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A REPORT ON TWO-BOAT BOTTOM TRAWL FISHING IN THE PHILIPPINES

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ABSTRACT

The two-boat bottom trawl adopted to Philippine condition was described. Observations of actual fishing with the use of the two-boat trawl were made. It was found that this preferrable method of fishing would be more adaptable in deeper areas than in comparatively shallow areas frequented by single boat trawlers.

INTRODUCTION

Two-boat bottom trawling is a method of fishing in which a conical-shaped bag net is dragged on the bottom of the sea by a pair of fishing vessels. Also called twin-trawling or bull trawling by Japanese fishermen, this method originated in Europe, (Scofield, 1948). Its Spanish name was *parega*.

Two-vessel trawling was practised in the coastal waters of Japan, the more distant grounds being fished by V-D type trawl (Scofield, 1948). Japanese fishermen modified the fishing paraphernalia to suit the conditions of Japanese fishing grounds.

Umali (1950) stated that several Japanese fishermen operated twin-trawling and otter trawling in the Philippines before and during the Japanese occupation.

Therefore, two-boat bottom trawl fishing has been in operation in Japan long before the outbreak of World War II. After the liberation of the Philippines from Japanese control, two-boat trawl fishing disappeared. However, during the post-liberation period

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the method one-boat trawl fishing gained popularity among local commercial fishermen and its popularity grew steadily through the years. In 1967, there were 600 units in operation in Philippine waters. This comprises 39% of the local commercial fishing fleet in existence.

Eight years after World War II, a fishing boat operator from Negros tried two-boat trawling but failed. This was possibly due to the lack of technical know-how about the proper operation. In the later part of 1967, two Filipino-owned fishing companies purchased three pairs of second-hand steel fishing vessels from Japan to be used for two-boat trawling in the Philippines. A third fishing company followed suit with a purchase of another two pairs of second-hand steel fishing vessels for the same purpose. These are the only outfits which are engaged in two-boat trawling in this country on a commercial scale at present.

Selection of fishing ground

In two-boat bottom trawling, the selection of the right type of sea bottom is very important. This is because of the nature of the gear which is characterized by a large net with heavy combination of towing rope and wooden-made bobbins or rollers attached to the ground rope. Such heavy materials make them unsuitable for dragging in soft and muddy bottom because the Dan Leno which is of iron construction often gets buried deep in the mud during dragging, thus causing frequent foul setting of the net. Furthermore, dragging the heavy combination of towing rope on this type of bottom causes adherence of big volumes of mud to the combination of rope warp. As a result, this imposes an extra load and resistance against the towing vessels. The extra load makes dragging unnecessarily difficult.

The first testing ground selected for two-boat bottom trawl operations in this study was Tayabas Bay in Luzon. The author supervised the fishing operations including the selection of the sea bottom terrain and the interpretation of the salient features in the fishing ground as reflected in the echo-sounding apparatus.

Table I shows the fishing grounds and areas being exploited by local two-boat trawlers since December 1967.

Vessel and Equipment

There are five two-boat trawlers operating in the Philippines at present. These are owned by three fishing companies. Figure 1 shows a typical two-boat trawl in the Philippines.

