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INTERREGIONAL FISHERIES DEVELOPMENT AND MANAGEMENT PROGRAMME
(WECAF Component)

REPORT ON MISSION TO THE NETHERLANDS ANTILLES (BONAIRE)



UNITED NATIONS DEVELOPMENT PROGRAMME



FOOD AND AGRICULTURE ORGANIZATION OF
THE UNITED NATIONS

Interregional Fisheries Development and Management Programme
(WECAF Component)

Report on Mission to the Netherlands Antilles (Bonaire)

by

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INTERREGIONAL FISHERIES DEVELOPMENT AND MANAGEMENT PROGRAMME

The Interregional Fisheries Development and Management Programme began its activities on 1 January 1980. It has three components (Headquarters, CECAF and WECAF) and the WECAF component is the successor of the Interregional Project for the Development of Fisheries in the Western Central Atlantic (WECAF) which was initiated in March 1975 and terminated its second phase on 31 December 1979. Its objectives are to assist developing coastal countries in assessing development opportunities offered by their available fishery resources and to formulate appropriate actions, to promote the rational utilization of fishery resources, to promote the development of technical and economic cooperation among countries of the region and to assist in the upgrading of their human resources. Its activities are coordinated by the Western Central Atlantic Fishery Commission (WECAFC) established by FAO in 1973. The Project is supported by the United Nations Development Programme (UNDP) and the Food and Agriculture Organization of the United Nations (FAO) as the Executing Agency.

As with the previous project, two series of documents will be prepared to provide information on activities and/or studies carried out. This document is the thirty third of the series WECAF Reports. The other series of documents is entitled WECAF Studies.

D.A. Lintern
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1. Conclusions and Recommendations

1.1 Conclusions

During this programme a total of 271 hours were spent at sea during 26 days. Some technical problems hampered the regular operation of the boat. The acoustic equipment had a very poor performance. Fish was also rather scarce. Some clear results were however obtained, the principal being the following:

(a) six trolling lines, instead of the two or three traditionally used by the local fishermen, are not an advantage for fishing wahoo and barracuda. However, they are superior to the traditional system for fishing yellowfin tuna, little tunny, frigate mackerel and dolphin;

(b) fish bait is the best for fishing wahoo, barracuda and dolphin, while artificial bait is superior for other species;

(c) for the pelagic species acoustic information is of great value for concentrating the fishing effort around mid-water concentrations of small fishes such as little tunny, frigate mackerel and small yellowfin tuna, and thus for increasing the chances of catching bigger fishes. This information could also be used for gill-netting mid-water operations oriented toward the exploitation of the pelagic species. Other advantages which were demonstrated were:

(1) concentration of the fishing effort in the best bathymetric interval for pelagic as well as for demersal species is greatly facilitated; (2) it is easier to observe bottom fish concentrations;

(d) no pelagic species were found during two exploratory cruises carried out toward the northwest and southeast of Bonaire;

(e) the actual technique for catching bait fish, mostly maulo, is adequate and, in spite of some difficulties and irregularities, does not seem easy to improve without introducing more sophisticated and costly methods;

(f) snappers and related species do not seem to offer very great potential, the essential findings were that night catches were superior to day time catches by some 32 percent and that light and thin gear had much better results than the stout lines usually used in other parts of the Caribbean Sea;

(g) the same observations applied for the pelagic species, the clearness of the water calls for the use of the finest gear possible and, finally, the selection of this gear has to be a compromise between solidity and fineness;

(h) no definite results could be obtained during a too short effort with bottom longlines and gill-nets. It seems, however, that some possibilities exist on the sandy-rocky and rather gently sloping continental shelf of the northeastern and eastern waters of Bonaire;

(i) fish traps, which were used by Venezuelan boats in the northeastern waters, could also offer the possibility of a heavier exploitation of the snapper and related species stock;

(j) the fishermen have a good level of seamanship and fishing experience. Their knowledge is high concerning the catching of the big pelagic species with trolling line. They demonstrated a strong interest about the use of the echosounder for pelagic and bottom species fisheries;

(k) the fishermen interested in the hiring of the 8.40 m boats of Visindustrie are mostly young men. They are good fishermen but, being generally without family and thus without social obligations, are rather erratic in their activities. For this reason the boats are little used;

(l) it would seem necessary to attract the older fishermen toward these boats but these are actually reluctant to hire units which are constantly plagued with mechanical troubles;

(m) these boats are in effect in very poor state, due essentially to a complete lack of organized maintenance;

(n) the general impression after the completion of this programme is that some fairly good possibilities are still existing to improve and develop fisheries in Bonaire. To do so the following recommendations should be taken into consideration.

1.2 Recommendations

1.2.1 Pelagic Species

(a) For wahoo and barracuda it is recommended to continue the actual system of working with only two or three lines baited with maulo; for the other pelagic species it is recommended to use as many lines as possible with artificial bait;

(b) for deep-water trolling the use of a planner-like depressor is recommended;

(c) since the use of the echosounder permits to locate mid-water fish agglomerations on which the fishing effort can be concentrated, it is recommended to introduce an echosounder sufficiently powerful and sensible to obtain as much information as possible (the basic characteristics of this equipment are given in Annex 4).

