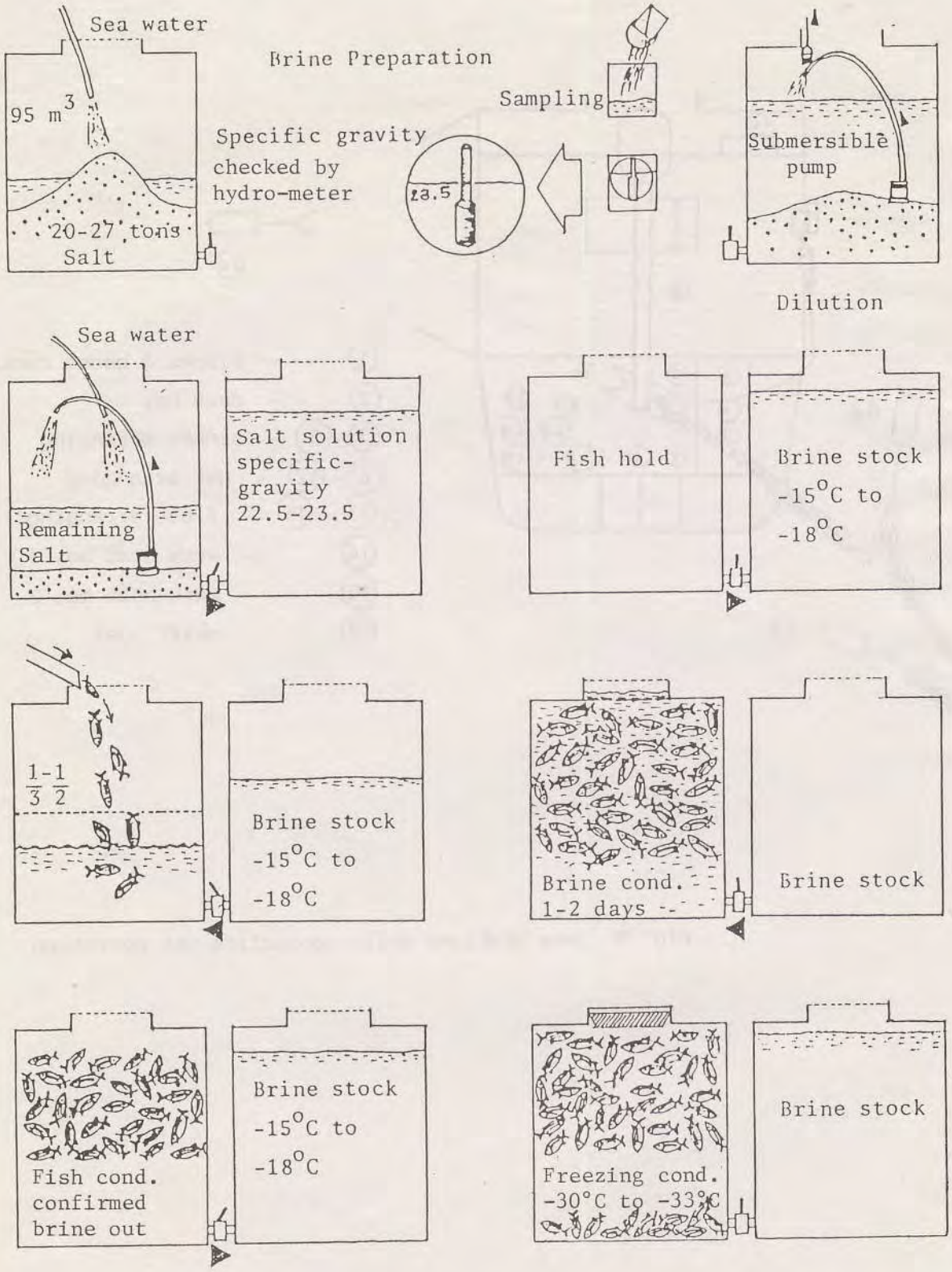


Fig. 10 Fish preservation onboard tuna purse seiner

7) Research on tuna biology

While the NIPPON-MARU was carrying out fishing operations, a researcher from JAMARC conducted research surveys on tuna biology. The sampling length, weight, stomach content, gonad stage, and tagging on skipjack and yellowfin tuna were conducted in every operation. The thermocline of the fishing ground was also surveyed using the bathy-thermograph (XBT). This data and fishing ground information was sent to JAMARC, Tokyo everyday, for analysis of tuna fishing conditions in this fishing ground. This study is very useful for both fishermen (purse seiner) and fisheries biologists for designating fishing grounds, fishing seasons and monitoring the tuna resource stock of the west Indian ocean every year.

