Technical Paper No. 134

TROLLING AND LONGLINING FOR TUNA

Two Papers

by

MICHEL ANGOT and RENE CRIOU

NOUMEA, NEW CALEDONIA
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The South Pacific Commission

The South Pacific Commission is an advisory and consultative body set up in 1947 by the six Governments responsible for the administration of island territories in the South Pacific region (Australia, France, the Netherlands, New Zealand, the United Kingdom and the United States of America).

The Commission's purpose is to advise the participating Governments on ways of improving the well-being of the people of the Pacific island territories. It is concerned with health, economic and social matters. Its headquarters are at Nouméa, New Caledonia.

The Commission consists of not more than twelve Commissioners, two from each Government. It normally holds one Session each year. There are two auxiliary bodies, the Research Council and the South Pacific Conference.

There is a Research Council meeting once a year. This may be either a meeting of the full Council, or of one or other of its three main sections, specialising in the fields of health, economic development and social development. Members of the Research Council are appointed by the Commission. They are selected for their special knowledge of the questions with which the Commission is concerned, and the problems of the territories in these fields. The chief function of the Research Council is to advise the Commission on what investigations are necessary. Arrangements to carry out those that are approved are the responsibility of the Secretary-General and other principal officers.

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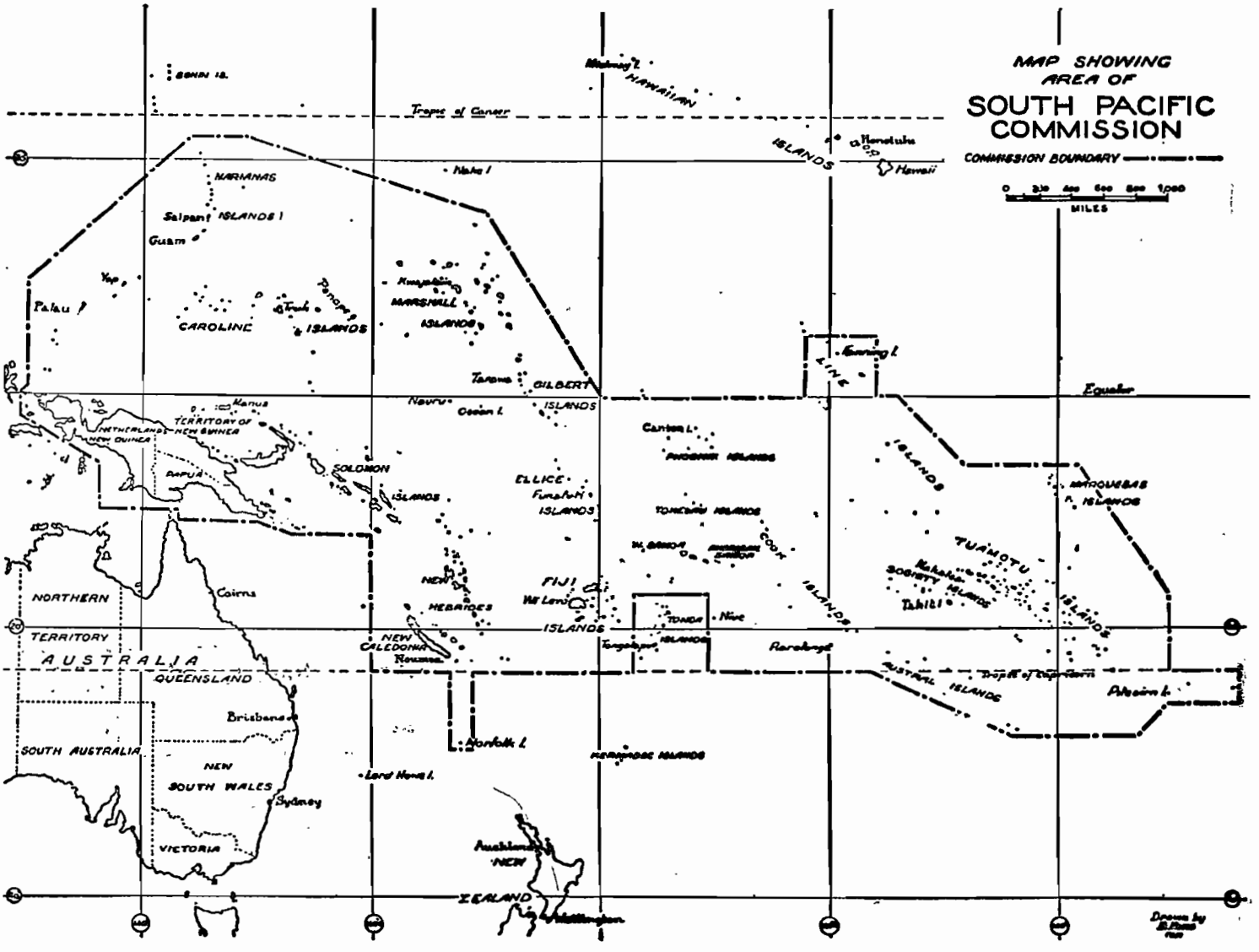

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Tuna Trolling And Its Prospects In New Caledonia

by

René Criou

Tuna Longlining And Its Prospects In New Caledonia

by

Michel Angot and René Criou

South Pacific Commission
Nouméa, New Caledonia
June, 1961

PREFACE

From time immemorial, tuna fishing has been practised off many of the tropical Pacific islands. However, while traditional methods are sufficient to cover subsistence needs they cannot, in most cases, provide adequate supplies for local markets.

Research on fishing methods better adapted to present needs can therefore only be beneficial for the economic development of the South Pacific islands.

Over a period of years, the Institut Français d'Océanie, an agency of the Office Français de la Recherche Scientifique et Technique Outre-Mer, has carried out, through the research workers and staff of its Oceanographic Centre, a programme of experimental trolling and longlining. This work has taken place on board "Orsom III", the Institute's research vessel.

The interesting results obtained more than justified the subsequent publication of two reports. These papers were of such interest for the whole of the South Pacific area that it seemed advisable to give them wider distribution.

The South Pacific Commission accordingly sought, from the Director of the Institut Français d'Océanie, permission to publish these reports in its Technical Paper series. They have been consolidated to form the present publication.

The reader will have no difficulty in fully appreciating the excellent work achieved by the oceanographers and fisheries technicians of the Institut Français d'Océanie.

Jacques Barrau
Executive Officer for Economic Development

South Pacific Commission,
Nouméa, New Caledonia.

OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER

INSTITUT FRANCAIS D'OCEANIE

CENTRE D'OCEANOGRAPHIE

TUNA TROLLING AND ITS PROSPECTS IN NEW CALEDONIA

by

René Criou
Commandant de l'"ORSOM III"
Ancien Directeur d'Ecole de Pêche

C O N T E N T S

1: TUNA IN NEW CALEDONIAN WATERS

A: General Description

The tunas are part of an important group of fishes, the Scombroids, which also includes the mackerels, kingfish, swordfishes and some zoological oddities such as the "snake mackerels" observed during the Kon Tiki expedition. All of these are present in New Caledonian waters.

In all the body is generally elongated, more or less laterally compressed in the case of kingfish, round in the case of tunas. The tail is almost always deeply forked, and the dorsal and anal fins, often high at the forward end, are frequently divided near the tail into a number of separate short finlets. The head finishes in a pointed snout which becomes a sword in the marlin and the sailfish.

The general appearance is that of a powerful swimming machine; actually, this group includes the fastest fishes and some of the largest species on record.

B: Species Found in New Caledonian Waters

Three species may be set apart as being of interest for trollers, namely:

(a) Little Tunny or black Skipjack (Euthynnus alleteratus Raf.)

This is the species best known locally at the moment. It is often found in schools in the lagoon, but catches are not on a scale with its apparent abundance.

This fish, of classical tuna shape, is characterized by a well-defined group of black markings on the posterior half of the back - in most cases, three black spots appear on the flanks, behind the head. Weighing normally $4\frac{1}{2}$ to 10 lbs., this fish has very dark flesh and is not generally esteemed.

(b) Skipjack (Katsuwonus pelamis L.)

Contrary to the black skipjack, this species is very seldom found in the lagoon.

Skipjacks normally weigh $4\frac{1}{2}$ to 7 lbs., but specimens of over 22 lbs. may be found. The true skipjack has a more elongated body than the black skipjack. It is characterized by four longitudinal black stripes extending from the back of the head to the tail, on each side of the belly.

In a number of countries skipjack fishing is an important activity. It is the fish most frequently caught by Tahitian fishermen, while American and Japanese livebait fishermen catch large quantities in the tropical Pacific.

This species lives in dense schools, and the whole school seems ready to bite at the same moment. When out of sight of land, skipjacks are observed near the surface more commonly than other tunas. Mixed schools of skipjack and yellowfin tuna are fairly common. Groups of sharks are sometimes found with skipjack schools.

(c) Yellowfin Tuna (Neothunnus macropterus Schl.)

This species comes first in order of importance for trollers. Its flesh is esteemed. Its average weight near New Caledonian shores is 17-22 lbs., but specimens of 90-100 lbs., and even heavier, may be caught. The yellowfin takes a trolling lure more readily than the skipjack, and it is common to have as many strikes at the same time as there are lines in the water.

The yellowfin is characterized by the brilliant yellow colouring on the edges of its dorsal and anal fins, which in medium or large-sized specimens are shaped like sickle blades and may extend beyond the tail.

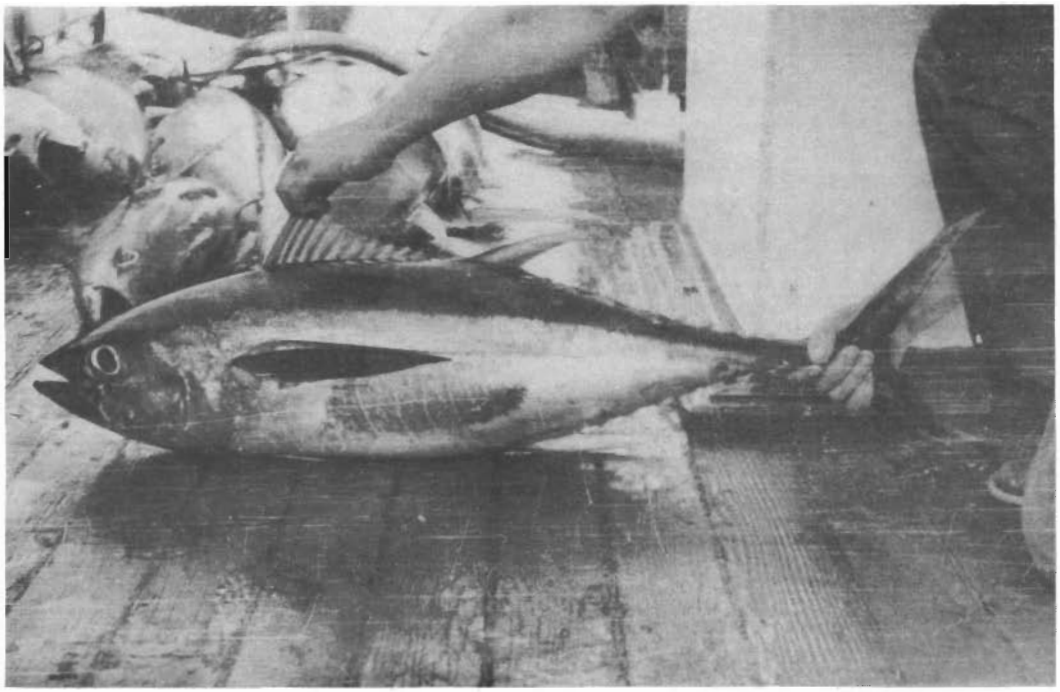
This fish usually lives outside the lagoon, often near passes. However, it occasionally comes far into the lagoon. In New Caledonian waters its breeding season seems to be in summer. Its food includes a wide variety of prey - from small fish to crab larvae and very small planktonic crustacea - captured at various levels. A school of yellowfin may stay for long periods at a certain depth, coming up several times a day at or near the same place, where it feeds actively. If good results have been obtained by trolling over a school it is usually profitable to work the place at length, even if the school is not sighted and no strikes occur for over an hour.

Yellowfin provide the bulk of catches for trollers and livebait fishermen on almost all the Pacific coasts, as well as a certain percentage of longline catches.