1.2.2 Demersal Fish

(d) light and fine fishing gear is recommended as well as night operations;

(e) hydraulic reels complicate the maintenance of the boats. The installation of manual reels is preferred and could improve the catch of demersal species;

(f) for the acoustic equipment the same recommendations as in (c) apply.

1.2.3 Future Technical Trends for Development

(g) For the pelagic species it is recommended to experiment, adapt and, if adequate, introduce the following techniques:

- mid-water gill-netting for the small and medium size pelagic fishes located by acoustic observations;
- mid-water horizontal longlines for big pelagic fish;
- raft attraction, mainly along the eastern continental shelf drop-off;
- live bait fishing with handlines, the bait being stored in a tank on board;
- surface gill-netting for flying fish in connexion with chumming attraction;
- surface gill-nets and lampara net in connexion with chumming and/or light attraction for small pelagic coastal species, maulo and masbangu.

(h) The same tactic is recommended for the demersal species with the following techniques:

- bottom gill-nets on the eastern and southeastern continental shelves;
- bottom longlines in the same area;
- Z-type fish traps in the same area and along the drop-off.

1.2.4 Acoustic Equipment

(i) The importance of this equipment for fishing pelagic and demersal species was indicated in (c) and (g) and it is recommended to equip the boats with an adequate unit of the type indicated in Annex 4. Fishermen would need to be practically trained in the use of this equipment.

1.2.5 Boats and Infrastructure

(j) The 8.40m fibreglass boats are adequate for polyvalent artisanal fishing in Bonaire. They need however some improvements as recommended in Annex 4;

(k) these boats are actually suffering from a complete lack of organized maintenance. It is felt that if this situation is not urgently changed the entire efforts for developing fisheries in Bonaire will collapse rapidly. It is therefore strongly recommended to organize a permanent maintenance service. This service would have to carry out a daily control of the boats.

A small modern dock should be installed, with fresh water and fuel supplies sufficient for the entire fleet. In its vicinity, a small workshop with the necessary tools and spare parts could be installed and all the maintenance operations and equipment should be under the entire responsibility of an experienced and serious technician.

1.2.6 The Fishermen

(l) The recommendations given in (i) and (k) are of utmost importance for attracting more fishermen and the best elements of them in hiring and using the 8.40 m boats with the final results of a better use of the capital invested, of more employment opportunities and of a greater production. It is thus another time recommended to repair and maintain the entire fleet;

(m) in order to avoid difficult control and useless friction with the fishermen when prices are decreasing, it is recommended to leave fishermen free to sell their production at the prices they can get, on the condition that they pay regularly the hiring of the boat or that they give Visindustrie the 30 percent representing the hiring cost;

(n) practical training should be continued for the use of acoustic equipment and for the introduction of any technique proven to be effective.

1.2.7 Fleet Control

It is recommended to establish a system which could permit obtaining a constant control of the boats' activities. This could be done with an exploitation sheet of the type given in Annex 6. This sheet would permit not only control of the exploitation but, also, to gather the detailed information necessary for the improvement of the said exploitation and also for resource assessment.

2. Introduction

The Netherlands Antilles are actually in the process of developing the full exploitation of their fishery resources. As a first step in this policy, an artisanal fisheries venture was started in Bonaire in 1978. A fleet of six 8.40 m fibreglass boats was introduced in the island. This fleet, owned by the Central Government and the Local Government on the basis of an equal share, is actually managed by a Governmental enterprise, Visindustrie, which rents it to the local fishermen on a daily rent basis.

In May 1979, the Central Government Fisheries Division in Curaçao requested the technical assistance of the Interregional Project for the Development of Fisheries in the Western Central Atlantic (WECAF) with the objectives of (a) improving the results of the new fleet in Bonaire and (b) establishing a general programme for the future fisheries development in the Netherlands Antilles.

The recommendations of this first WECAF mission were to carry out two development programmes: (a) a short-term coastal fisheries development programme in Bonaire and (b) a long-term distant water fisheries development programme. The first of these programmes was divided into two phases: (a) a first phase of immediate technical assistance with the essential objective of improving the catches of the new fleet based in Bonaire; (b) a second phase, more experimental than the first, aimed at developing the fisheries of the little or non-exploited resources.

An FAO consultant masterfisherman was then sent to Bonaire for the completion of the first phase of the first programme. This report indicates the results obtained and observations made during this mission.

3. Development Programme - Phase 1

During the first week of his assignment, the consultant masterfisherman was assisted by the WECAF fishing technologist. He just exploited commercially the stock of pelagic species and snappers, without any attempt to carry out exploratory or experimental fishing. His objectives were the following:

(a) To use his boat to her maximum capacity in order to try to catch more fish than the local fishermen, who are using the same 8.40 m boat but actually using only three trolling lines, no echosounder and no hydraulic reels.