V. Result

During the period from 8 November 1992 to 7 January 1993, NIPPON-MARU sailed for 61 days around Seychelles waters accept in the southern area. Large schools of tuna were found only in the east fishing ground. Twenty-six drifting FADs (PAYAO) were set, six units in the east fishing ground and twenty units on the west fishing ground. Due to so many purse seiners operating in the east fishing ground, four FADs were lost, only two operations could be conducted and the catch was poor. Six FADs on the west fishing ground were left in the sea for more than one month with no one touching them, they drifted about 200-300 nautical miles to the west of their setting location. Two of them drifted into Somalia and Kenya EEZ waters and fishing could not be conducted. The others four FADs were still in international waters, and fishing operations were carried out several times on each one; catch varied from 15 to 42 tons of skipjack and yellowfin tuna. The other 13 FADs were set only 1-2 weeks before the end of the cruise, five of them were used for fishing, with 4-17 tons of catch. Twelve drifting objects were found, eight on the east fishing ground and four on the west fishing ground. The biggest catch was on a drifting log in the east fishing ground, four fishing operation were conducted on this object and the catches were 95, 5, 103 and 14 tons. The catch was mostly skipjack (*Katsuwonus pelamis*)

and yellowfin tuna (*Thunnus albacares*). The others were a mixture of little tuna (*Enthynnus affinis*), dolphin fish (*Coryphaena hippurus*), rainbow runner (*Elegatis bipinnulata*), shark (*Carcharynus* spp.), horse mackerel (*Decapterus* sp.), and leather jacket (*Abalistes* sp.). Almost 40 fishing operations were conducted during the cruise, 19 times on FADs, 14 times on drifting objects and seven times on fish schooling. (see Table 1 and Annex IV) Total catch on this cruise was about 670 tons of skipjack and yellowfin tuna, other fishes were thrown away and only shark fins were collected.

VI. Discussion

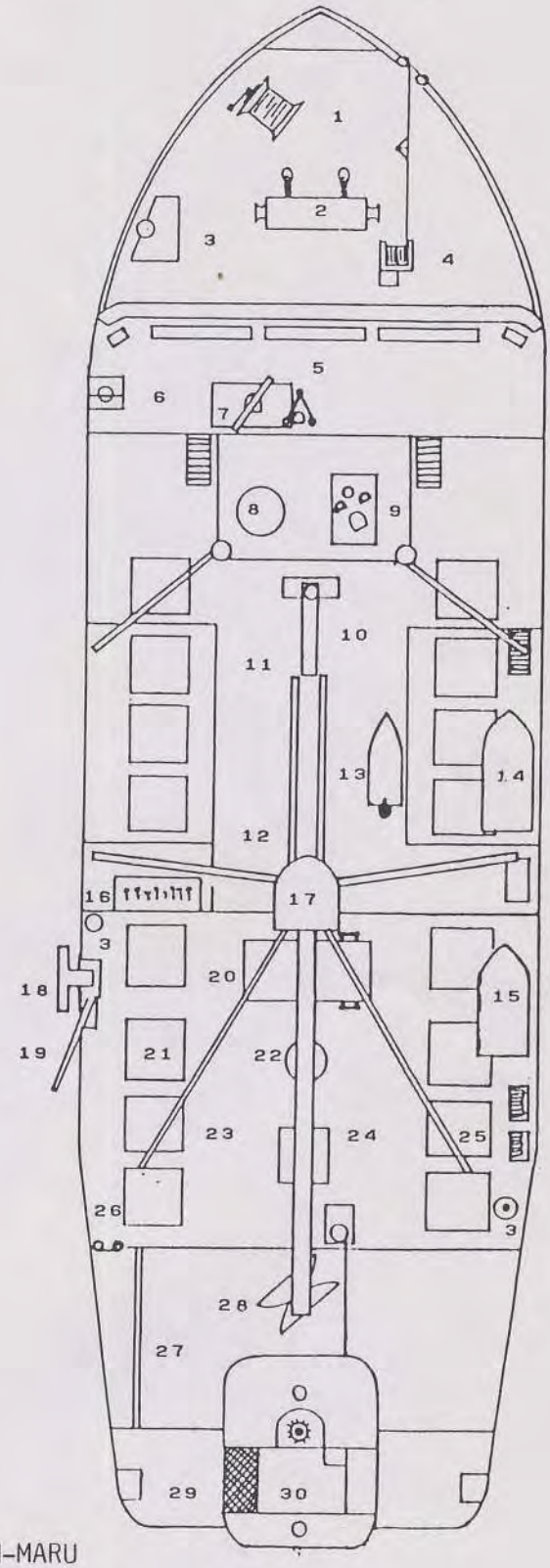
NIPPON-MARU is a modern tuna purse seine fishing vessel, fully equipped for fishing, navigation, communication, engine and power supply, and also with accommodation facilities. She is highly efficient for long fishing cruises at sea, up to 61 days, and has a maximum capacity fish hold up to 1,150 tons. The design of this vessel is very efficient, providing the most convenient fishing facilities such as the wheel control console and fishing instrument's room being close together on the high bridge deck with a clear view to the stern deck. Blocks, booms and some winches are on one control console too.