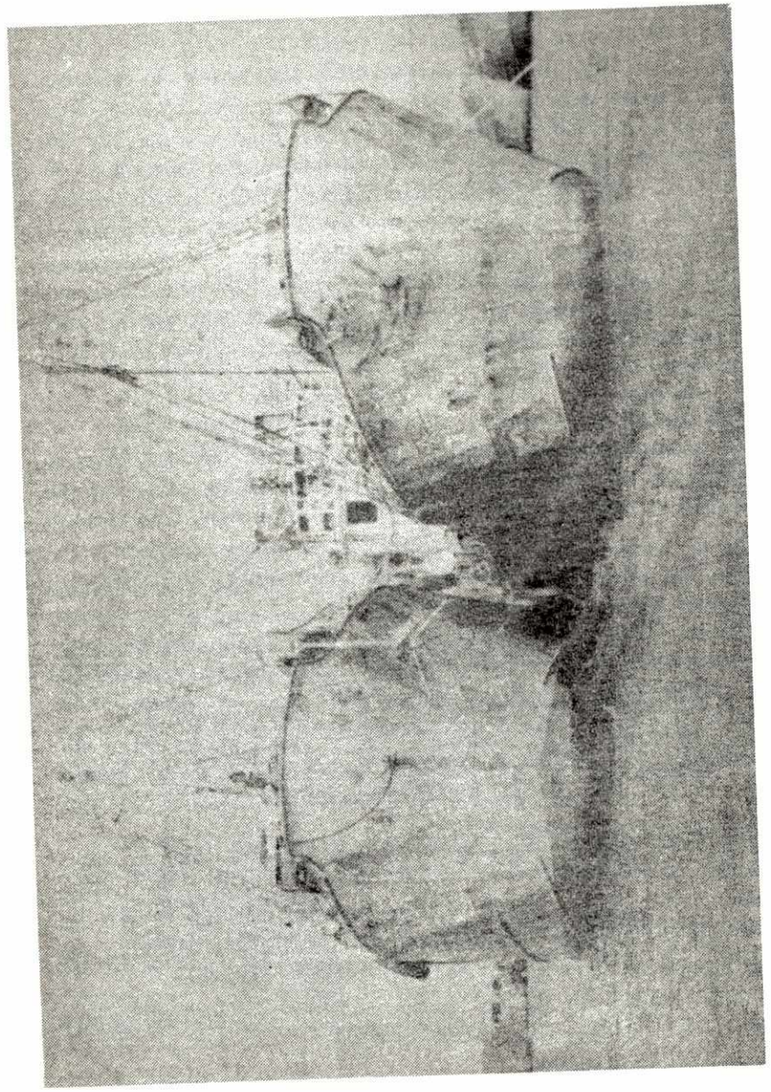

Fig. 1. A typical two-boat trawler anchored in Navotas fishing boat anchorage.

TABLE I. *Fishing grounds covered by local twin-trawlers.*

Fishing ground	Area Sq. miles	Average Depth in fathoms	NATURE OF BOTTOM
Tayabas Bay	350	35	Generally muddy-sandy bottom, coral bottom.
Approaches to Guimaras Strait from Panay	200	37	Muddy, coral and sandy bottom
Jintotolo Channel West of Zapato Island	250	29	Sandy-muddy and coral bottom
Bulalacao Bay in Southern Mindoro	80	37	Sandy-muddy and coral bottom
Samar Sea	300	38	Muddy-sandy bottom
Ragay Gulf	200	40	Sandy-muddy
Sorsogon Bay	120	35	Sandy-muddy

The local two-boat trawlers are of the standard Japanese type fishing vessels of the 100 G.T. class with the superstructure constructed amidship. Generally, this class of fishing vessel has an overall length of 26.80 meters, breadth of 5.30 meters; and depth of 2.60 meters. The cruising speed ranges from 8 to 9 knots.

Engine

Generally, the propulsions of these vessels are of the heavy duty type direct reversible low speed diesel engine with 380 r.p.m. and 330 b.h.p. respectively. Five (5) kilowatts and one (1) kilowatt generating units supply the overall power requirement of the boat. The fuel consumption rate is 13 gallons per hour at cruising speed and 13.5 gallons per hour at dragging speed of 2.5 knots to 3.0 knots.

Deck Rigging and Arrangement

Forward from the amid-ship wheel house is the working deck which extends to the base of the forecastle (Fig. 2). The catch is dumped for sorting on the working deck and then placed in the wooden containers or galvanized iron fish tubs. Beneath the working deck are two fish hold compartments. Local boats can accommodate 10 tons of crushed ice and 30 tons of fish. The hydraulic motor power reels are mounted on the starboard and portside of the foremast located behind the forecastle. The hydraulic motor powered reels are capable of winding the towing wire rope at a speed of about 70 rpm which maintains constant tension on the towing ropes from the gypsy head during the hauling operation. The gypsy head runs at 65 rpm or equivalent to a hauling speed of about 80.7 meters per

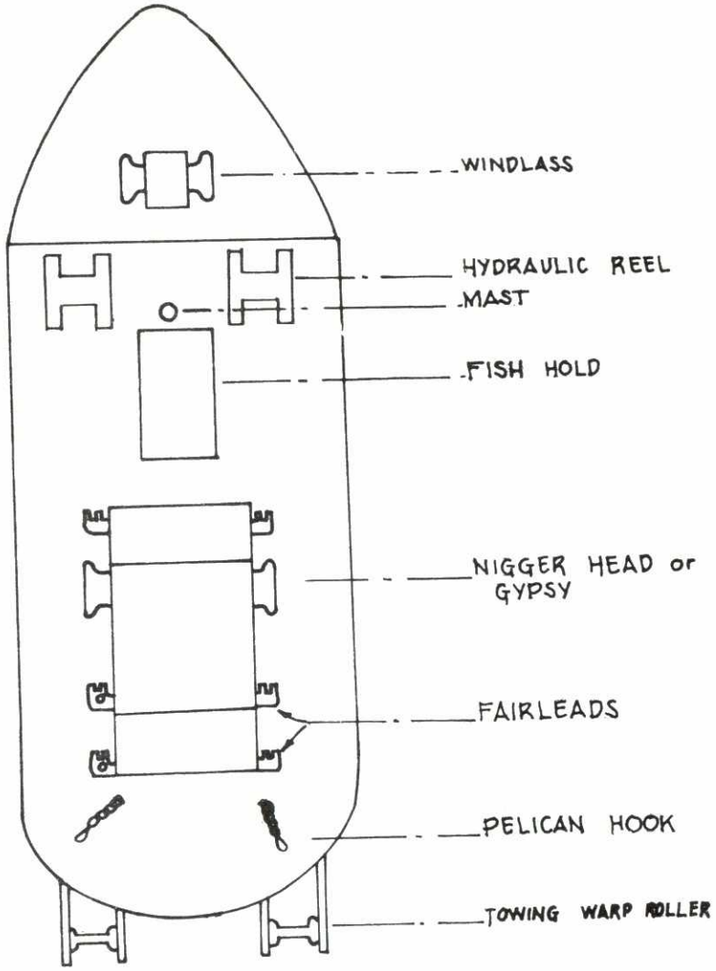

Fig. 2. Diagramatic Deck Rigging arrangement of a Local two-boat Trawler.

minute during a hauling operation. The combined hauling time is 75 per cent efficient in comparison with the gypsy type winch hauler of the local one-boat trawler. Two fairleads located on the starboard and portside of the engine house guide the towing ropes from two large protruding stern rollers which are aligned with the gypsy heads.