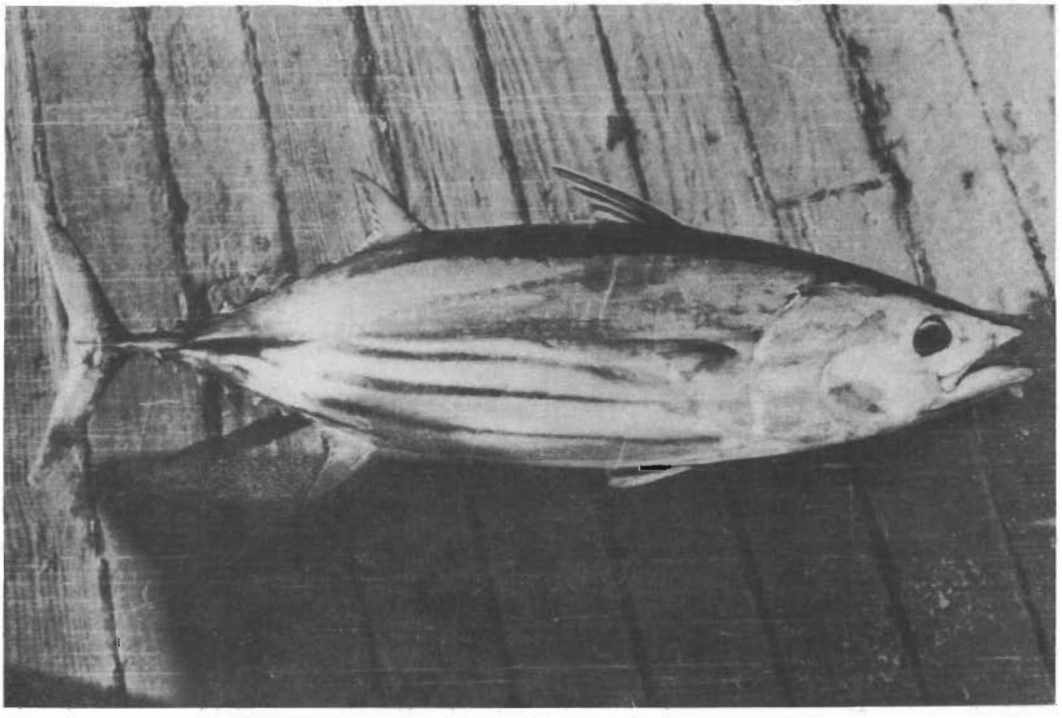
C: Some Other Species Caught By Offshore Trolling

Spanish mackerel (Cybium commersoni Lac. and related species) are well-known in this country, and can be found outside the lagoon, near the reef. The wahoo (Acanthocybium solandri Cuv.) is similar in appearance to the Spanish mackerel, but has a more rounded body and stronger teeth. Large specimens of 45-60 lbs. and over are common.

One of the most prized fish caught by trolling is the dolphin (Coryphaena



The yellowfin tuna (Neothunnus macropterus Schl.) is the tuna most commonly taken in New Caledonian waters by trolling. It is found mainly near the outer reef and in the vicinity of passes.



The skipjack (Katsuwonus pelamis L.) is often taken by trolling off New Caledonia, sometimes at considerable distances from land.

hippurus L.). This fish is paddle-shaped, compressed laterally, has a very high head with a nearly vertical profile, and a sail-like dorsal fin. When brought on deck it goes through spectacular colour changes, with yellow dominating. The dolphin is found almost exclusively far from shore, and actively chases flying fish.

Mention should be made of:

- The various swordfish and sailfish, characterized by the bill or sword terminating the snout. These very large fishes, sometimes seen by offshore fishermen, are seldom caught by commercial trollers.

- Various other tuna species, such as the albacore, the bigeye tuna, which live deep and are therefore caught chiefly on the Japanese longline.

Finally, one species is occasionally caught near the reef: the dogtooth tuna (Gymnosarda nuda Gthr.), whose name is a description in itself.

II: TUNA FISHING

A: Trolling

In this method, which is by far the simplest, a number of lines (12 to 18) called "trolling lines " are towed behing the boat.

An artificial bait or "lure" is always used, such as horsehair, maize husks, imitation horsehair, metal jigs, etc. This very old method has retained essentially the same characteristics since its origin. The mechanization of boats has only served to improve the preservation and transport of fish.

To give an idea of its importance, it is enough to say that several hundred ships use this method in France from June to October each year. During the last few years these ships landed from 15 - 17 thousand tons per season.

B: Livebait

This method was practised first by the Japanese, then by the Americans, and more recently by Basque and Breton fishermen in France. Essentially it consists of keeping a school of tuna close to the ship by chumming it with small live fish thrown in in varying amounts, according to the exigencies of fishing. The fishing crew fishes with short lines and stout bamboo poles.

This technique gives excellent results, but it is essential that good quality livebait be readily available.

C: Flagline Or Japanese Longline

This is a huge drifting line carrying hundreds of hooks hanging in mid-water at depths of 160 - 650 feet. The mainline, which may be 40 - 50 sea miles in length, is buoyed at intervals. The hooks are baited with frozen or salted fish.

This is a deep-sea fishing technique which produces high yields.

D: Madragues (traps)

The madragues will only be mentioned in passing. They are vast fish traps,

set in the vicinity of the shore in places where tuna pass through during their seasonal migrations.

E: Purse Seine

In this technique, tuna schools are encircled with a huge, wide-meshed net. Specially-equipped ships, as well as costly and bulky gear, are necessary.

Among all these methods, only the first-named offers possibilities for a small-scale commercial fishery. The others rather belong in the realm of industrial fishing, as they require considerable equipment and capital.

III: TUNA FISHING IN NEW CALEDONIA

"Orsom III" is a 73-foot ship specially equipped for oceanographic research work in the South Pacific. She belongs to the Institut Français d'Océanie. In addition to scientific research work, activities on board this vessel include applied research on fishing techniques capable of development in the area. To this end, "Orsom III" has been equipped for trolling and longlining.

For trolling, the ship is rigged with two 55 ft. bamboo outriggers, and can troll 14 - 15 lines, 6 from each outrigger and 2 or 3 from the stern (Plate I).

The rigging of the lines is very simple, and is identical with the arrangement described later for a local cutter. It is the age-old system used by Breton tuna fishermen.

"Orsom III" started operations early in 1956, and has made a number of cruises for the purpose of investigating tuna populations along the coasts of New Caledonia, the Loyalty Islands and the New Hebrides.

On extensive cruises, during which the life of tuna in the South Pacific was investigated from a rather more scientific and general angle, experimental trolling was still carried on.

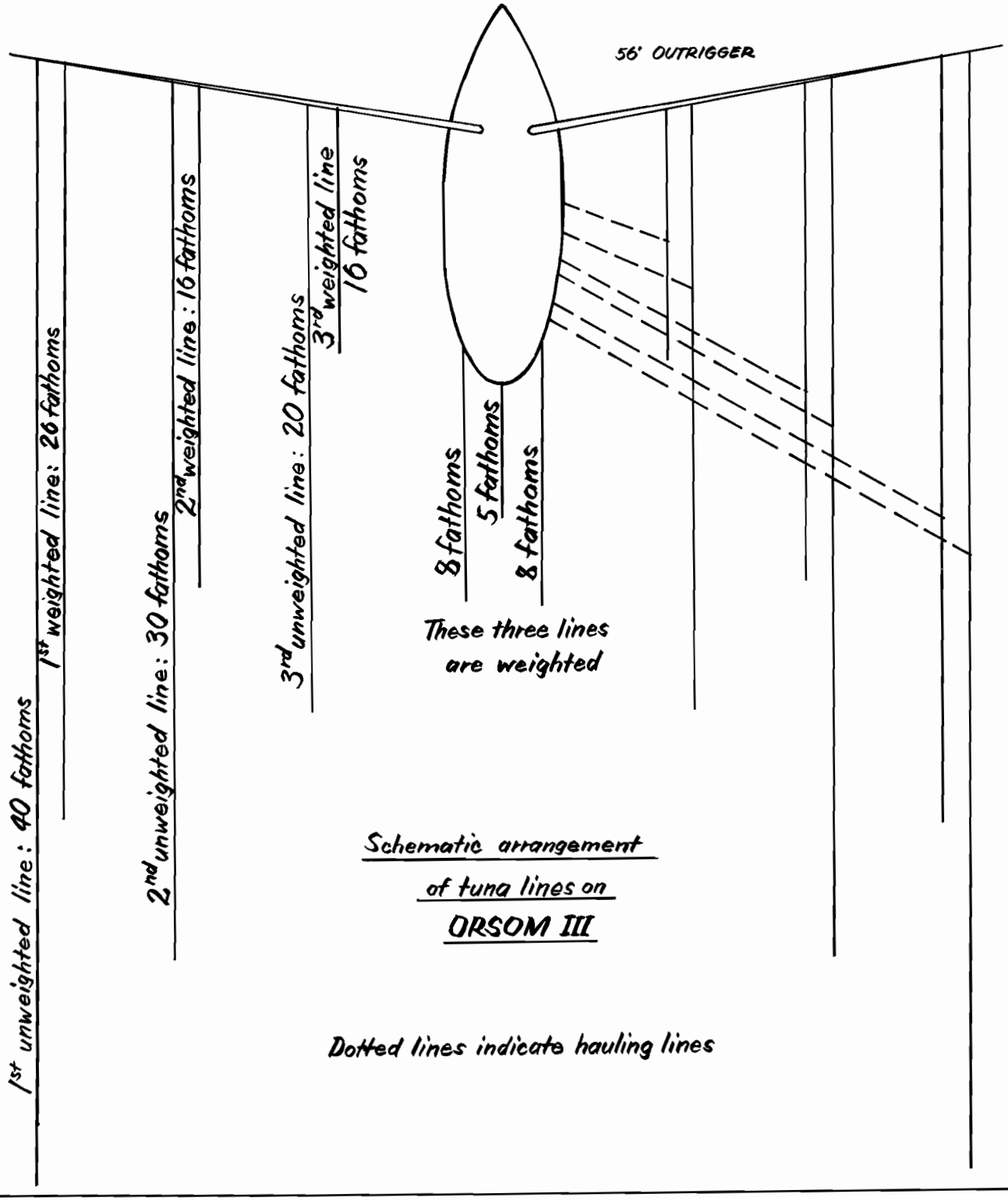
While the best fishing areas cannot yet be defined exactly, it has been possible to show that, with very few exceptions, surface schools of fish are found only in the immediate vicinity of land.

A detailed account of the results obtained during each cruise of the "Orsom III" for the last few years would be tiresome. A few examples will suffice to illustrate the possibilities existing in the area.

In February 1956, fishing off the Uitoë, St. Vincent and Isié Passes, "Orsom III" took 136 tuna in one afternoon. The next morning 65 tuna were caught off the Uaraï Pass and the Mara Break, i.e. two hundred fish, weighing over 3,300 lbs., in under 24 hours.

During a cruise in February 1957, 165 tuna weighing one ton were caught in the Thio, Yandé and Bourail Passes and off Taom. Early the following May 20 large tuna, weighing over 900 lbs., were caught in a few hours off Bourail. In August of the same year, during a trip from Vila to Nouméa, 3,080 lbs. of small tuna were caught in one day between Jouan reef and the north-west shore of Lifou. In December, sailing across the Uvea Lagoon from the Anemata Pass to the Fayaoué anchorage, "Orsom III" caught 1,432 lbs. of fish, mostly "Rainbows" (Aprion virescens V.).

PLATE I



Schematic arrangement of tuna lines on ORSOM III

Dotted lines indicate hauling lines

In January 1958, 770 lbs. of tuna were caught between the entrance to the Havannah Pass and the Woodin Canal.

Tuna are not so commonly caught inside the lagoon, but the I.F.O. vessel has occasionally caught them off the Porc Epic (Porcupine Islet) and even off the Ouen Toro.

From these few examples it is evident that small-scale commercial tuna fishing is quite feasible around New Caledonia.

It should be noted that whereas "Orsom III" cannot be used on a full-time basis for experimental fishing, a commercial fishing vessel remaining on the fishing grounds as long as necessary after fish have been sighted would certainly obtain even better results.

IV: ADAPTATION OF LOCAL FISHING CUTTERS FOR TROLLING

A: The Boat

Although a length of about 40 feet would be best for an offshore tuna troller, it is nevertheless quite possible to use any 22 - 26 foot local fishing cutter. The necessary gear is quite simple, and costs are low.

The only essential point is that the after-deck should be as free of obstructions as possible so that line handling and fish cleaning will be easier. The type of engine is not important as long as a fishing speed of 4 - 6 knots can be maintained. Diesels are, however, more robust and safer than petrol engines.

B: The Fishing Gear

A 22 - 26 foot cutter could troll 8 lines, 3 on each outrigger and 2 from the stern (Plate II). A 40-foot boat could rig 12 lines, 5 on each outrigger, 2 from the stern.

The fishing gear proper includes:

- the outriggers, with their sockets and guys,
- the lines complete with hauling lines, traces and shock absorbers,
- the hooks and lures.