There were 19 officers and crew onboard. They were very active people, everyone having their own duty, but while on fishing operations or others activities onboard, they all joined in. This system was very good and meant that work could be finished within a short time. The total catch of 670 tons valued at about US$ 402,000 for the two months, is good income for a 1,200 gross tonnage purse seiner in these fishing grounds. There were, however, many purse seiners operating there (about 70 or more), so the catch may decrease in the future. A not so small amount of other fishes were thrown back into the sea, rainbow runner, little tuna, horse mackerel, dolphin fish, shark and leather jacket, because there is no market in the Seychelles. We should be able to make better use of this by-catch.

Tuna purse seine is a large scale fishing gear, it needs big investment and is also quite dangerous for the people working onboard ship. Nowadays, after the establishment of EEZs and the international law of the sea, the fishing ground for tuna purse seining has become limited to seas such as the West Indian Ocean and South Pacific Ocean, so that it is necessary to carry out tuna purse seine fishing under joint venture fishing operations with the rich tuna resources countries. Training and studying for the people who are going to work onboard or carry out tuna purse seine fishing is needed in the future.

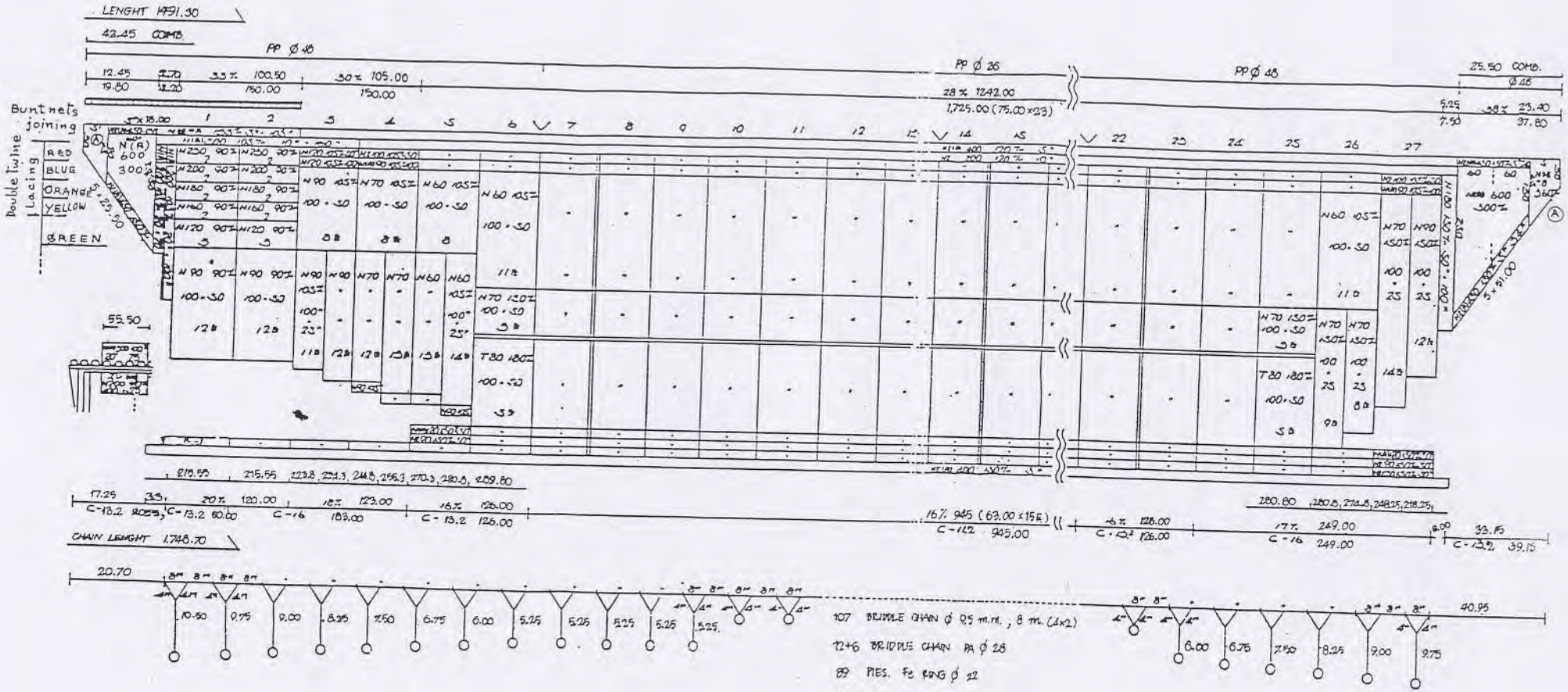
Annex I

1 skiff towing wrap drum
2 anchor winch
3 capstan winch
4 skiff towing wrap winch
5 high bridge deck
6 remote control wheel console
7 fishing instruments room
8 dome of Inmasat antenna
9 exhaust funnel
10 0.9 ton crane
11 upper deck
12 derick booms
13 speed boat
14 No. 1 workboat
15 No. 2 workboat
16 block and boom control console
17 high basket on main mast
18 davit
19 ring stripper
20 purse winch
21 fish hold hatch
22 fish hold funnel
23 fishing booms
24 main boom
25 choke winches
26 towing wrap guide roller
27 net space
28 power block
29 slip way
30 skiff boat