Forward of the gypsy are two fairleads, which are located on each side of the wheelhouse. The stacked net is on the starboard side of the vessel of the fishing commander. The fairleads are at the foremast base and at the starboard side. The fairleads located forward of the gypsy at the portside of the wheelhouse is used as guide in hauling the briddle line. In the case of the assistant commander fishing vessel, the hauling technique is reversed because the stacked net is located on the portside of the vessel.

Other deck accessories used in the hauling operation consist of two pelican hooks connected to the welded iron ring by a galvanized chain 50 cm. long at each opposite side of the base of the stern and of the engine house. These hooks hold the right and left connecting link of the towing rope and wing briddle line preparatory to the hauling of the net to the starboard for the commander fishing vessel. At the top of the foremast are two single block pulleys which are used for hauling the right wing of the net. A double block pulley located also at the top of the foremast is used to haul the bag of the net.

Electronic equipment

In pair-trawling, as well as in single boat trawling, the fish finder is an important gadget used by the masterfishermen in detecting and assessing the availability of fish stock beneath the water surface to a depth of about 80 meters. The maximum echo-sounding depth of a fish finder is around 800 meters. The gadget also helps the masterfisherman in determining the nature of the sea bottom. Generally, fishing vessels of this type are equipped with combination fish finders having sensitive paper recorders and cathod ray tube screen for televiewing. Another feature is the base blanker control or white line separator which could distinguish clearly the bottom fish from the seabed.

Two-boat trawl fishing requires a very good communication system between vessels for effective coordination of their movements. In the Philippines, each of the two-boat trawlers is equipped with 10-watts single sideband radio telephone units with audible range

of zero to fifty miles radius, operating on a frequency range of 1.6 to 9.0 megacycles. The radio telephone is the only means of communication between the catchmaster of the command vessel and the assistant catchmaster in the other vessel. The channel is always kept switched on for use by the catchmaster in giving instructions to the other vessel in checking the engine revolution, dragging direction, parallel distance between vessels and in giving signals for setting and hauling the net. Generally, Philippine two-boat trawlers have one powerful wireless radio transmitter and receiver unit which is usually installed in the command vessel. It is used in transmitting messages to the home base on vessel position, volume of catch and other information. It also enables the home base to inform the fishing commander about prices and fish marketing trends. It is also very useful intercepting daily weather forecasts.

The Net

The net is a four-seam type made of polyethelene knotless netting materials (Table II). The head rope measures around 63.2 meters and the ground rope around 67.0 meters. The total length of the net from the wing tip to the cod end is 51.2 meters (Fig. 3). The wings are divided into two sections; the inner wings or regular wings and the outer wings or false wings (Fig. 4). A triangular net section forming the outer wedge runs from the shoulder edge of the upper belly joining the upper wing to the tip end. Another triangular net section runs from the shoulder base of the upper belly and joins the square section down to the first side belly section. The headline quarter is braided by 5 vertical rows and 160 horizontal rows of double twines. The headline nettings are braided, except at the headline quarter by 3 vertical rows of double twines. The footline nettings starting from the end of the lower wing to the end of the right lower wing are braided also by 3 vertical rows of double twine, except a portion of the center ground line bottom of the lower belly which is braided by 35 vertical rows and 140 horizontal rows of double twines. The flapper or funnel is laced around the center section of the side bellies through the upper and lower bellies. This funnel serves as the door of the cod end.

Net Accessories

The accessories of the net are composed of the following (Fig. 5).

1. Towing rope — the length of the towing rope under operating conditions is 800 meters long. This is composed of 500 meters of

TABLE II. *Specifications of a two-boat bottom trawl net*

PARTS	SYMBOL	Kind of Materials	TWINE SIZE	MESH SIZE	NUMBER OF MESHES			NUMBER OF PIECES
					1st	2nd	3rd	
Outer Wings	A_1 A_2	Polyethylene	P-57	150	26	56	110	2
Upper Inner Wings	C_1 C_2	-do-	P-39	90	60	60	110	2
Lower Inner Wings	B_1 b_2	-do-	P-57	150	20	20	110	2
Top Outer Wedges	D_1 D_2	-do-	P-39	90	1	100	183	2
Square Net Section	E_1 E_2	-do-	P-39	72	117	62.5	83	2
	E_3 E_4	-do-	P-39	72	125		83	2
	E_5 E_6	-do-	P-39	60	160	140	100	1
	E_7	-do-	P-57	90	1	27	67	2
Side Belly Wedge	H_1 H_2	-do-	P-39	72	62.5	1	83	2
Side Bellies	G_1 G_2	-do-	P-39	60	140	140	100	2
	J_1 J_2	-do-	P-39	60	140	74	100	2
	M_1 M_2	-do-	P-39	54	82	46	100	2
Bottom Bellies	F_1	-do-	P-57	60	220	120	100	1
	I_1	-do-	P-57	60	120	100	100	1
	L_1	-do-	P-57	54	110	90	100	1
Top Bellies	F_2	-do-	P-39	60	140	120	100	1
	I_2	-do-	P-39	60	120	100	100	1
	L_2	-do-	P-39	54	110	90	100	1
Funnel	K	Polyethelene	P-39	60	140	140	125	1
Bag	N_1 N_2	-do-	P-39	54	90	90	120	2
	O_1 O_2	-do-	P-39	54	46	4	12	2