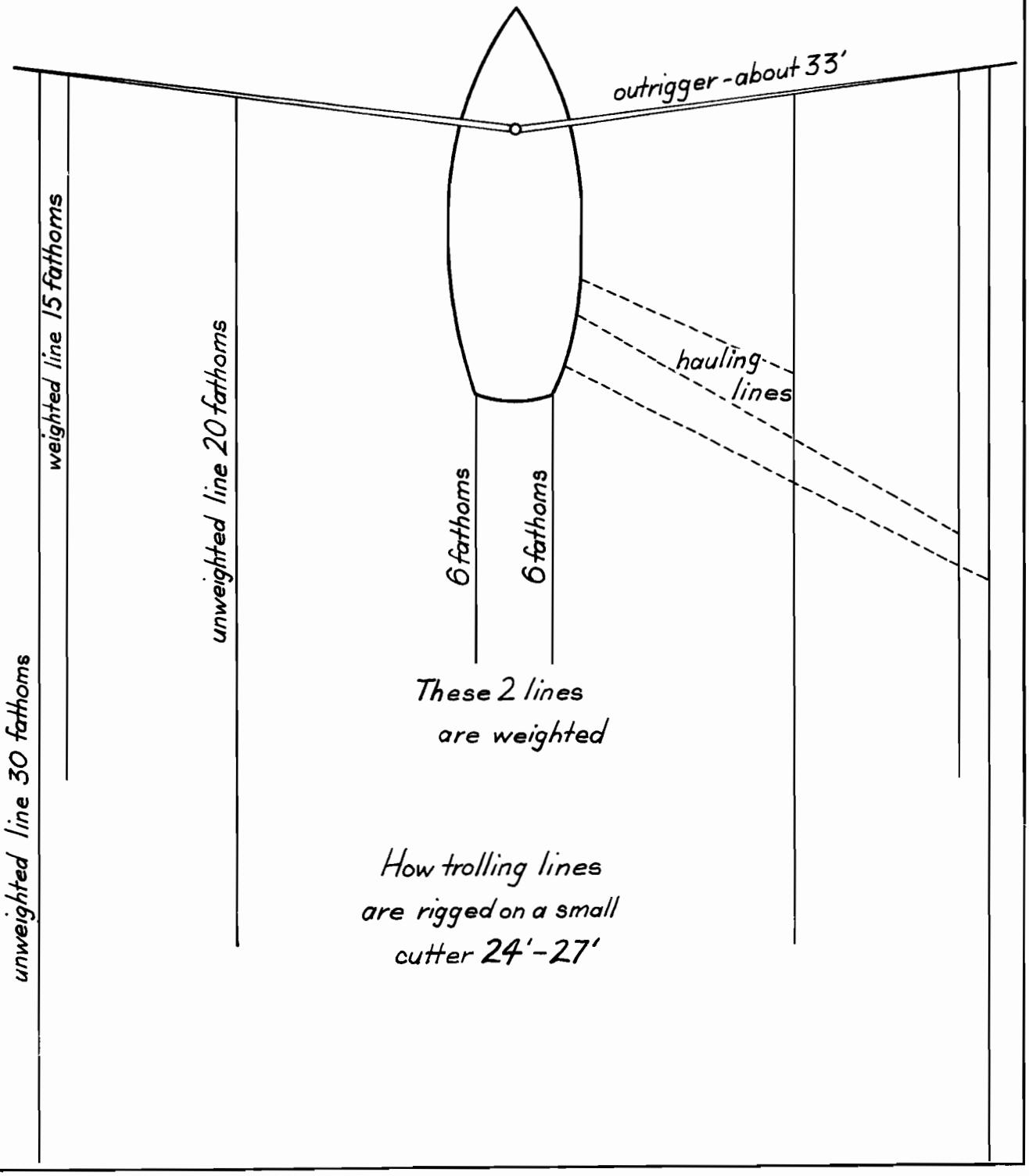
1. The Outriggers

On a 22 - 26 foot boat, the outriggers will be bamboo poles about 33 feet long, with a diameter of $3\frac{1}{4}$" to $3\frac{1}{2}$" at the big end.

As these outriggers must be free to move up and down and fore and aft, they will be stepped in articulated sockets fixed to a two-eyed collar encircling the bottom of the mast (Plate III, Fig. 1).

Each outrigger is supported from above by a topping lift. A rope, called a bobstay, is fixed to the gunwale to stiffen the pole and prevent it from bobbing

PLATE II



How trolling lines are rigged on a small cutter 24'-27'

up (Plate III, Fig. 2).

In the fore and aft plane, the outrigger is guyed with two ropes bent to the upper end of the pole, one-quarter of its length down. One guy is made fast to the quarter of the transom, the other to the stem.

A lighter rope is bent to the tip of the pole and made fast to the stem. It seems to balance the stresses affecting the pole when fish strike the outermost lines (Plate III, Fig. 3).

When actually fishing, the outriggers are lowered to an angle of 60° - 65° with the mast. They are not at right angles to the centreline of the boat, but are pulled forward a little. In the "off" position, the outriggers rest vertically against each side of the mast.

It is advisable to paint bamboo poles to ensure a longer life.

2. The Lines

Each line comprises a main line, hauling line, trace, and shock absorber. 18-thread hemplines are commonly used in France. From our experience aboard "Orsom III" we recommend a stronger line - 27-thread - for the New Caledonia area.

A distinction should be made between weighted and unweighted lines. The weighted lines carry a few links of old chain exactly at the point where they meet the surface of the water. In the example under discussion, $3\frac{1}{2}$ - $4\frac{1}{2}$ lbs. would be necessary for the weighted lines bent on the outriggers, while 1 - 2 lbs. would be sufficient for the stern lines. The weighted lines make it easier to avoid tangles when a number of fish are being hauled at a time.

As indicated on the sketch (Plate II) there will be :

(a) at the tip of the outrigger, an unweighted line 30 fathoms long;

(b) 12" to 16" from the first line, a weighted line 15 fathoms long;

(c) in the middle of the pole, an unweighted line 20 fathoms long;

(d) at each quarter, one weighted line 6 fathoms long.

Hauling lines, as indicated by their name, are used to haul the lines to the gunwale. These hauling lines will be bent on to the mainline at a point where the distance between "A" and "B" should at least equal the distance from "A" to "C" (see Plate IV, Fig. 1).

Shock Absorber: On each line, somewhere between the outrigger and the

PLATE III

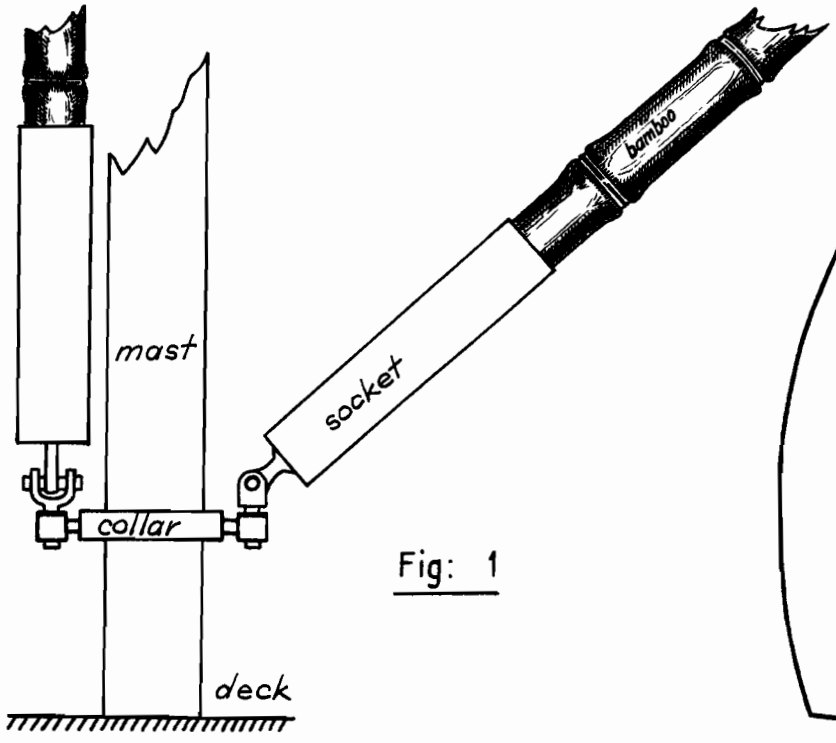


Fig: 1

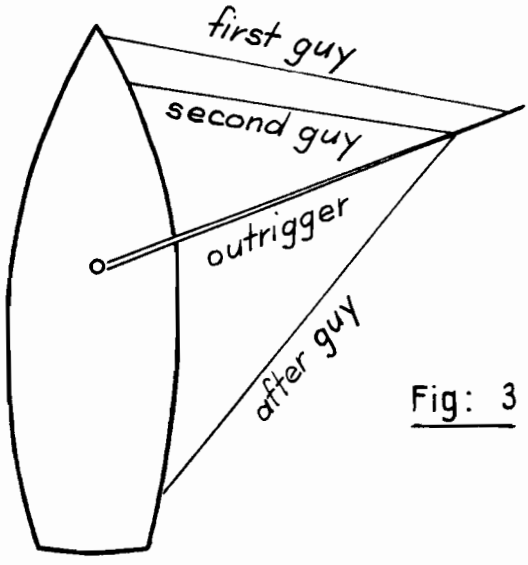


Fig: 3

An eye made of galvanised wire is soldered to the shank of the hook

Fig: 5

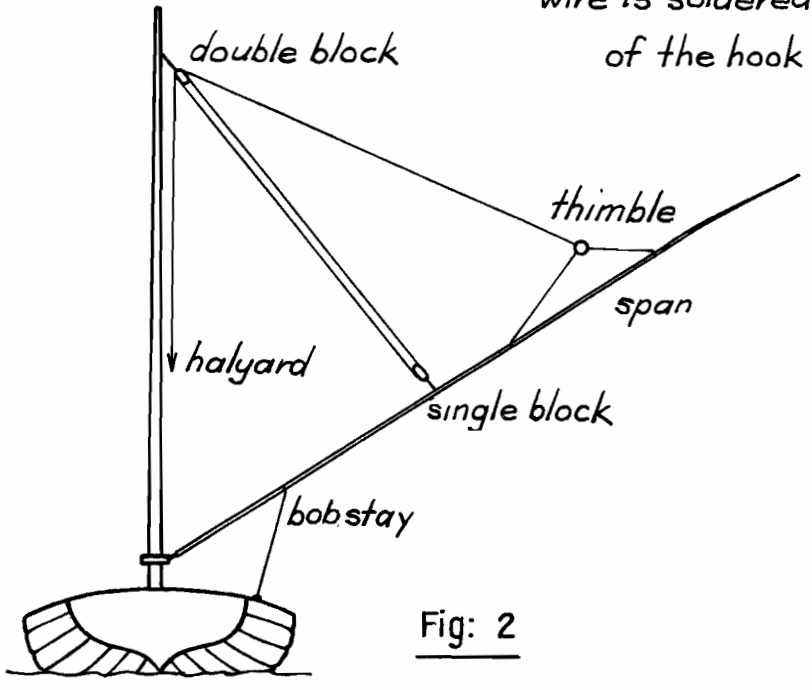


Fig: 2

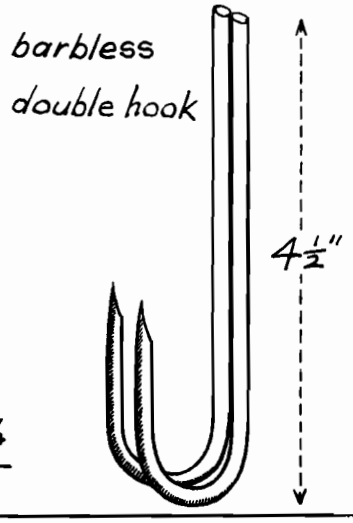


Fig: 4

hauling line, a shock absorber should be fixed. This lessens the strain on the line when a fish strikes.

The shock absorber is a sandow 3 - 5 feet long solidly fixed to a bight of line at its extremities (Plate IV, Fig. 2). On occasions, when a high proportion of large tuna (50 - 90 lbs.) was striking, the shock absorbers have been doubled or even trebled aboard "Orsom III".

Traces: As a result of several tests, 260 lb. test nylon traces have been adopted aboard "Orsom III". These are from 5 - 6 fathoms long.

3. Hooks and Lures

The hooks used for tuna trolling are double barbless hooks. The absence of barb makes it easier to unhook the fish. The speed of the boat is sufficient to strike the hook home. French size No. 7 or equivalent is best (Plate III, Figs. 4 and 5).

The lures most commonly used are:

(a) Artificial horsehair (nylon thread). With this, horsehair, fashion a minute deck swab as thick as a man's finger and 4" to 6" long. This "swab" is whipped at the top with a few turns of sailmaker's thread. The nylon trace is threaded through the lure, which is then trimmed so that it just covers the points of the hook (Plate IV, Fig. 3).

White "horsehair" is generally used, with the addition of red, yellow, green or blue in the proportion of 1 to 4 or 1 to 5.

(b) Maize husks: These are bleached in chlorinated water, dried, tied in a bunch as above, then split fine with a steel-toothed comb or a table fork.

(c) Rubber tubing: Red rubber tubing about $^{3}/_{8}$" diameter (the size generally obtainable from pharmacies and drugstores is all right) is cut into pieces about 6" long and one end is cut slantwise (Plate IV, Fig. 4).

(d) Japanese feather jigs: These are made of a shiny metal head to which multi-coloured feathers are attached. Generally available in stores. Medium sizes are best.

(e) Spoons: Generally made of a chrome-plated piece of metal with hook attached; shape may vary considerably.