Deck equipment and machines on NIPPON-MARU

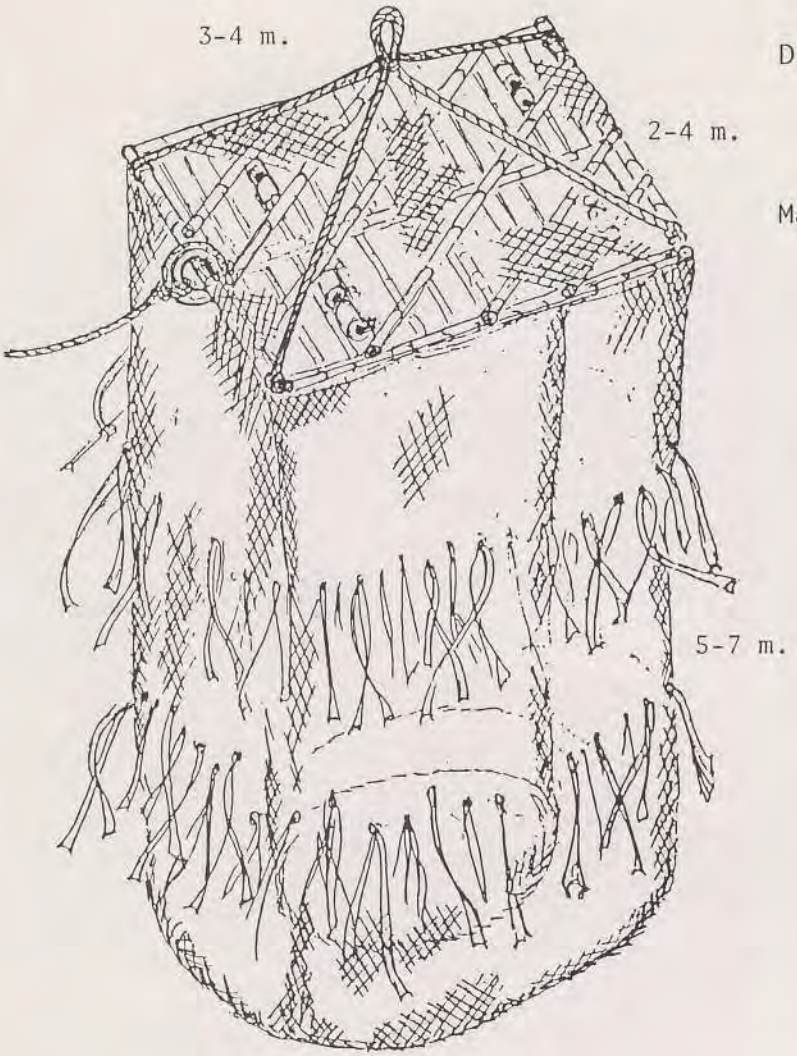
Annex II



Net construction design of NIPPON-MARU

Annex III

NIPPON-MARU DESIGNED PAYAO or FAD



Dimension - width 2-4 m.
length 3-4 m.
depth 6-8 m.

Material - Frame - substand wood or Iron frame
- Bamboo
- 4 floats

Hanging rope
- Nylon ϕ 20 mm.

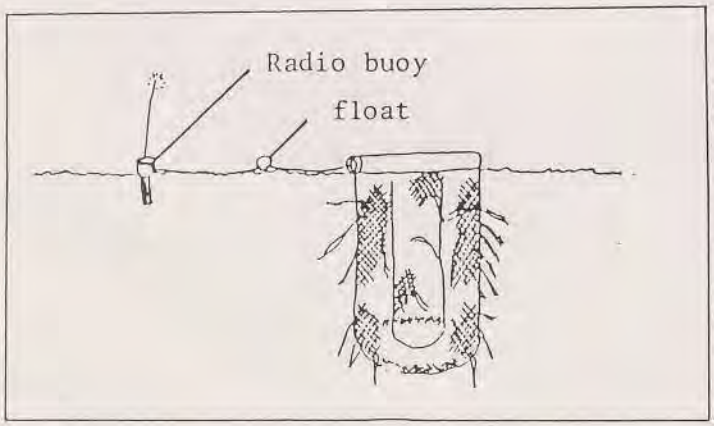
Towing rope
- Nylon ϕ 30 mm.
- used tyre

Cover net
- used fish basket net PE ϕ 4 mm, # 90 mm.

Hanging net (inner & outer)
- Nylon No. 120-230 # 90 mm, 5-7 m.

Sinker
- used wire ϕ 16-28 mm.

Branch
- PE rope filament (Black & white)
- Plastic sheet (Black) 0.2x3-4 m.