NOTE:

Lower inner wing B_1B_2, 3 rows of double twine meshes. Top outer wedge - D_1D_2 3 rows of double twine meshes. Headline quarter E_5 5 rows of double twine meshes. Outer ground line bosom 140 horisontal by 5 vertical rows of double twine meshes. Bottom belly wedge line E_6E_7 3 rows of double twine meshes.

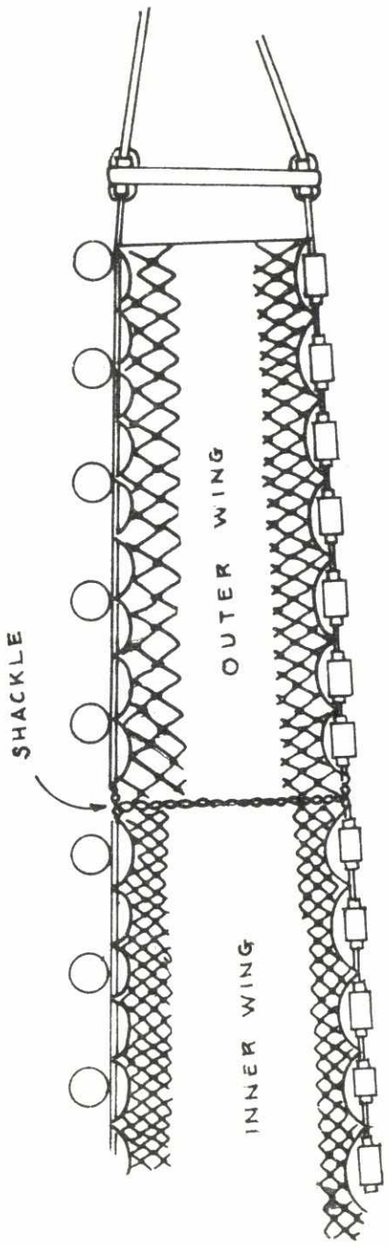

Fig. 3 A diagramatic representation of a wing of a Two-boat Trawl net showing the detachable portion of the inner wing and the outer wing or false wing.

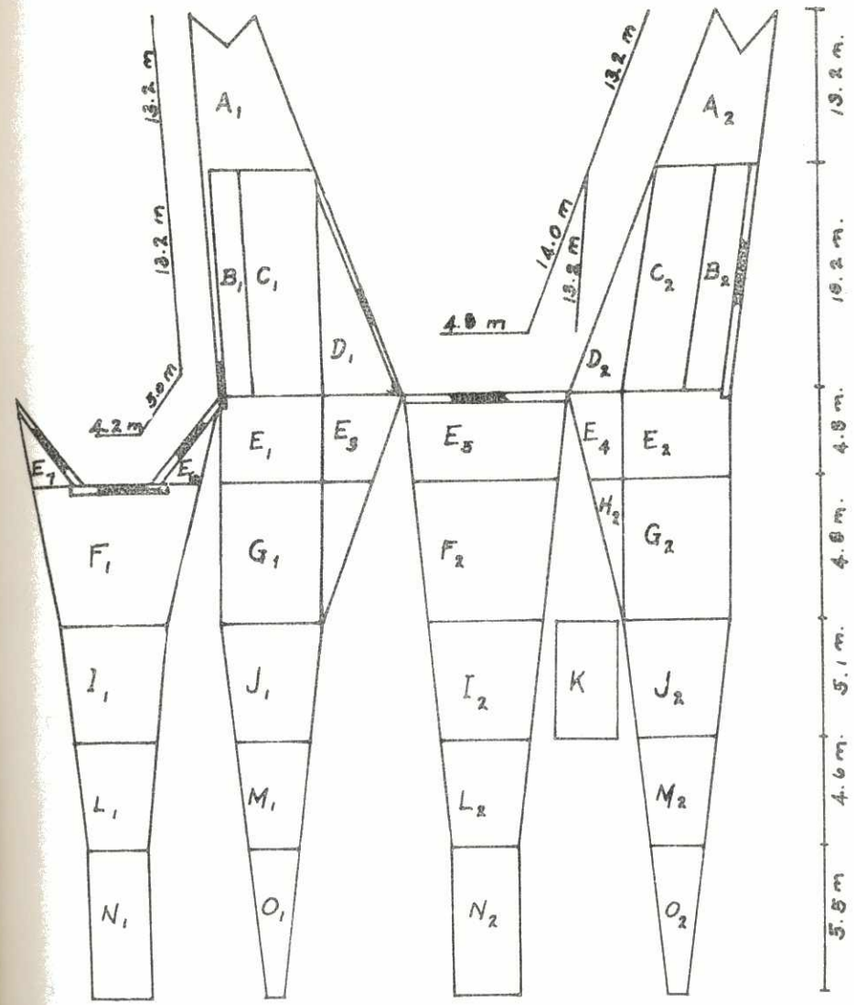

Fig. 4. Showing diagramatic plan of the net.