Of all these lures, the most popular - because it is also in the majority of cases the most effective - is the artificial horsehair. Next in order of efficiency is the Japanese feather jig, but this is more expensive and does not

PLATE IV

Shock absorber
3'to5' sandow

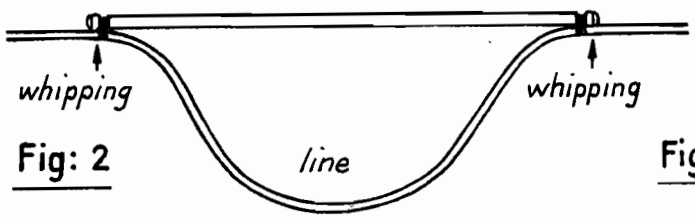


Fig: 2

How to determine where
to bend on the hauling line

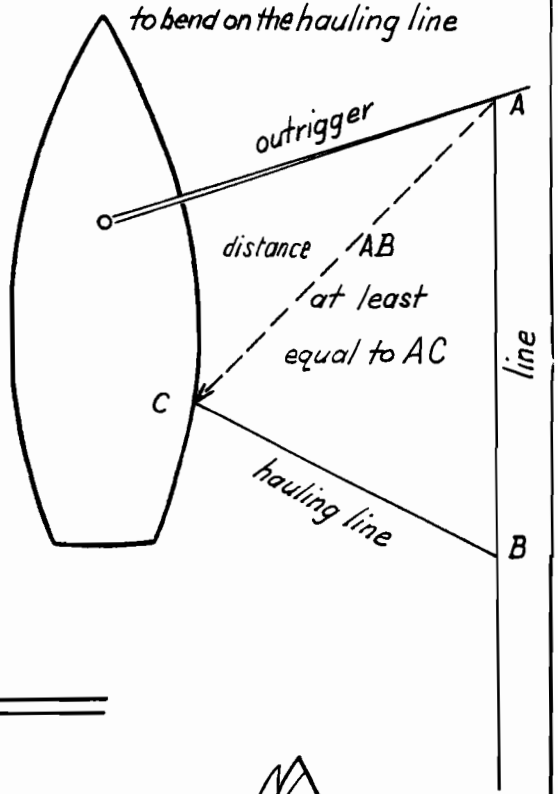


Fig: 1

nylon thread lure

Fig: 3

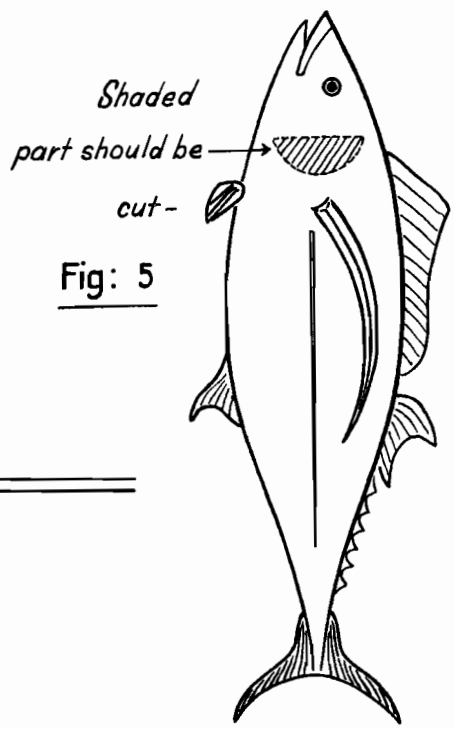


Fig: 5

rubber lure

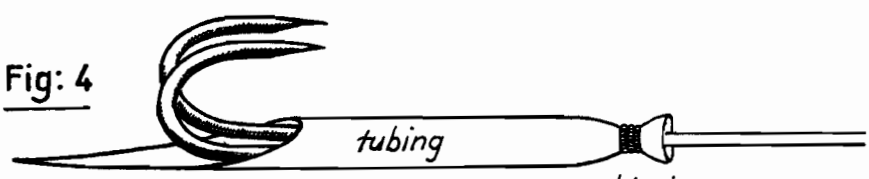


Fig: 4

The end is cut
slantwise

last long, as the feathers deteriorate quickly.

Trolling spoons are used successfully in France by Basque fishermen, but they gave rather mediocre results in New Caledonia.

4. Maintenance of Gear

Maintenance of gear is very simple. The lines should be coiled carefully every night. After each fishing trip they should be washed and dried in the open before storing.

The hooks alone require much care; any hook which has one or two rust stains becomes immediately inefficient. After fishing, it is essential to wipe each hook carefully and to grease it with tallow.

C: Fishing Technique

1. Locating The Fish

Tuna trolling is a daytime technique; the best times seem to be at dawn and at dusk. Wise fishermen should, therefore, be in the vicinity of the fishing grounds at the break of day.

Experimental fishing has shown so far that fish is more abundant in the passes and in the immediate vicinity of the main reef outside the lagoon.

2. Signs

Flights of sea birds (especially brown petrels) are a sign of fish. A little experience will enable the fisherman to tell whether the birds are active or whether they are only looking for a problematic school.

Birds should not be the only sign sought, since both here and in European waters, heavy catches are often made with no birds in sight. The colour of the water is important: deep blue water with oily looking patches on the surface is best.

3. Boat Handling

As soon as a school of tuna is sighted, the fisherman will try and keep with it, even if some manoeuvering is involved. A boat under sail should preferably keep the wind aft when coming about, in order not to tangle the lines. This manoeuvre also offers the advantage of spreading the lines fanwise, thus covering more ground. A motor boat should not come about in a tight turn, but gradually, so as to avoid tangling the lines.

It is important to remember that when the fish are biting freely, the hooks should not be kept on deck longer than can be helped. As soon as a line has been hauled in and the fish unhooked, the line should go back in the water,

before another one is hauled in.

When trolling it pays to check the lines frequently, to see that they are not fouled by floating weeds and debris.

D: Preservation Of Fish

In order of efficiency, the techniques for keeping the fish on board in good condition are:

1. Freezing

This requires the installation of a freezer capable of producing temperatures between 0° - 5° F. The adaptation of this method to a 22 - 26 foot cutter seems difficult, as there is little room available on such a boat. In addition, the cost of such an installation is comparatively high.

2. Icing Down

For cruises not exceeding 4 - 5 days this method is good. It is only necessary to have a small compartment insulated with cork, spun glass, etc., in which the fish will be stored between layers of crushed ice. An outlet should always be provided at the bottom to permit the water to drain away.

3. Open-Air Method

This is the oldest of the techniques listed. It was still practised in France up to a few years ago, and fairly good results were obtained if the cruise did not exceed a fortnight. However, thunderstorms or misty weather could spoil the whole catch. Under the comparatively hot and humid climate of New Caledonia it might be possible to use this method on cruises not exceeding two days. The great advantage of this technique is in its simplicity: the fish is gutted, bled, then hung by the tail from a wooden rail laid on high trestles. At night, or during rainy weather, or under intense sunshine, it is wise to cover the fish with a tarpaulin.

4. Killing And Cleaning

Tuna should be killed as soon as they are on deck, by stabbing the brain with a thin spike. Whatever the preservation method chosen, the fish should be carefully cleaned before storage. This is essential to obtain good preservation. Split the belly, gut and wash the fish with plenty of water, hang it up to drain. It is an excellent practice to massage the flanks from tail to head to help drain the blood properly. In the case of open-air conservation it is preferable to cut the gill plates (Plate IV, Fig. 5) to ensure good ventilation of the main cavity.

V: THE FISHERMAN'S LOG

We strongly advise fishermen who take up tuna trolling to develop the habit, on every trip, of jotting in a notebook the following information:

- Date
- Fishing grounds
- Weather
- Catch (specifying as far as possible the proportion of small, medium or large-sized tuna).

These notes will ultimately provide the fishermen with interesting data and knowledge of seasonal variations in the yields of their fishing grounds, thus enabling them to cut down the number of unproductive days.

OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER

INSTITUT FRANCAIS D'OCEANIE

CENTRE D'OCEANOGRAPHIE

TUNA LONGLINING AND ITS PROSPECTS FOR NEW CALEDONIA

by

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C O N T E N T S

INTRODUCTORY

Five methods yield commercial catches of tuna in the world's seas: madrague (trap), trolling, seineing, longlining and livebait fishing.

It is only with the last three methods that catches of industrial significance are landed. Longlining is, under present circumstances, the second most important technique. It is, however, coming into more general use, and the fact that rich tuna areas discovered recently cannot be fished except by longline will tend to bring this technique to pre-eminence.

These remarks justify the following text, in which the authors attempt to survey briefly the evolution of longlining. After a brief historical picture of the development of longline fishing, information will be found on :

(a) The Japanese technique as used on commercial fishing boats.

(b) The method developed by American fishermen of Japanese descent based in Hawaii.

(c) The technique practised on board the ships of the United States Fish and Wildlife Service, Hawaii, formerly known as Pacific Oceanic Fishery Investigations (POFI).

(d) The method used on board the research vessel "ORSOM III" by the Personnel of the Laboratory of Oceanography of the Institut Français d'Océanie (IFO). This chapter has been treated in a rather elaborate way and describes in detail the fishing installations aboard "ORSOM III" as well as the composition and actual operation of the gear.

(e) The general results of the first series of experimental longlining cruises in the vicinity of New Caledonia.

I: A BRIEF HISTORY OF LONGLINING

The longline consists of a main line carrying snoods equipped with hooks baited with dead fish, the whole being laid at a certain depth. This depth is determined by the length of the droppers linking the main line to its supporting floats. The floats also serve as markers.

Gear of this type was mentioned in the chronicles of the Boso area (now the Chiba prefecture) in Japan, over two hundred years ago. However, its development can be traced only since 1850. Japanese longliners then were small boats, using about 75 hooks. Advances in shipbuilding soon resulted in bigger boats and fishermen ventured ever further from the coasts. While in 1868 they stayed within 25 miles off the shore, by 1907 they were venturing 60 miles off shore, although they used sailing and rowing craft exclusively. Many boats became a total loss during these too venturesome cruises and, in the Tomisaki District, the name given to the longline could be translated literally as "the widow-making line", so great was the number of fishermen's widows.

In 1907 the Japanese fishing fleet was mechanized, almost simultaneously. Engines replaced sail and, from an average of 20 tons with a 20 h.p. engine, the ships very quickly reached 200 tons with 400 h.p. engines.

In addition, the type of mechanical line hauler in use today appeared on board Japanese longliners as early as 1911. At first imported from England, it was soon adopted and the ships were able to fish some 2500 hooks on a single mainline.

The line hauler increased yields, and marine engines enabled the Japanese to extend their fishing grounds. Before World War II they remained within a radius of 2,000 miles from Japanese shores, but today all the warm seas of the world are visited by Japanese longliners. The Indian Ocean west to the coast of Africa and the Pacific east to America were the first areas exploited. Operations in the Atlantic, especially in the Gulf of Guinea, were started in 1954.

II: COMMERCIAL LONGLINING IN THE PACIFIC

A: Commercial Longlining By Japanese Fishermen

The longline is centered on a mainline from which snoods carrying hooks hang downward, and buoy lines lead upwards to the floats and flags. The line, once of hemp, is now made of cotton. It is divided into a certain number of identical units called "baskets" because they were formerly stowed in individual basket containers. Nowadays each "basket" is merely tied up with pieces of old line.

A basket includes about 1,000' of mainline (Plate I, Japan). A buoy line of varying length, according to the species of fish sought and the fishing area concerned, is attached to the mainline. Generally speaking the buoy lines are about 80' long. The snoods include three distinct parts, which are (from top to bottom) - a cotton line about 50' long, a "sekiyama", and a steel wire (9 x 27 or 7 x 25) 10' to 15' long. The "sekiyama" was formerly made of a hemp core served with fine cotton thread; this hemp core is now replaced by a steel wire (9 x 28). The steel wire hanging from the "sekiyama" is equipped with a hook.

The floats are glass balls 1' in diameter, enclosed in a net made of heavy twine. They are attached at the upper end of the buoy lines and carry a bamboo pole some 13' long with a cotton flag or a bunch of palm fibres at the upper end. At night, light buoys are used. The acetylene lamps once employed have been abandoned in favour of electric lights working from batteries.

The number of hooks attached to each basket varies according to the fishing area, the species of fish it is desired to capture, and the opinion of the master fisherman. Generally, about 10 are used for albacore and 5 or 6 only if yellowfin tuna is the main catch. The length of cotton line in each snood is in inverse ratio to the number of hooks, since no two hooks should touch if the snoods are laid parallel with the mainline.

The number of baskets used varies with the size of the boat. At present, fishermen generally use 250 to 350 baskets, or from forty to fifty-seven sea miles of mainline, carrying 1,500 to 2,100 hooks at the rate of 6 hooks per basket. Taking into account the slack in the line when it is in the water, it is reckoned that a longline fishes on 60% of its total length, i.e. 25 to 30 sea miles.

The longline is "shot" from the stern of the ship, which is sailing at an average of seven knots. This work generally starts before dawn, commencing at 4 a.m. and finishing around 7 a.m., the average shooting time being about 40 seconds per basket. The operation requires uninterrupted work from a dozen men, whose tasks are exactly defined and must always be carried out with great care.