Annex IV

Table 1. Description of each fishing operation

Serial No.	Date	Time Operation hrs./h:m.	Position Lat. S	Position Long E	Fishing ground	Current Kt./Dir	Wind Kt./Dir	Sur.Water temp. °C	Thermocline layer m/°C	Fishing Object	Catch ton.	Composition main C%/Bye-C%	Remarks
01	19-11-92	0450-1110/5:30	05°-47.5'	58°-34.6'	near E	0.4/S	1-2/NNW	27.6	-	Drifting log	95	95/5 (RR,HM,LT,SK,DF)	main catch
02	20-11-92	0448-0820/3:32	05°-23.0'	58°-27.6'	near E	0.4/E	2/N	28.0	-	Drifting log	5	80/20 (" ")	- Skipjack - SJ
03	21-11-92	0825-1200/3:35	05°-30.0'	62°-35.0'	far E	0.4/NNW	1-2/NE	-	-	Schooling	45	99 (YFT & SJ)/1 (SK)	- Yellowfin tuna - YFT
04	21-11-92	1255-1450/1:55	05°-06.0'	62°-44.4'	far E	0.4/NW	2-4/S	28.7	-	Schooling	-	-	bye catch
05	21-11-92	1540-1830/2:50	05°-03.8'	62°-38.0'	far E	0.8/NW	3-5/SE	28.7	-	Schooling	7	100 (YFT & SJ) 10	- Rainbow runner - RR
06	22-11-92	1038-1430/4:08	05°-21.1'	62°-32.5'	far E	0.4/NNW	3-5/SW	28.1	-	Schooling	28	100 (YFT,SJ) 10	- Horse mackerel - HM
07	23-11-92	0955-1215/2:20	05°-08.1'	62°-47.9'	far E	0.5/SSW	1-3/SE	28.4	-	Schooling	-	-	- Little tuna - LT
08	23-11-92	1540-1800/2:20	05°-04.0'	63°-02.0'	far E	0.4/SE	3-5/SSE	28.3	-	Schooling	-	-	- Shark - SK
09	25-11-92	0433-0855/4:22	04°-49.3'	63°-14.1'	far E	0.3/SSE	10-15/SSW	28.7	-	Drifting log	12	92/8 (RR,LJ,HM,SK)	- Dolphinfish - DF
10	27-11-92	0502-0815/3:13	05°-46.2'	58°-24.2'	near E	0.5/E	1-2/NNE	-	-	Drifting log	24	96/4 (RR,DF,LJ)	- Leather jacket - LJ
11	28-11-92	0455-0930/4:35	04°-23.0'	58°-02.3'	near E	0.7/N	5-8/SSW	27.8	-	Drifting log	104	99/1 (SK,RR,HM)	
12	29-11-92	0456-0750/2:54	05°-39.7'	57°-58.1'	near E	0.7/NE	5-7/WNW	28.5	-	Drifting log	1	80/20 (RR,LJ)	
13	30-11-92	0446-0755/3:09	06°-03.3'	57°-16.8'	near E	0.3/N	5-7/SE	28.4	-	Drifting log	4.5	90/10 (RR,DF)	FAD - Fish Aggregating
14	01-12-92	0433-0840/4:06	04°-16.8'	59°-08.9'	near E	0.3/SW	5-7/SE	27.8	-	Drifting log	15	95/5 (RR,SK,DF)	Device or PAYAD
15	01-12-92	1245-1600/3:15	04°-33.0'	59°-52.4'	near E	0.5/ESE	3-5/SSW	28.5	-	Drifting wood	3	85 (YFT)/15(SK,DK,LJ)	
16	03-12-92	0433-0740/3:07	04°-30.0'	63°-15.5'	far E	0.3/SE	15/SSW	28.3	-	Drifting log	5.5	95/5 (RR,LJ,SK)	
17	04-12-92	0425-0740/3:15	04°-16.6'	64°-03.0'	far E	0.5/SSE	18/W	28.3	-	Drifting wood	4	90/10 (DF,LJ,HM)	
18	05-12-92	0422-0800/3:38	04°-02.6'	64°-45.9'	far E	0.8/S	10-12/W	28.1	30-100/-15°	Drifting log	12	85/15 (RR,DF,LJ,HM,SK)	
19	06-12-92	0425-0800/3:35	03°-12.6'	65°-23.5'	far E	0.7/SSW	8-10/SW	28.3	28-80/-16	Drifting log	6	35/65 (HM,RR,DF,SK,LJ)	