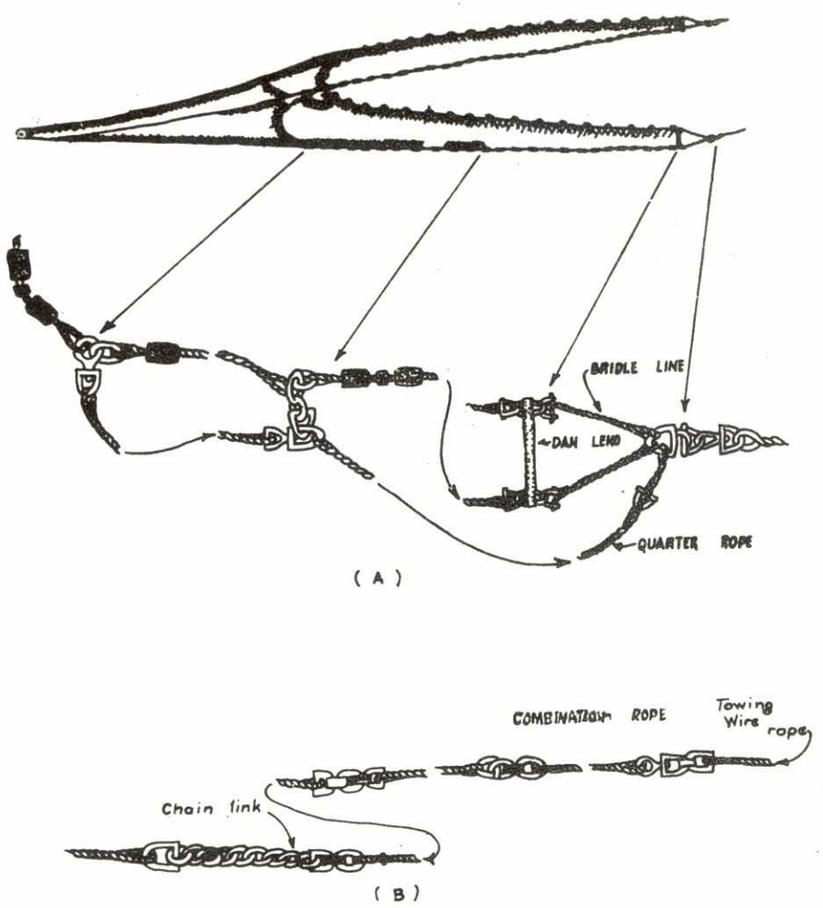

Fig. 5. Showing accessories of the net: A. Diagramatic illustration of Bridle line, Dan Leno and Quarter rope. B. Diagramatic illustration, of towing wire rope, Combination rope and chain link.

1.58 cm. diameter of 5 strands texture of galvanized wire and 300 meters long of combination rope (galvanized wire covered by manila rope) with 7.62 cm. circumference. These two sections of the towing rope are connected to each other by a 22 mm. size swivelled connecting link. The combination rope section is further subdivided into length of 100 meters each. These ropes are connected by swivelled connecting link. The end portion of the combination rope is connected by a galvanized chain No. 22 mm. which is around 20 kilograms in weight to a 30 meters long compound rope whose end is shackled and swivelled fixed to the end of the briddles.

2. Wing briddles — The briddle lines measure around 3.7 m. long and are made of 1.58 cm. diameter wire covered by Kuralon twine. The terminal ends of the briddles are connected to he towing rope by shackles and swivels while the other ends are shackle linked into each of the Kelly's eye of the Dan Leno.

3. Dan Leno — It is made of iron materials. It is cylindrical in shape measuring around 101.6 cms. long and 4.45 cms. in diameter. Both ends of the Dan Leno are provided with a pair of Kelly's eye which serves as connecting link of the briddles and tip end of the head rope and ground rope. In operation, it is in contact with the ground and travels vertically over the seabed. It is attached to the wing ends of the trawl net.

4. Quarter ropes — These are wire ropes of about 1.27 cm. in diameter and covered by Kuralon rope. The length is such that it is extended between the ends of the briddles which are in turn fixed by a splicing into the quarter chain. The latter, which is provided with a swivel, prevents turns from being linked into the rope when tension is applied on the latter during the hauling operation. The quarter chain is attached to the shackled links with the wooden bobbins and Kuralon covered centre section of the ground rope. Thus, by heaving on these quarter ropes the central section of the trawl is moved to a position where it can be lifted on board the trawler by a slip wire placed in the after-most quarter chain links.

5. Floats — Fig. 6-A shows the float plan. There are 3 sizes of floats, namely: 18-cm. diameter, 21-cm. diameter and 24-cm. diameter. All of these are made of plastic material which is anti-pressurized to withstand pressure at great depths.