Photo 1. Shooting the longline. The baskets of longline in the foreground are still in their net wrappers, while one unwrapped basket in the background is being shot over the side.

Photo 2. Hauling in the line. Visible at lower left, the snap fasteners of the main line, snapped in their respective order on one side of the net wrapper.

The bait used is small frozen fish, generally "saury" (Cololabis saira), or sometimes sardine (Sardinia melanostica).

Hauling in usually begins at noon the same day. This operation will last until about midnight, the time depending on the number of fish caught. Over 15 men take part in the work.

The line is coiled by a special winch or "line hauler" equipped with two rubber-rimmed pulleys turning in opposite directions. This line hauler is generally placed on the starboard side of the ship, and always forward. The ship is headed so as to bring the line in at an angle of 15^{o} to 45^{o} with the ship's course.

The fish hooked are lifted on board with gaffs and if not already dead are killed as soon as possible. Only large fish are gutted before being stowed in the fish hold, generally within 30 minutes of being brought on deck. Preservation in crushed ice is common in the case of old ships or short cruises, while modern refrigeration systems are used aboard more recently built ships, or ships working far from any base.

B: Commercial Longlining In Hawaii

Tuna longlining was introduced into Hawaii in 1917 by Imose, a Japanese fisherman working near Oahu. Today this technique is used by American fishermen of Japanese descent, together with a few Filipinos and Hawaiians.

A basket of Hawaiian longline measures 790' to 1180' according to the number of snoods, 4 or 6. Each section of the cotton mainline is 196' long (Plate I, Hawaii). The three-piece snood already mentioned is again found here, with the exception that the "sekiyama" is replaced by the "shanawa" (the core of which is linen instead of hemp or steel wire). Total length of the snood is 98', including 65' of cotton line, 23' of "shanawa", and 10' of galvanized steel wire.

Buoy lines average 98', and are attached to wooden floats (imported California redwood). These floats carry 16' bamboo poles with flags. In addition, a buoy line is attached in the middle of each basket and supported by a single float without a flagpole. Metal balls of the type used by northern Pacific trawlers, or army surplus oxygen tanks of about 5 gallons capacity, are commonly used as single floats.

The favourite bait of the Hawaiian fishermen is salted "operu" (Decapterus sanctae-helenae) which they catch themselves with a special liftnet baited with mashed taro. Other kinds of bait are used, such as frozen sardine or squid, but these must be imported.

The Hawaiian longliners are small boats (42' to 65' overall length) built along the lines of a Japanese sampan. The crew number from 3 to 5. This small-

scale type of exploitation allows only for 20 to 34 baskets of line on each cruise.

On a boat with a crew of 5 using 33 baskets, shooting commences around 6 in the morning and takes approximately 30 minutes. The crew begins to haul in the gear at 5 p.m. and normally finishes around 8 p.m. Between 6.30 a.m. and 5 p.m., the boat patrols the floats and if one is sunk (indicating that a fish is hooked), that part of the line is hauled up, the fish unhooked, the hook rebaited and thrown back into the water.

Hauling in is made easier by the use of a winch of classical type: a simple horizontal winch head. Opposite the winch, a pulley lifts the line clear of the gunwale. All the work is generally done on the port side. The skipper takes part in it: the wheel is left free and the clutch of the main engine is operated by remote control.

The catch is kept on ice. Twelve tons of ice for a 14-day cruise and a catch of 3 tons of fish are considered normal. This large quantity of ice is necessary in tropical waters.

III: EXPERIMENTAL LONGLINING IN THE PACIFIC

A: Experimental Longlining By POFI Personnel

Research workers based in Hawaii have endeavoured to standardize Hawaiian and Japanese gear in order to produce a longline which could be accepted by United States fishermen, i.e. a longline which could be handled by a smaller crew through a maximum of mechanical aids, and which would also make the work easier for the crew.

In the longline used by Pacific Oceanic Fisheries Investigations personnel since 1953, a basket comprised 1220' of mainline, with a buoy line at one end and snoods at regular intervals along the mainline. The general disposition was a 59' buoy line and 6 snoods 88' long at a distance of 177' from each other.

However, this being experimental and not commercial gear, the number of snoods and their length varied considerably, as do the length of the buoy lines. Fishing at different depths was therefore possible, and some relation was established between depth and the species caught on the one hand, and between the yield and the number of hooks per basket on the other.

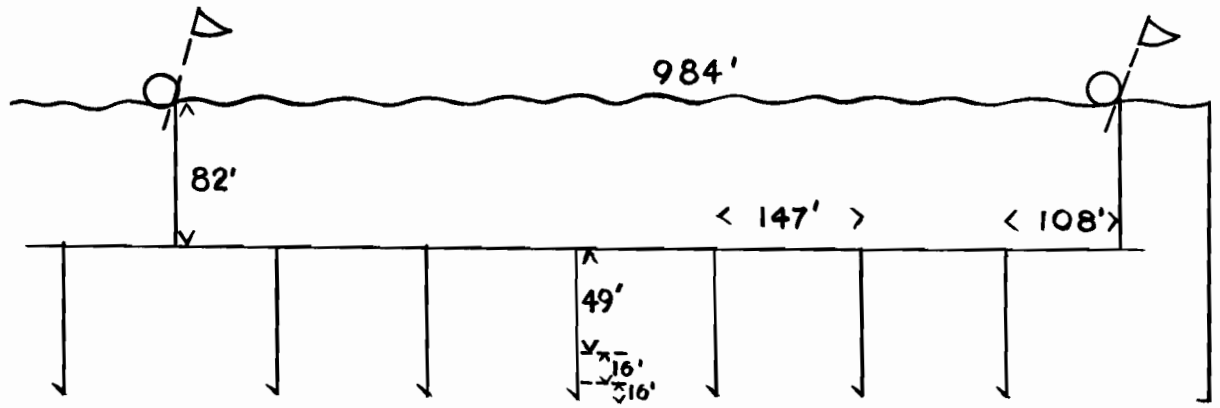
At present, the main line in each basket is made of 14 identical sections 88' long carrying 13 snoods made of 12' cotton line and 6'6" of galvanized steel wire. The buoy lines are 59' long (Plate I, POFI). Most of the bait used is frozen sardine (Sardinops caerulea), imported from California.

One of the main improvements over the types described above has been the almost total elimination of knots; instead, metallic snap fasteners lock into eyes spliced into the line. Operations are quicker, and the crew does not need to be as specialized as before. The crew of an oceanographic research vessel, obviously unused to this fishing method, can shoot a basket in $1\frac{1}{2}$ minutes and haul it in in about $3\frac{1}{2}$ minutes. This makes it possible to use about 40 baskets systematically during experimental cruises.

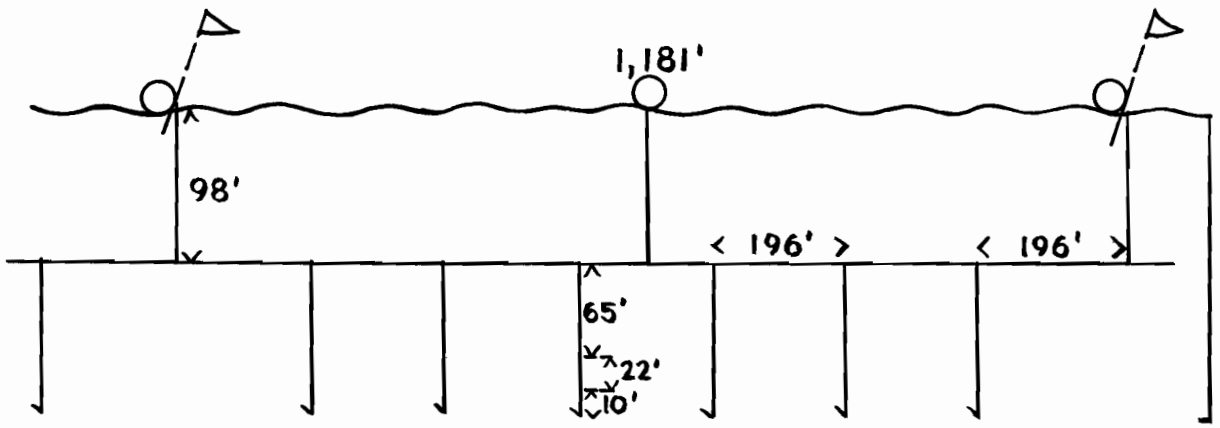
The POFI workers have of course tried to mechanize operations as far as possible. A line hauler of Japanese type is used, and as well, new equipment has been developed.

The main item is a large cylindrical wooden tub revolving on a central pivot and into which is coiled the whole of the mainline. There is therefore no longer any need to divide the latter into separate units. The only removable parts are the buoy lines and the snoods. Each of these is attached with a snap fastener to a D-shaped ring set on the mainline. This D-ring can be strung on one of a number of small rods on the rim of the tub. When a basket has been

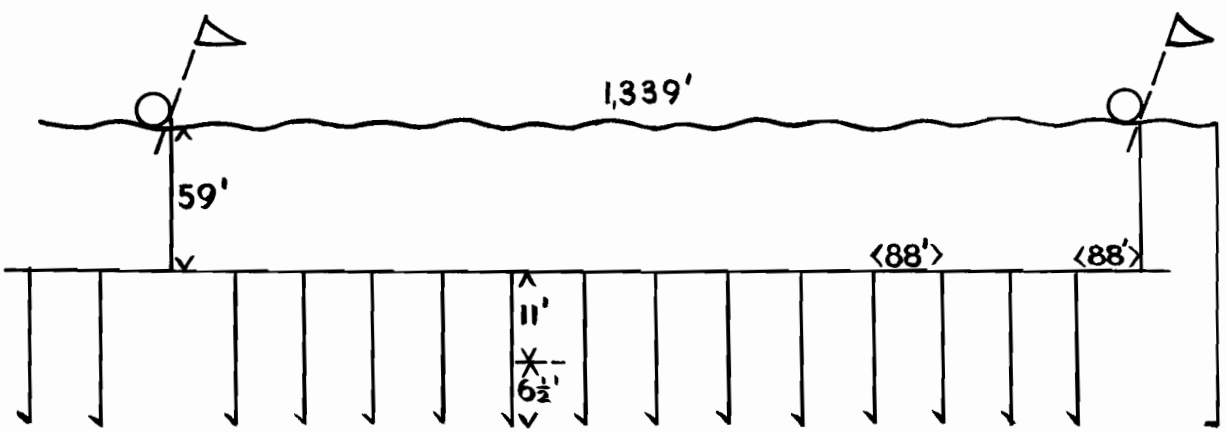
PLATE I



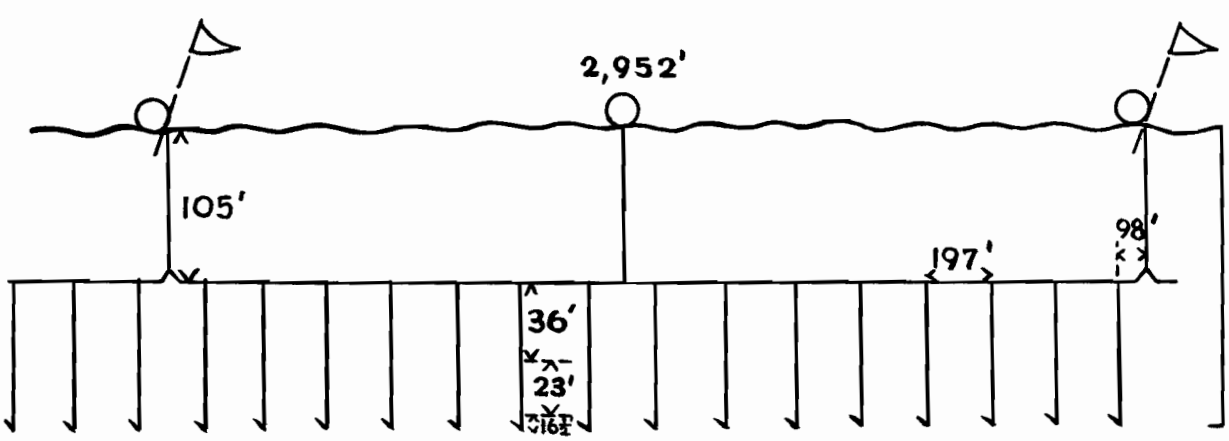
JAPAN



HAWAII



POFI



IFO

hauled in, the tub is pivoted so that the D-rings of the next basket may be strung on the next rod.

The combined use of tub and winch makes it possible to use up to 100 baskets with a crew of only 5, instead of the 11 men required before for 50 baskets. Shooting and hauling-in times remain the same as with the other technique (at least this is so at the time of writing, when initial experiments only with the tub have been completed).

B: Experimental Longlining By The French Institute of Oceania

The Division of Oceanography of the Institut Français d'Océanie has devoted its efforts to a methodical investigation of tuna resources in the vicinity of New Caledonia and the New Hebrides. Experiments have been made with two techniques :

(i) Trolling for surface schools;

(ii) Longlining for deep swimming tuna.

These experiments were made on board "Orsom III", a 73' 90-ton boat equipped with a 135 h.p. diesel and auxiliary sail.