20	08-12-92	0433-0800/3:27	03°-14.1'	62°-28.7'	far E	0.4/SW	3-5/S	28.2	-	Drifting FAD	4	50/50 (DF,LT,SK)	
21	09-12-92	0709-0950/2:41	04°-51.1'	60°-13.3'	near E	0.2/NNE	0-3/NE	28.3	-	Schooling	-	-	
22	11-12-92	0503-0745/2:42	04°-40.6'	59°-02.0'	near E	0.8/WNW	13-15/NNE	28.6	-	Drifting FAD	0.2	-/100 (DF,SK)	
23	14-12-92	0540-0940/4:00	05°-25.9'	49°-40.6'	near W	0.6/SW	12/SE	28.5	50-100/-13	Drifting FAD	36	90/10 (DF,LT,LJ)	
24	15-12-92	0600-0930/3:30	04°-50.0'	45°-55.6'	far W	0.8/W	10-12/SE	-	-	Drifting FAD	25	95/5 (DF,LT)	
25	16-12-92	0545-0940/3:55	03°-28.0'	44°-26.0'	far W	0.5/W	6-8/WSW	28.1	50-100/-15	Drifting FAD	26	99/1 (DF,LJ)	
26	17-12-92	0547-1015/4:28	05°-22.9'	45°-50.0'	far W	0.4/NNE	6-8/E	28.3	20-90/-14	Drifting FAD	42	95/5 (DF,SK,LJ)	
27	19-12-92	0545-0900/3:15	05°-46.1'	45°-45.8'	far W	0.7/NNE	6-8/NNW	28.4	-	Drifting FAD	9	99/1 (DF,LJ,SK)	
28	20-12-92	0555-1000/4:05	05°-51.2'	44°-27.6'	far W	0.6/NNE	4-5/N	28.4	50-120/-14	Drifting FAD	31	80/20 (RR,DF,LT)	
29	22-12-92	0535-0905/3:30	05°-13.4'	49°-54.0'	near W	0.5/SW	2-4/SE	28.5	50-120/-14	Drifting FAD	23	95/5 (DF,SK)	
30	24-12-92	0529-0830/3:01	06°-30.7'	51°-53.7'	near W	0.6/NNW	3-5/SE	27.9	30-100/-14	Drifting Bam.	1	100 (SJ)/-	
31	27-12-92	0545-1040/4:55	04°-38.9'	46°-52.0'	far W	0.3/W	10-12/E	28.8	-	Drifting FAD	34	90/10 (LT,DF)	
32	28-12-92	0552-0930/3:38	06°-04.8'	44°-29.5'	far W	0.7/SSW	10-12/NE	28.7	30-110/-13.7	Drifting FAD	15	100/-	
33	29-12-92	0555-0845/2:50	03°-47.8'	44°-25.9'	far W	0.5/NNW	10-12/NE	28.5	30-100/-15°	Drifting FAD	1	50/50 (DF,LJ,SK,HM)	
34	31-12-92	0538-0840/3:02	05°-53.6'	49°-13.9'	near W	0.9/WNW	6-8/ENE	29.3	25-100/-14.5	Drifting FAD	2.5	80/20 (DF,RR,SK)	
35	01-01-93	0542-0930/3:48	06°-12.8'	49°-02.1'	near W	0.7/S	4-5/WSW	29.3	35-100/-15	Drifting FAD	17	100/-	
36	02-01-93	0538-0910/3:32	06°-34.2'	48°-17.2'	near W	0.8/NWW	2-4/ENE	29.2	30-120/-15	" FAD+log	12	80/20 (RR,HM,DF,LJ,SK)	
37	03-01-93	0531-0910/3:39	06°-15.5'	47°-55.7'	near W	0.9/W	8/W	29.4	30-100/-16.8	Drifting FAD	15	100/-	
38	03-01-93	1043-1330/2:47	06°-30.0'	47°-44.4'	near W	0.9/N	5-8/W	29.5	25-100/-17.0	Drifting FAD	14	100/-	
39	04-01-93	0547-0900/3:13	06°-33.0'	47°-47.1'	near W	0.3/W	10/NE	29.5	20-60/-20	Drifting FAD	4	100/-	
40	05-01-93	0534-0900/3:26	05°-12.1'	48°-55.6'	near W	1.0/NNE	6-8/NNW	29.1	30-110/-14.5	Drifting FAD	17	95/5 (RR,DF,LT)	
Total Catch											699.7	SJ & YFT - 670.0 tons others - 27.7 tons	