6. Sinkers — Fig. 6-B shows the sinker plan. Wooden rollers 12.7 cms. long by 10.16 cms. diameter which are threaded

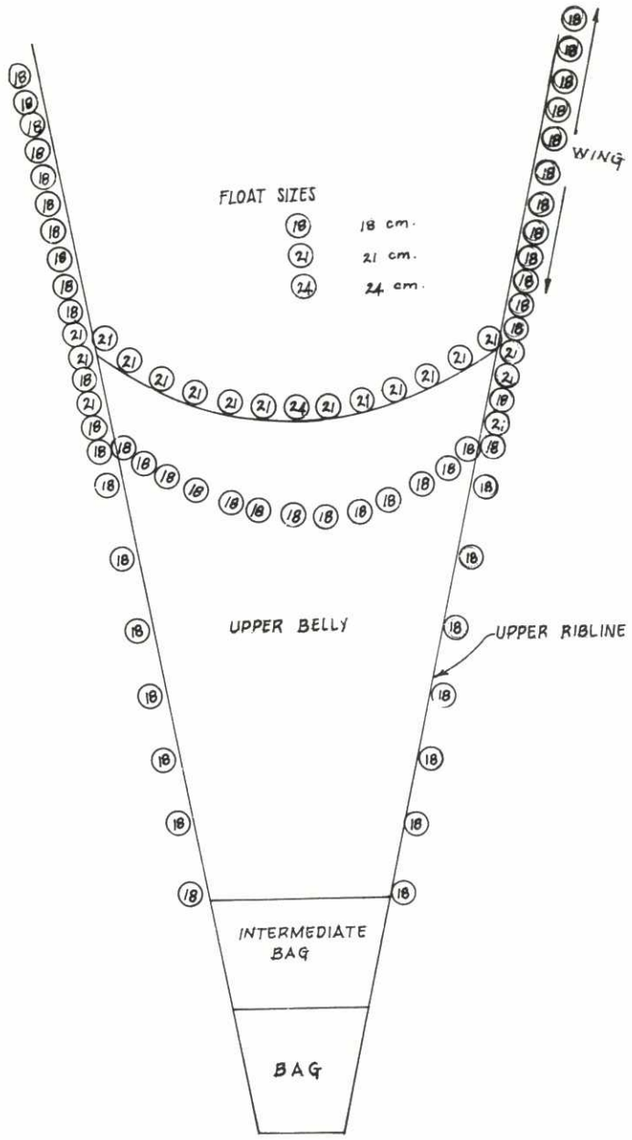

Fig. 6-A. Float arrangement.

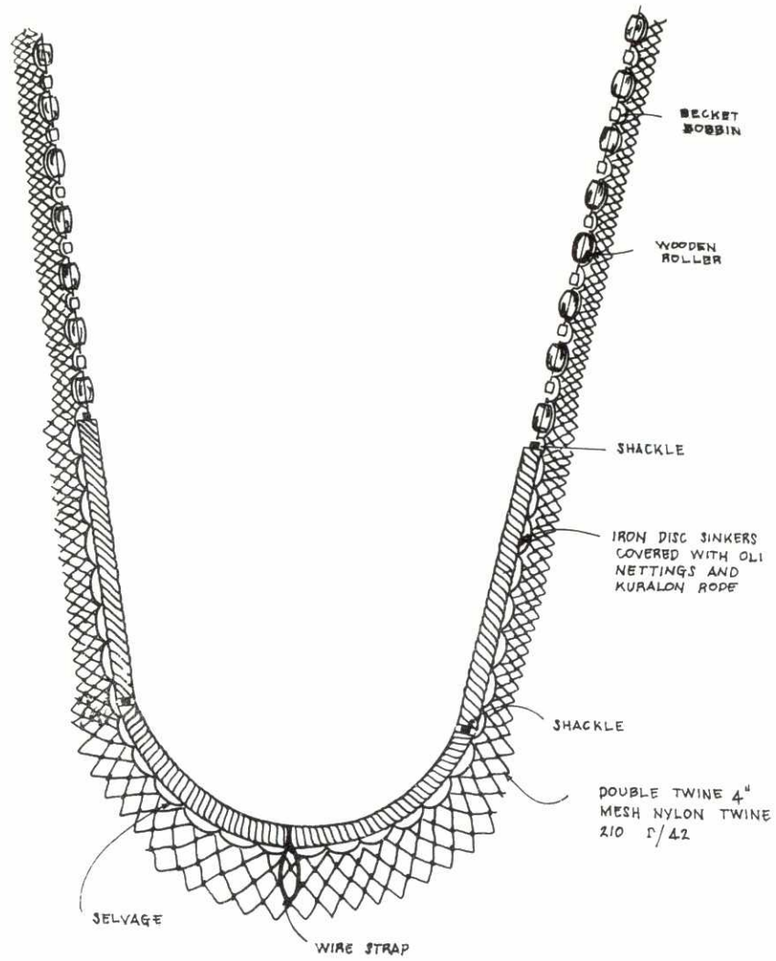

Fig. 6-B. Sinker arrangement.

through the ground rope are commonly used as sinker in the wingfoot rope. Becket bobbins made of hard cylindrical rubber with a dimension of 6.98 cms. long by 5.08 cms. in diameter are use as spacer in between wooden rollers. Iron-made disc of 7.62 cms. long by 3.81-cms. diameter are threaded through the 6.4 meters long wire rope which forms the central ground rope. The latter is covered by old nettings and wrapped with 7.62-cms.-circumference Kuralon rope.