IV: LONGLINING INVESTIGATIONS BY THE FRENCH INSTITUTE OF OCEANIA

Longlining trials were initiated in 1956 by Mr Legand who, even then, foresaw the possibilities for this technique in the area.

In the following sections are briefly described the fishing installations on board "Orsom III", the composition of the longline used at present, and fishing operations.

A: Fishing Installations Aboard "Orsom III"

(a) Shooting Platform

This platform is $6\frac{1}{2}$' x 5' and is placed at the stern, on a level with the gunwale.

(b) Line Hauler

For the last year, a line hauler of classical design (see Photo 2) has been used on board "Orsom III". This is a Japanese IZUI, standard model, 4'8" high, weighing 617 lbs. It is powered with a 5 h.p. Bernard petrol engine.

Before the installation of this line hauler, "Orsom III" could use only an oceanographic winch, with which the line was hauled on a horizontal head. Operations were difficult, the winch being on the after deck and not very suitable for this type of work. Several longlining cruises were nevertheless carried out with this temporary equipment.

The IZUI line hauler was placed on the foredeck, on the starboard side immediately before the bridge, approximately one-quarter of the ship's length from the bows. (If it had been feasible, it would have been placed one-third of the length from the bows).

(c) Work Table

This table is 4'4" long, 2'4" wide and 2'6" high. It is placed next to the line hauler and covers its motor (Plate II, Fig. 2).

As the longline comes out of the hauler, it coils itself on this table. The distance between the lower pulley of the winch and the table determines the diameter of the coils. This distance is about 9" on "Orsom III", and the coils are about 10" in diameter.

PLATE 2

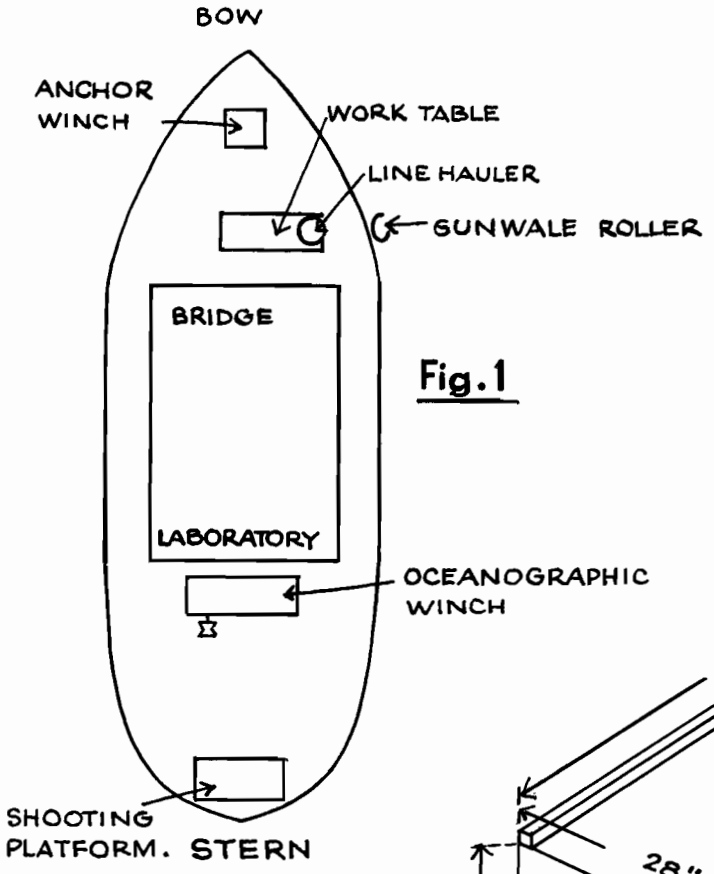


Fig.1

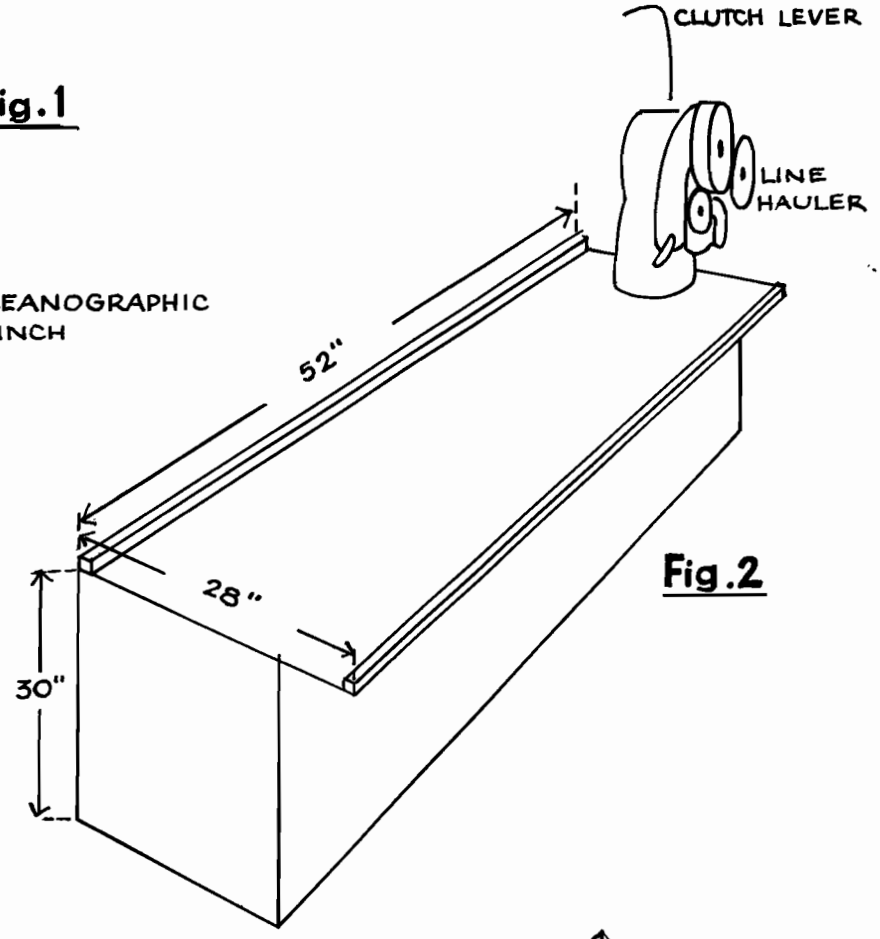


Fig.2

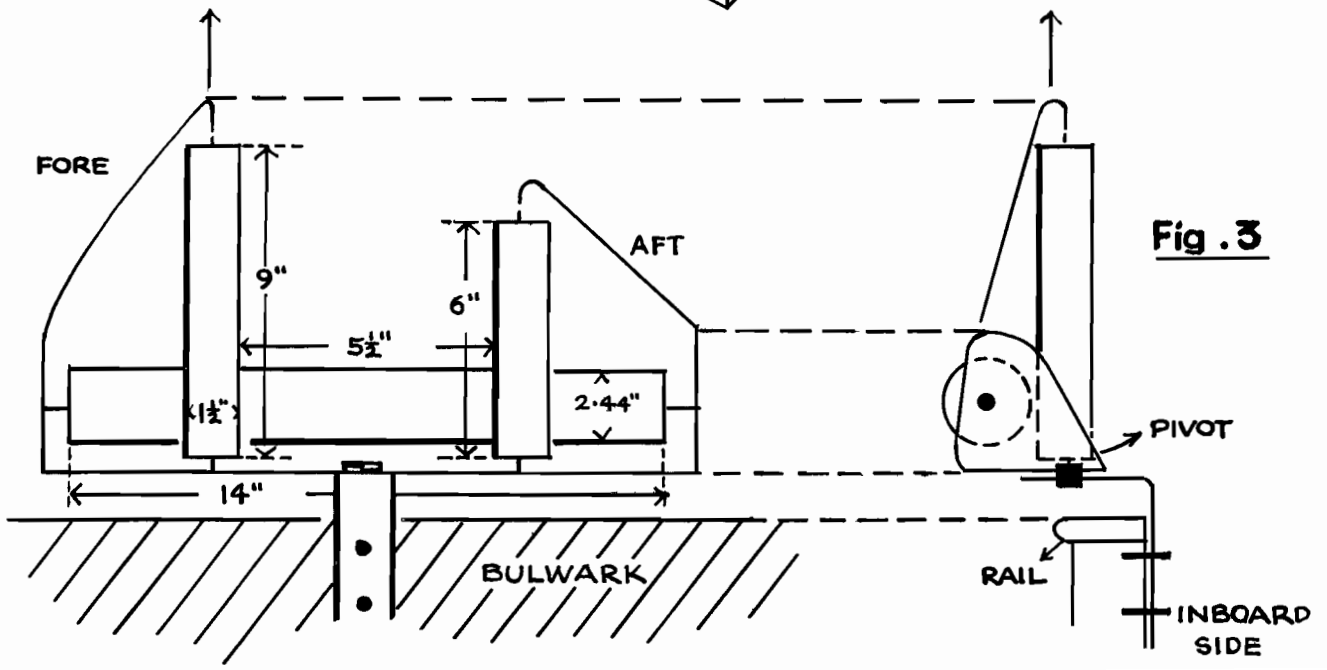


Fig.3

(d) Gunwale Roller

The line comes aboard over a gunwale roller (Plate II, Fig.3). This is identical with those used by Japanese fishermen, and consists of a horizontal roller, guarded at both ends by two vertical rollers.

The rollers are made of bronze. The whole is mounted on a vertical pivot and can be swivelled in any direction.

B: The Longline

Since the first experiments made on board "Orsom III", the longline has been modified several times as regards the number and length of snoods, length of buoy lines and accessories.

Taking into account the results obtained and the exigencies of the technique, operations being of necessity carried out by an untrained crew, the rig described here has proved most practical. This rig was developed and perfected after several experiments in which a most important rôle was played by Mr. Largenton, Chief Officer and fishing specialist.

For experimental fishing, "Orsom III" carries 22 baskets identical with that described below.

(a) General Outline (Plate I, IFO)

Each basket is 2,952' long between end buoys. It is made up of 14 units of 197' tied end to end, and two units of 98', one at each end of the basket. Each basket carries 15 snoods, each 66' long and spaced every 197'.

The flag buoys supporting the basket at each end are linked with the mainline by buoy lines 105' long.

In addition, each basket is supported in the middle (between the 7th and 8th snood) by an intermediate buoy, without flag.

Everything works as if there were two half-baskets, fishing under approximately identical conditions and carrying respectively 7 and 8 hooks.

(b) The Mainline

One part of the mainline is made of 261-thread, hard-laid cotton twine, the other of $\frac{1}{4}$" diameter spun nylon line.

Each 197' unit finishes at one end with an 8" spliced eye, and at the other with a snap fastener of the type used by POFI (AK Snap) made of tinplated

brass.

Each unit is bent to the next with a double sheet bend, tied so that the free end, carrying the snap, dangles approximately 2'4" (Plate III, Fig.1).

Once rigged, the 16 units in a basket are not taken apart unless they become worn or broken.

(c) The Snoods (Plate III, Fig. 4)

Each snood is about 66' long and carries a hook. It is made of three distinct parts which are (from top to bottom) :

(i) A 3-strand sisal line, $\frac{1}{4}$" diameter, 36' long. An eye is spliced at the top for fastening to the snap. At the lower end, it carries a swivel snap.

(ii) A 23' "sekiyama" of classical Japanese type (steel wire core completely served with cotton thread). The "sekiyama" has an eye spliced at each end. One eye is made fast to the swivel snap, the other is looped into a reef knot with the corresponding eye at the top of the wire.

(iii) A steel wire, $6\frac{1}{2}$' long - actually 7 x 25 (or preferably 9 x 27)galvanized wire is used. An eye is made at the top, while the bottom end is simply passed through the eye of the hook and brought up against the standing part. Both the eye at the top and the hook tie are fastened by special "Nicopress" sleeves, swaged with the "Nicopress" tool.

(d) The Hooks (Plate III, Fig. 5)

These are tinned hooks, size 8/0 or 9/0 of the type used by Japanese fishermen. The first experiments were made with American-made "longline hooks".

(e) Buoys And Flags

(i) Buoys: The buoys may be classed into two categories, basket buoys and intermediate buoys -

Basket buoys: These are large rubberized canvas balloons, approximately 22" in diameter, or Japanese glass floats, 1' to 1'2" in diameter. Each float is wrapped in a wide-mesh net of heavy twine, and carries a 10" end of rope finishing with a snap to connect it to the flagpole.