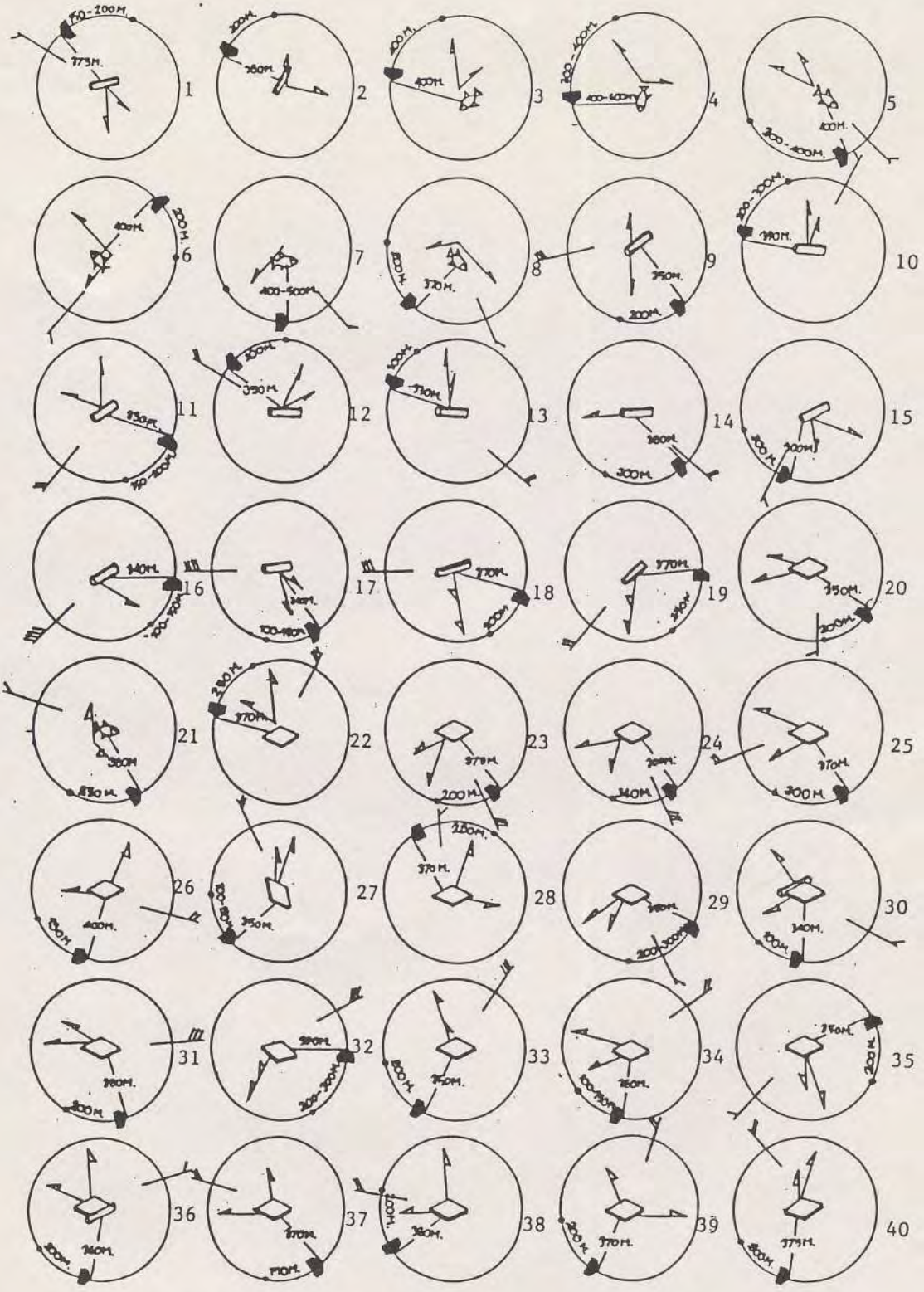
Annex V

Table 2. Time requirement for each fishing operation

Operat. No.	Date	Time hrs.	Operation time (min./hr:min.)									Catch
			NS	NE	PL	RT	NH	BT	CT	FIN	Total	Tons
01	19 11 92	0450-1110	7	200/18	32	3	1:42	1:15	1:12	50	5:00	95.0
02	20 11 92	0448-0820	7	200/10	43	3	1:03	0:30	0:10	40	3:32	5.0
03	21 11 92	0825-1200	5	400/-	-	-	-	-	-	-	3:35	45.0
04	21 11 92	1255-1530	7	300/18	35	3	1:05	-	-	40	2:35	-
05	21 11 92	1540-1840	-	-	30	-	-	-	-	40	3:00	7.0
06	22 11 92	1038-1430	-	-	-	-	-	-	-	-	3:52	28.0
07	23 11 92	0955-1210	5	200/12	30	3	1:05	-	-	30	2:15	-
08	23 11 92	1540-1800	8	200/10	29	5	1:00	-	-	30	2:20	-
09	25 11 92	0433-0830	7	150/10	30	4	1:30	40	15	40	3:57	12.0
10	27 11 92	0502-0815	8	200/14	31	6	50	50	20	30	3:13	24.0
11	28 11 92	0455-0930	8	150/10	31	10	1:10	50	1:05	30	4:35	104.0
12	29 11 92	0456-0740	7	200/9	29	4	50	30	10	30	2:44	1.0
13	30 11 92	0446-0730	10	100/5	25	4	1:00	30	5	30	2:44	4.5
14	1 12 92	0433-0840	6	300/9	35	5	1:20	30	30	35	3:57	15.0
15	1 12 92	1245-1600	7	100/8	33	5	50	30	5	30	3:15	3.0
16	3 12 92	0433-0740	7	100/8	30	10	1:15	20	10	40	3:07	5.5
17	4 12 92	0425-0740	9	100/8	25	5	1:22	27	5	35	3:15	4.0
18	5 12 92	0422-0800	8	200/10	29	3	1:23	28	10	50	3:38	12.0
19	6 12 92	0425-0800	8	250/13	25	7	1:17	27	10	50	3:35	6.0
20	8 12 92	0433-0800	6	200/11	30	4	1:22	24	10	45	3:27	4.0
21	9 12 92	0709-0950	7	250/12	36	4	1:05	25	-	45	2:59	-
22	11 12 92	0503-0745	7	250/12	33	4	1:00	20	5	30	2:48	0.2
23	14 12 92	0540-0940	7	200/9	30	3	1:20	50	30	40	4:00	36.0
24	15 12 92	0551-0930	8	340/14	37	3	1:05	40	20	45	3:39	25.0
25	16 12 92	0545-0940	8	300/12	32	4	1:20	40	20	45	3:55	26.0
26	17 12 92	0547-1015	7	150/7	30	5	1:20	50	40	55	4:28	42.0
27	19 12 92	0545-0900	5	120/8	36	5	1:00	25	10	40	3:15	9.0
28	20 12 92	0555-1000	7	250/12	38	3	1:27	35	20	40	4:05	31.0
29	22 12 92	0535-0905	7	200/11	29	4	1:13	32	30	30	3:30	23.0
30	24 12 92	0529-0830	7	100/8	23	3	1:00	30	31	45	2:59	1.0
31	27 12 92	0545-1040	7	200/9	42	3	1:30	1:10	25	40	4:55	34.0
32	28 12 92	0552-0930	8	200/11	25	3	1:25	28	15	45	3:38	15.0
33	29 12 92	0555-0845	7	200/12	34	3	1:05	15	5	35	2:50	1.0
34	31 12 92	0538-0840	5	100/7	34	3	1:10	25	5	40	3:02	2.5
35	1 1 93	0550-0930	7	200/8	26	3	1:44	27	15	40	3:40	17.0
36	2 1 93	0538-0910	7	200/10	30	3	1:15	37	10	45	3:32	12.0
37	3 1 93	0531-0910	7	150/12	33	3	1:16	40	10	45	3:39	15.0
38	3 1 93	1037-1330	5	150/8	28	4	57	26	10	30	2:53	14.0
39	4 1 93	0547-0900	7	200/11	28	3	1:24	26	5	35	3:13	4.0
40	5 1 93	0534-0900	7	200/9	31	3	1:17 *	25 *	17 *	40	3:26 *	17.0
Average			6.82	150-/ 200-10	29.65	4.14	1:00 - 1:30	20- - 50	5- 1:10	39.08	2:30- 5:00	ΣC/699.7