The Crew

The vessel of the fishing commander or catchmaster has a total of 16 crew while the vessel of the assistant fishing commander or assistant catchmaster has a crew of 15. The following is a typical crew component of a command vessel; one Master, one Asst. Master, one Engineer, one Asst. Engineer, one Oiler, one Catchmaster, one Radio Operator, one Cook-fisherman, and 8 fishermen. The component of the assistart vessel is the same except for the radio operator.

Fishing Operation

There are two methods of setting the net. The first is by maneuvering the two vessels in parallel position, with a stone's throw distance separating them in order to transfer the towing warp of the waiting vessel to the setting vessel before net setting follows. The two vessels will then steam ahead in parallel courses with a uniform dragging speed (Fig. 7-A).

The second method is by maneuvering the setting vessel past the stern starboard side of the waiting vessel to connect the towing warp. The waiting vessel then releases the brake of the hydraulic motor powered reels to let loose the towing warp and then steams ahead towards the opposite direction of the waiting vessel. When all the towing warp of the waiting vessel has been fully released, the setting vessel will execute a semi-oval turn and then set the net. After setting the net, the setting vessel will proceed towards and in a course parallel to the waiting vessel until it comes abreast of it. The two vessels will then start dragging the net with a uniform speed (Fig. 7-B).

Each vessel has its own net. The nets are used alternately after each drag. In each fishing operation, the standard dragging time is two hours. Scofield (1948) stated that two-boat trawlers in San Francisco (1915) were usually conducting 2 drags a day of

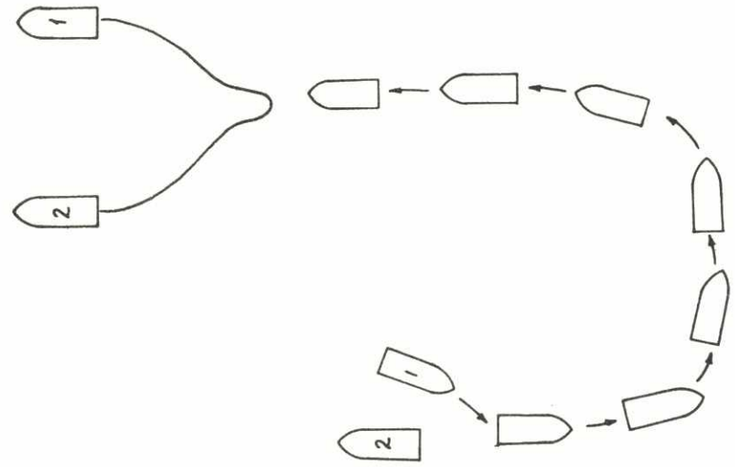

Fig. 7-A. Showing the first method of setting the net.

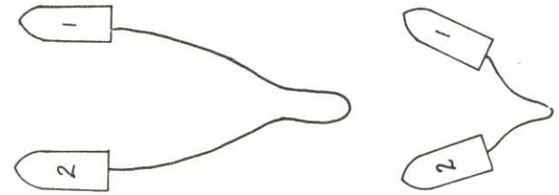

Fig. 7-B. Showing the second method of setting the net.

1½ to 2 hours each, either with or against the current. Hauling operation is done on the starboard side of one vessel, and on the portside of the other vessel.

RESULTS AND DISCUSSION

Table III-A shows the summary of the two-boat trawl fishing operation in Tayabas Bay. It can be noted that the first operation yielded a very poor catch of 420 kilos (about 430 kgs.) of fish. The second operation was fouled when the Dan Leno hit a sticky mud ground upon setting and necessitated immediate hauling of the net. The catch showed big improvement in the subsequent operations after trying various combinations of engine revolution and parallel dragging distance. The biggest amount of catch was during the 6th operation when the vessels catch per hour average 525 kilos. These results were strong indications that the correct adjustment or combination of engine revolution and parallel dragging distance between the two vessels must have been attained successfully. The dragging technique of the net was tested from the shallow to the deeper area. This was indicated by the echo-sounder graph. The technique of dragging was based on the circulation of the water by tide and currents influencing the behaviour of fishes and operation of trawling gear. Variations at 320 rpm and 300 rpm of the engine at dragging speed and at 350 to 250 meters parallel dragging distance between vessels were tried. The series of operations performed in this study showed that the best results in terms of volume of catch were attained at the engine speed of 300 rpm and parallel dragging distance of 300 meters. Clark (1935, 1936) stated that California two-vessel trawler steered parallel dragging courses, 300 to 457 meters apart at two to three knots. At this combination, the average catch per hour was .4 metric tons.

Assuming that the ideal combinations of engine speed and parallel dragging distance were already established, the volume of fish catch would be primarily dependent on the availability and density of fish stock in the fishing ground.