Intermediate buoys: According to the equipment available, metal trawl floats or Japanese glass buoys are used. They

PLATE 3

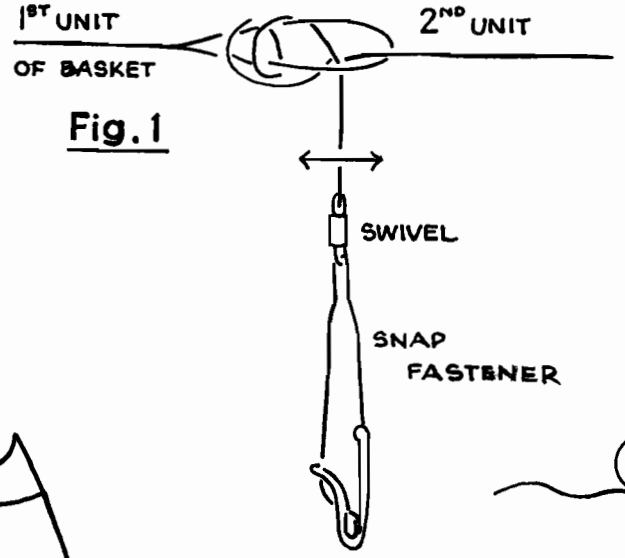


Fig. 1

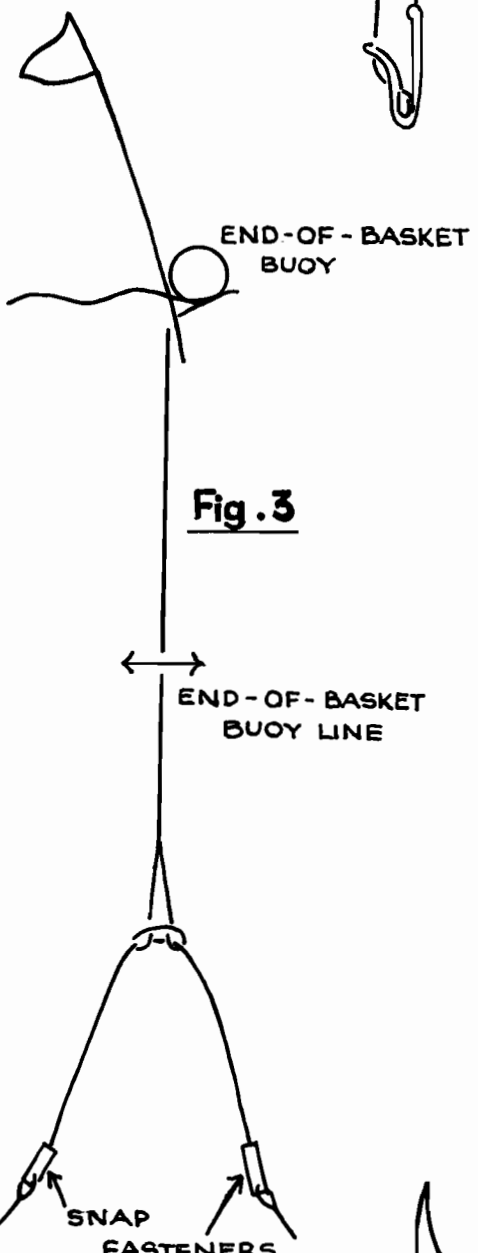


Fig. 3

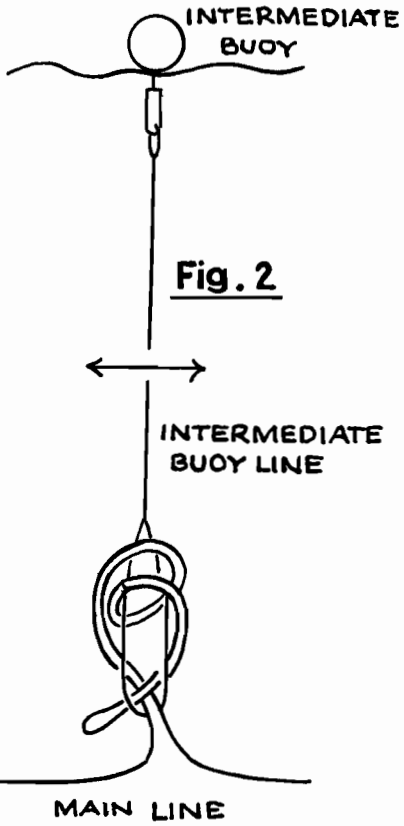


Fig. 2

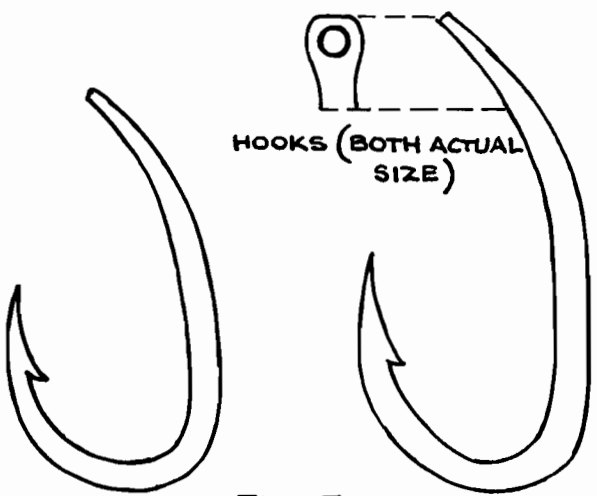


Fig. 5

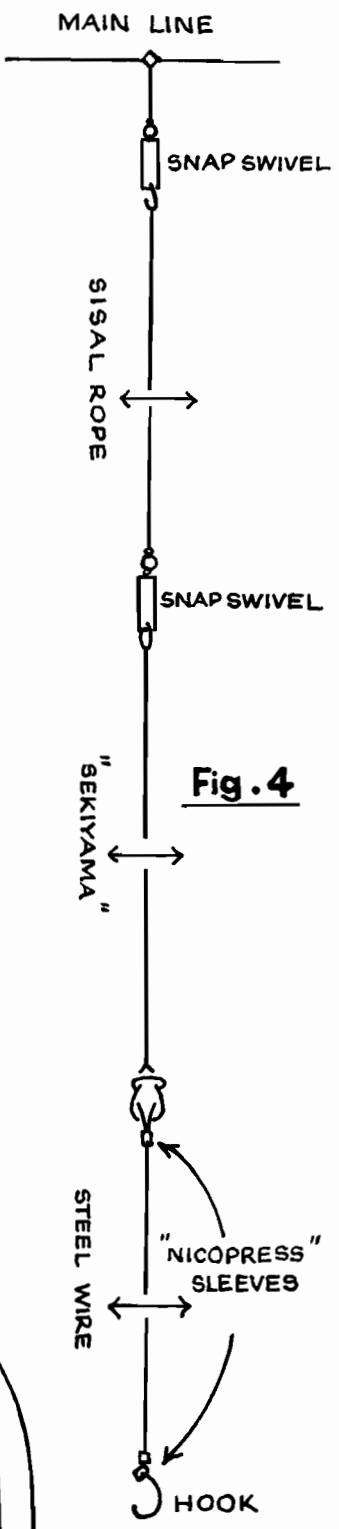


Fig. 4

also carry a short line and snap and are attached directly to the intermediate buoy lines.

(ii) Flags: Each end buoy is attached to a 13' to 16' bamboo pole carrying a bunting flag which makes it easier to locate the longline from a distance. The dimensions or colour of some of the flags help to identify easily the various parts of the longline. The bamboo pole carries at its base a thick whipping which prevents the buoy line from slipping off. A little higher is placed a loop of rope, to which the buoy snap is attached (Plate IV, Fig. 1).

(f) Buoy Lines

The 98' buoy lines are made of 3-strand sisal about 5/16" diameter. An eye is spliced at each end.

If the line is attached at the end of a basket, the bottom eye receives a short length of rope with a snap at each end. One snap fastens into the end of a basket, the other into the beginning of the next basket.

If the line is in the "intermediate" position (Plate III, Fig. 2) part of the main line is doubled, passed through the eye of the buoy line and tied into a double sheet bend. This avoids cutting the mainline and makes any modification such as removing or shifting the buoy much easier.

(g) Light Buoys

In order to work at night, light buoys are necessary. On board "Orsom III", with 22 baskets covering an average distance of 7 to 8 sea miles, 3 light buoys are generally used, occasionally 4 when visibility is bad. Two types are used, according to availability.

(i) Japanese Buoys: A large glass float mounted in a metal frame, supporting a watertight container in which is placed a motorcycle type wet battery; the lamp placed at the top of the frame is about 5' above water.

(ii) French Buoys of the type used by Breton drifters and trawl liners (Plate IV, Fig. 2). An inner tube (motor car) is placed between two wooden crosses and supports a flagpole stiffened by a stay. This pole carries two fittings to which can be hooked watertight, battery-powered electric lanterns. Stability is ensured by hanging 65 to 80 lbs. of pig iron under the buoy.

Light buoys are always attached to a basket end buoy by means of a 32' line. This long line makes it easier to haul the buoy aboard.

(h) Storage Of Baskets

Each basket is wrapped in a square of wide-mesh net with a 20" piece of line at each corner for tying up the bundle.

The snap fasteners of each basket "unit" are snapped in succession along one side of the net so that they come up in order when shooting the line. Buoy lines are coiled on top of the basket before closing the net.

The snoods are carefully coiled and wrapped in similar net squares.

(i) Preservation Of Gear

After each cruise the gear is dried in the sun in the open air and stored in the storeroom. The hooks are greased with tallow. From time to time the line is tanned. All the components of the line are dipped in boiling cutch and dried.

The Japanese method of tarring the lines seems to give efficient preservation, but stiffens the line considerably.

C: Fishing Operations

Before describing in detail the shooting and hauling operations, it may be useful to set out in summarized form the principles which govern the whole of the manoeuvres as they are carried out aboard "Orsom III".

Hauling the gear is always the longest and most delicate part of the operation. It is therefore preferable that it should take place under the best possible conditions. Such conditions are found when, during the hauling, the ship is headed at an angle of 30° to 45° with the direction of the wind. In the case of "Orsom III", the line hauler being to starboard, the gear is hauled with the ship closehauled on the starboard tack; for instance, with a N.E. breeze the course is due north.

It is logical to begin hauling with the first basket shot, so that shooting must be carried out in the same direction as hauling. The course of the ship will therefore be the same during both operations.

The course is determined beforehand, taking into account the prevailing wind and, as far as possible, any variations in wind direction likely to occur in the few hours following.

These manoeuvres are made much easier if the ship can set a jigger sail aft. This sail is sheeted home and keeps the ship's bows into the wind.

These principles are obviously valid only where tide currents are negligible. Wherever such currents are felt, manoeuvering is more difficult, as the

PLATE 4

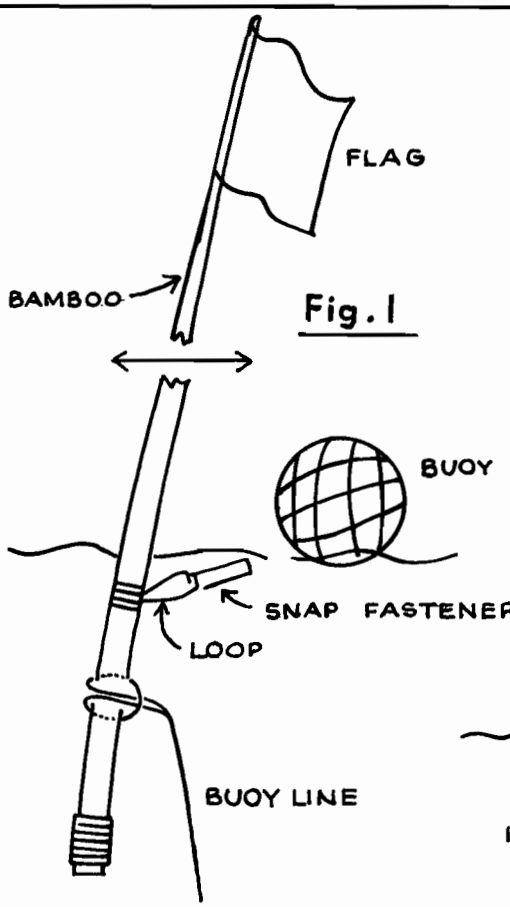


Fig. 1

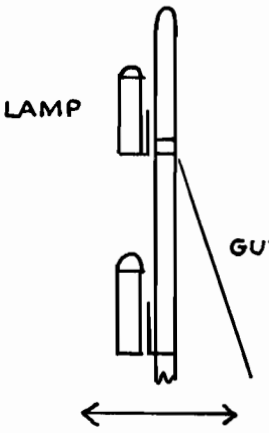
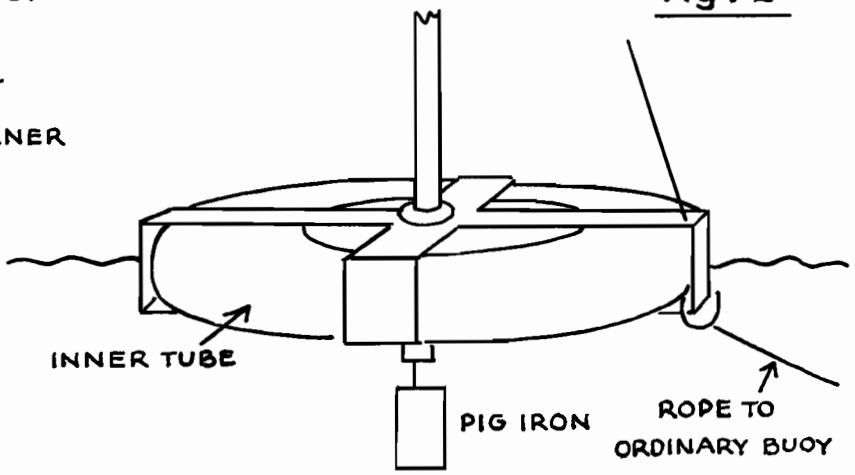