* Vary due to catch

Annex VI



Relation of current, wind, fish schools and shooting starting position of 40 fishing operations.

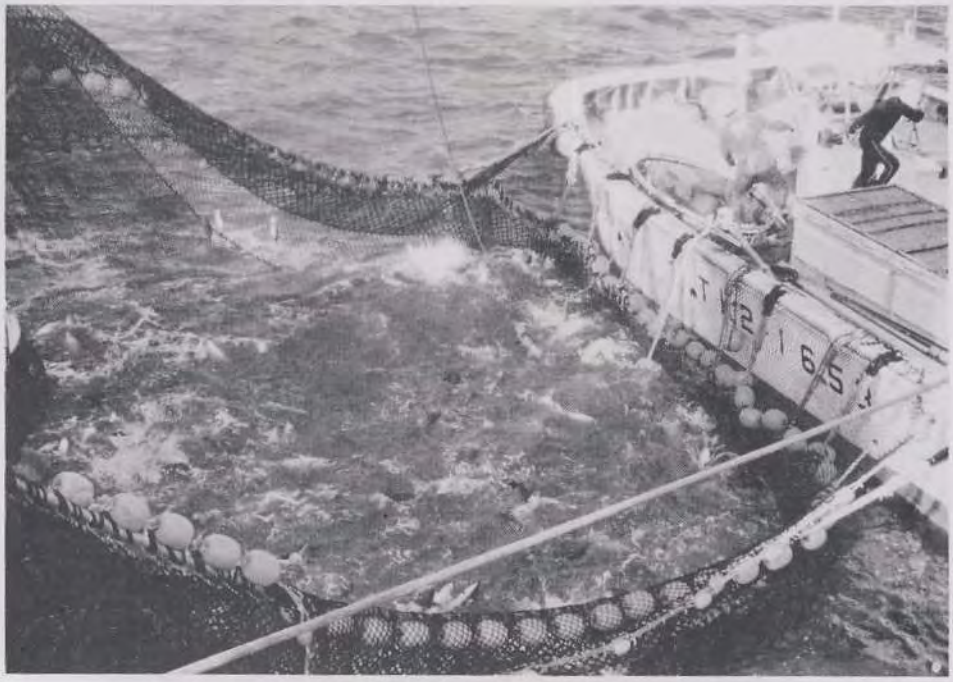
Annex VII

Tuna being transferred from fishing vessel to fish carrier at Port Victoria, Mahe Is., Seychelles

Tuna purse seiner "NIPPON-MARU" at Port Victoria, Seychelles

Net hauling onboard the NIPPON-MARU

Two workboats working on fishing operations together



Tuna in the bunt before transferring to fish hold onboard the fishing vessel

Big size yellow-fin tuna in the bunt being taken up on deck