This theory was proven a month after the initial operation, when the catchmaster of vessel No. 2 was able to catch about 6 tons of fish in a single haul of only two hours dragging. This was achieved in Samar Sea (Table III-B). Scofield (1948) stated that the two-boat trawl or paranzella fishery in San Francisco (USA)

TABLE III-A. *Summary of two-boat trawl exploratory fishing operation in Tayabas Bay.*

Fishing Vessel	Fishing Operations (No.)	Fishing Depth Fathoms	Engine RPM	Parallel Distance of Vessel (meter)	Fishing Time (min.)	FISH CATCH Qty. kilos	FISH CATCH Av. per kilos	REMARKS
No. 1	1	35	320	350	120	420	210	Poor Catch
No. 2	2	35	320	350	10	none	none	Incomplete drag, Dan Lenos buried in the mud.
No. 1	3	38	300	250	120	840	420	Fair Catch
No. 2	4	38	300	250	120	970	435	Fair Catch
No. 1	5	38	300	250	120	930	465	Fair Catch
No. 2	6	38	300	250	120	1,050	525	Fair Catch

TABLE III-B. *Summary of two-boat trawl exploratory fishing operations in Samar Sea.*

Fishing Vessel	Fishing Operations (No.)	Fishing Depth Fathoms	Engine RPM	Parallel Distance of Vessel (meter)	Fishing Time (min.)	FISH CATCH Qty. kilos	FISH CATCH Av. per. hr. k.	REMARKS
No. 1	1	37	280	250	120	910	455	Fair Catch
No. 2	2	37	280	250	120	1,150	575	Fair Catch
No. 1	3	39	280	250	120	1,000	500	Fair Catch
No. 2	4	36	280	250	15	—	none	Net hit snag
No. 1	5	39	280	250	120	5,540	2,770	Excellent Catch
No. 2	6	39	280	250	120	3,111	1,555	Excellent Catch

Average Catch per Hour 1,171

1915 were making a daily catch average of 10,000 lbs. per net or about 3,000 lbs./hr. dragging. The operating conditions as to engine speed, parallel dragging distance between vessels, and nature of the sea bottom were almost exactly the same as those that were found most successful during the previous operations in Tayabas Bay.

Fish Catch Composition

The major species of fish caught by two-boat trawlers consisted of Hairstails (*Trichuridae*); Groupers (*Serranidae*); Lizard fishes (*Synodeontidae*); Pomadasids (*Pomadasidae*); Cavallas (*Carangidae*); Mackerels (*scombridae*); *Nemipterids* (*Nemipteridae*) Croakers (*Sciaenidae*); Parrot fishes (*Scaridae*); Big-eyed scads (*Selar crumenophthalmus*) and Snappers (*Lutjanidae*).

The fishes caught vary with the type of the bottom of the fishing ground. In sandy-muddy bottom, the major catches were hairtails, mackerels, croakers, etc. In rocky or coral bottom, the major catches were snappers, groupers, parrot fishes, etc.

Handling of the fish catch consisted of sorting them into first class and second class size groups, washing the fish with sea water, placing them in tubs, and covered with crushed ice. Then the fish tubs were immediately stored in the fish hold.

Two-boat trawling using vessels of 70 gross tonnage equipped with 330 BHP diesel engine seemed to be very appropriate for operation at depths ranging from 50 to 100 fathoms which is more or less prevailing in Philippine fishing grounds. At this depth, it was observed that the catch was predominantly of big-sized fishes. The author had occasion to observe first hand the difference as regards to size of the fish catch when in Dalahican fish landing in Lucena City, the fish catch of the two-boat trawl was placed side by side with those being landed by the single boat trawlers. Those being landed by the small one-boat trawlers were smaller than those of the same species caught by the twin-trawlers. Possible explanation of this phenomenon maybe that the adults of these bottom fish species stay in deep waters. Another explanation is that because of the bigger size of the nets used in the two-boat trawler and the big meshes of such nets, smaller fishes are allowed easy escape.

The main advantage of this method over that of the single boat trawl is the ability to drag a very large net of high vertical opening which facilitates coverage of wide areas in much shorter time. The average dragging time for this variation ranges from 3 to 4

hours. The much shorter dragging time also accounts for the relatively good quality of the fish catch. The catch is unspoiled and fresh looking and therefore with proper handling normally would command better prices than those caught with the one-boat method.

The usefulness of the two-boat trawl is not absolutely limited to deep waters only. This could also be operated in shallow waters as long as the size or tonnage of the vessel, engine horsepower and size of the fishing gear are approximately reduced. However, two-boat trawling in shallow waters in the Philippines does not appear feasible because our traditional shallow trawling grounds are mostly crowded with different kinds of fishing boats. This would make efficient operation of the gear difficult since crowding would tend to affect the maneuvering of twin vessels during operations.

The success of two-boat trawling operations depends mainly on the skills and coordination of the fishing commander and the assistant catchmaster. Adequate training and trials must be done so that the crew would acquire mastery of the techniques involved in the operation of this gear. This is likely to present a problem since this method calls for a more or less continuous availability of the services of the catchmasters. If one of the two catchmasters suddenly fails to join the trip for some reason, then the two vessels cannot operate and therefore will remain idle.

ACKNOWLEDGMENT

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