Fig. 2



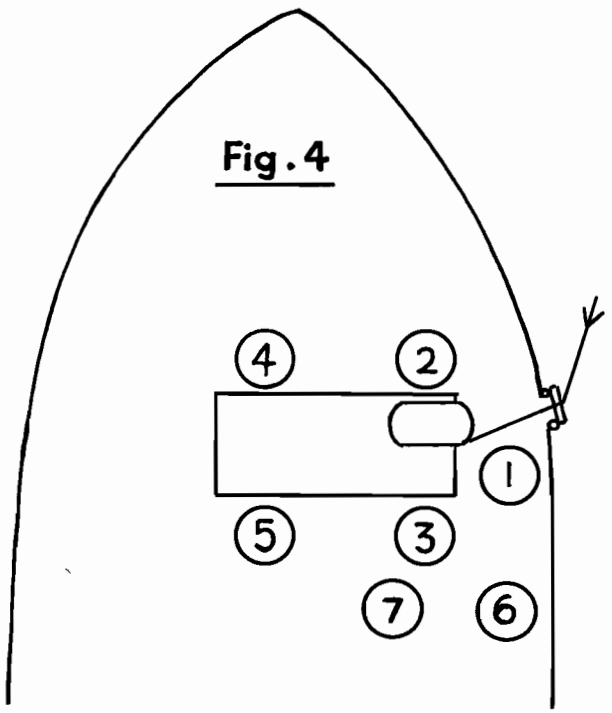


Fig. 4

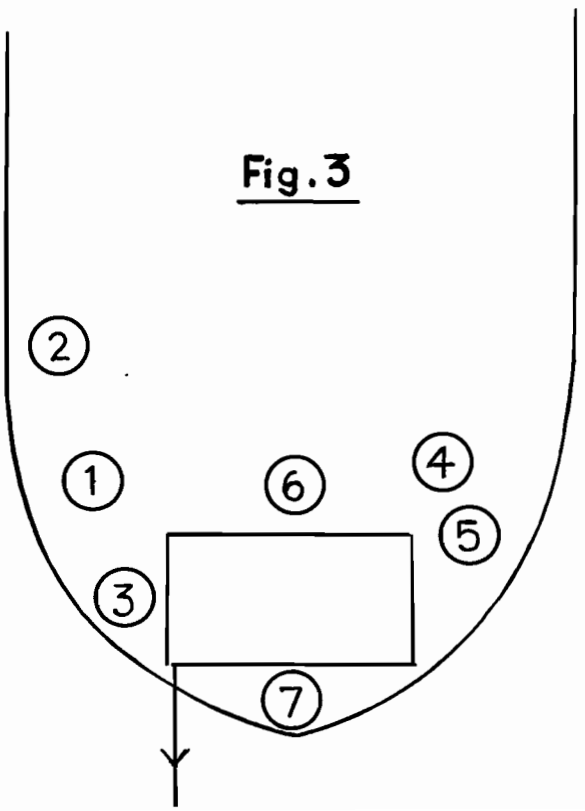


Fig. 3

simultaneous action of winds and currents, as well as the possible predominance of one or another factor during some period of the day must be taken into account.

(a) Shooting The Line

The line is shot from the stern; the baskets are brought to the shooting platform as required.

When frozen bait is used, it should be brought out of the freezer in good time to thaw before use.

During shooting operations, the crew is placed as indicated in Plate IV, Fig. 3, where each crew member is represented by a numeral (see also Photo I). The role of each crew member is as follows :

No. 1 - Fishing master supervises operations. He also opens each basket in turn, ties the end of a basket to the beginning of the next and places the buoy lines in the port alleyway to facilitate as far as possible No. 2's work.

No. 2 - Attaches the basket end buoys and intermediate buoys to the top end of the buoy lines and dumps them overboard as the mainline unrolls. No. 1 helps him to lower the light buoys.

No. 3 - Dumps the mainline overboard, coil by coil, taking care to keep an even tension.

Nos. 4 and 5 - Bait the hooks and pass them on to No. 6. A whole small fish is used in most cases; the point of the hook is pushed into the top of the head and comes out at the level of the gill openings on the ventral side.

No. 6 - Snaps snoods with baited hooks on to the mainline and passes them to No. 7.

No. 7 - Takes the snoods from No. 6 and throws them overboard as the mainline unrolls. This is a delicate task, requiring much attention to prevent tangling and to avoid the bait being knocked from the hook on contact with the water.

The first basket is generally shot rather slowly, then the speed increases to $5\frac{1}{2}$ up to 6 knots, which seems to be a maximum speed for a non-specialized crew such as is employed aboard "Orsom III".

The best time recorded for a 2,952' basket was 3 minutes, but $3\frac{1}{2}$ minutes per basket is the normal average.

During the whole operation the helmsman keeps the ship on course and regulates engine speed to orders given from the stern.

(b) Hauling In

The rôle of each man, whose place is indicated in Plate IV, Fig. 4, (see also Photo 2) is explained below :

No. 1 - Fishing master supervises operations. He picks up each snood as it comes up near the gunwale roller and unfastens it from the mainline if possible. In any case he hands the snood to No. 6.

No. 2 - Regulates the speed of the line hauler with the clutch lever and brake.

No. 3 - Sees that snap fasteners get over the two pulleys of the line hauler, unfastens the snoods if this has not been done, controls the coiling of the main line and pushes the coils towards the net square prepared on the work table by No. 4.

No. 4 - Stows the basket "units" one at a time in the net square, taking care that the ends carrying snap fasteners should remain free and snapping them in their turn on to the edge of the net (Photo 2).

No. 5 - Coils the buoy lines as soon as they come aboard and places them on top of the basket. He closes the net and stows the whole bundle on the foredeck. As this is intermittent work, No. 4 can lend a hand wherever it is needed.

No. 6 - Receives the snoods from No. 1, coils them quickly and passes them on to No. 7. He also hoists aboard the buoys, unfastens the buoy lines and flagpoles, and stows the poles on top of the bridge.

No. 7 - Receives the snoods from No. 6 and stows them away in net squares.

When a fish is sighted by No. 1, he and No. 6, as well as all crew members not directly participating in the operation (engineer, cook, etc.) pull the fish aft, where it is brought aboard as far as possible. In the meantime, No. 5 substitutes for No. 1 and carries on at reduced speed.

The rôle of the helmsman during this operation is to keep the boat at an angle of 30° to 45° with the longline. He must also regulate the speed according to the wind, the direction of the seas and the way the longline comes in. An even strain must be kept on the line without making it too taut. If the line "tends" aft, speed must be reduced and it may be necessary to stop and even to go astern.

Under normal working conditions, the crew of "Orsom III" takes about 9½ minutes to haul one 2,952' basket carrying 15 hooks.

(c) Likely Incidents During Hauling Operations

Three types of incidents may arise - tangled line, broken line, capture of very large fish :

(i) Tangles are by far the most frequent incident; in most cases they are caused by the struggles of a large fish (swordfish, shark etc.). The first thing to do is to bring the whole tangled lot as it is on deck, then try to find the free end, to resume hauling with the winch. Practice makes it easier to take the necessary decisions.

(ii) Breaks in the line are caused by a wrong manoeuvre, or by gear in poor condition, or sometimes by the struggles of a very large fish, although this is very rare. The boat goes to the next buoy, which is picked up, and while a few men haul in the broken end, the rest of the crew resume normal hauling.

(iii) The presence of very large fish on the line may disturb the rhythm of the work, as it is generally necessary to stop hauling to allow the whole crew to help bring the fish on deck. The helmsman must then manoeuvre to get some slack in the line, so that the drift of the ship will not break it. Hauling large fish aboard is much easier if the ship is equipped with a small cargo boom.

As soon as the longline is aboard, all the gear is carried aft for the next shoot. If necessary, tangled baskets set aside during the hauling operations are set to rights.

V: RESULTS OF EXPERIMENTAL FISHING WITH "ORSOM III"

A: Bait

At first, small fish caught with seines or drift nets off the shores of New Caledonia were used. These included Rastrelliger, Chirocentrus, Gerres and Hemiramphus. Unfortunately, investigations indicated that the fish were too scattered to provide regularly the required quantities of bait.

Frozen sauries (Cololabis saira) imported from Japan were then used. These are the bait normally used aboard Japanese longliners.

Our best yields appear to have been obtained with saury bait, probably on account of their firm flesh, which holds well on the hook.

B: Catches

The most important species of tuna caught on the longline by "Orsom III" is the Albacore (Germo alalunga) (Photo 4). Its average weight is 45 lbs., and it is generally caught on the deepest hooks as it is a cold-water fish which, in tropical areas, lives deep down.

Large yellowfin tunas (Neothunnus macropterus) are also caught, as well as a closely-related species, the bigeye tuna (Parathunnus sibi). These two species average 110 lbs. and sometimes weigh over 220 lbs. Swordfishes from 65 to 550 lbs. and over (Photo 3) are not uncommon (blue marlin: Makaira ampla; striped marlin: Makaira audax; spearfish: Tetrapturus sp.; broadbill swordfish: Xiphias gladius).

Besides commercially-valuable species, catches include various sharks, true parasites of the longline, which damage both the gear and the fish already hooked (Photo 5). Finally, deep-living and little-known species are brought up such as the lancet fish (Alepisaurus sp.) and the king of herrings (Trachypterus sp.). These are mere oddities to the professional fisherman, but priceless to the biologist.

Taking into account only the fish of commercial value (tuna and swordfishes), since the gear was perfected and the crew had gained sufficient experience, the yields obtained were satisfactory - 3 fish per 100 hooks on the average, with a maximum of 5 per 100 hooks - 3% is considered sufficient by Japanese fishermen to make operations self-supporting. It should be noted that the Japanese fish with lines covering distances of 25 miles, with which they

Photo 3. Hauling up an average (242 lbs.) striped marlin (Makaira audax).

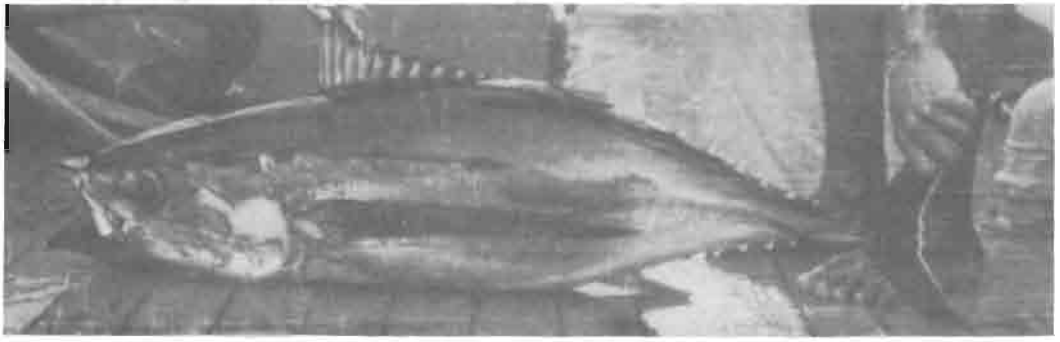


Photo 4. Typical longline fish, the albacore (Germo alalunga). This specimen weighed 44 lbs.

Photo 5. A large yellowfin tuna (Neothunnus macropterus) badly damaged by sharks.

obviously have more chances of coming across schools of tuna than the IFO personnel with their line covering about 7 miles.

The results obtained in January and May 1959 in the area W.S.W. of New Caledonia show a catch composition of 45% albacore, 27% yellowfin, 15% bigeye and 13% swordfish. The average weight of fish is about 88 lbs. In comparison with previous catch records of "Orsom III", these figures indicate that albacore are present in this locality at various times of the year, bigeye are also present - at least in Autumn - while yellowfin and swordfishes appear to be present all the year round. It should also be noted that shark catches have become much rarer during the last cruises, most likely because the line was set over 50 miles from the coast, well away from the areas where these predators are normally concentrated.

C: Conclusions

The experimental nature of longlining operations carried out on board "Orsom III" by the scientific and technical staff of IFO should be emphasized. The small number of baskets used (22 baskets of 2,952' equivalent to 66 Japanese baskets, 55 Hawaiian baskets or 52 POFI baskets), the far-from-perfect adaptation of the ship to this fishing technique, the lack of specialization of the crew of a research vessel, are all factors which should lead to the above-mentioned results being considered merely as indicating possibilities. It seems likely that a commercial fishing craft, specially-equipped and manned, would have obtained better results than "Orsom III", both in total weight and yield in the same fishing areas.

It seems, therefore, that longlining could probably be successfully used for the commercial exploitation of tuna in the waters surrounding New Caledonia.

(Continued from outside back cover)

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