(b) To transfer his experience to the local fishermen immediately and directly on board their own boat, when they have been attracted by his superior results. This experience will be related to the following essential topics:

- rigging and manoeuvring of six to eight trolling lines instead of the three actually used;
- using the hydraulic snapper reels for the trolling lines;
- acoustic fishing with the trolling lines by constant crossing of the continental shelf drop-off;
- adaptation of the trolling speed, fishing depth and bait type and size to the fish species, size and behaviour;
- very deep close-to-the-bottom trolling;
- snapper fishing with the boat heaving-to;
- reading and interpretation of the echosounder;
- adjustment, maintenance and repair of the echosounder.

(c) To study the marine fauna and environment in order to identify as many development opportunities as possible for further development.

(d) With the help of the WECAF fishing technologist, to provide the Government with a comprehensive final report and a complete fishing log.

As can be seen, this phase concentrated on the two factors essential to any artisanal fisheries development: first, the superiority of the new techniques was visually demonstrated to the fishermen; secondly, the experience of the more experienced fisherman was transferred to the one who is less skilled, at the latter's own request, on board his own boat and on the fishing grounds he knows well.

4. Boat, Gear and Methods

4.1 Boat

The boat assigned to the programme is the standard 8.40 m unit introduced into Bonaire by the Government Fisheries Development Programme. This unit has the following principal characteristics:

- material: fibreglass
- length O.A: 8.40 m
- length W.L.: 7.30 m
- beam: 2.90 m
- depth: 0.75 m
- weight: 3.2 t
- engine: Tempest diesel, 70 hp at 2 500 rpm
- reduction: 2 : 1
- speed: 12 knots
- fuel capacity: 380 l
- water: 60 l
- fish holds: 1.2 m³
- bunk: 2
- trolling booms: 2 aluminum, \emptyset 4 cm, 5.20 m
- echosounder: 550 m range, Gemtronic GT 120 2D
- radio: 1 SSB
- snapper reels: 2 hydraulic

4.2 Gear and Methods

4.2.1 Trolling Lines

Various types of trolling lines were used. Their description is given in Annex 2 as well as in Figures 1, 2 and 3.

4.2.2 Bottom Snapper Lines

These lines were used in connexion with the snapper reels which, after several breakdowns, had to be transformed into manual reels. Description of this gear is given in Figures 4 and 5.

4.2.3 Shark Longlines

Two attempts were made with this gear in mid-water. No results were obtained.

4.2.4 Bottom Gill-net

A 50 m long gill-net was used occasionally. Its principal characteristics were: 6 cm stretched meshes, multifilament PA R 100 Tex (210/4), 150 M.D.

4.2.5 Other Methods

Acoustic surveys as well as visual observations by diving were carried out.

5. Results and Observations

5.1 General Results

- fishing days	26
- hours at sea	271
- hours fishing	200
- approximate linear acoustic survey in miles	1 200
- production surface fish in kg	271
- production bottom fish in kg	275

Details of the operations are to be found in the fishing log given in Annex 3.

5.2 The Boat

Generally speaking the 8.40 m boat is well designed for the fishing conditions in the area. Its simplicity and good seaworthiness are important advantages. It suffers, however, from several defects which are due, not to conceptual or basic building errors but, to: (a) a lack of contact between the boat-builder and the users, and these are the ones providing the boat-builder with the constructive criticisms based on the operation at sea of any new unit, and (b) a nearly complete lack of maintenance. The essential results of this state of affairs is that the fleet is actually underused. During this programme, for example, only two of the six Visindustrie boats were working.

Annex 4 indicates the essential points for the improvement of the boats and their exploitation.

5.3 Gear and Methods

5.3.1 Trolling Operations

Two principal facts were first observed: (a) that the local fishermen did not use the two 5.20 m booms, working with an average of two lines when the booms offered the possibility to work with up to six lines, and (b) that most of the time they used only maulo (*Decapterus macarellus*, *D. punctatus*) for bait. It was also observed that no echosounder was utilized and that most of the fishing effort was taking place in the morning, along the continental shelf drop-off and in the vicinity of the capes of Willemstore, Boca Spelonk, Boca Cocolishi, Oude Toren and Wekoewa Punt (see Figure 6).

The experimental work was oriented on: (a) the use of six lines with the booms; (b) the use of artificial bait in comparison with the natural one and (c) the systematic use of the echosounder. In addition, effort was concentrated on the investigation of the coastal waters little exploited by the local fishermen, on more distant waters to the northwest and southeast of Bonaire, on deep-water trolling, on the effect of trolling speed and on the catch of bait fish.

The observations resulting from these studies were the following:

(a) No problems were met in using six trolling lines, even with only one man on board (see Figure 1). Six trolling lines had no bigger catches than the two to four-line system used by the local fishermen for wahoo (Acanthocybium solanderi) and barracuda (Sphyræna barracuda). This indicates a decrease of the fishing productivity when six lines are used and seems to explain the reason why local fishermen have reduced their number of lines. It is believed that, as wahoo and barracuda are generally found in a very dispersed pattern, the operation of two to four lines is adequate for productivity reasons and also because less bait fish is consumed.

Six trolling lines had bigger catches than the traditional two to four-line system for the following species: yellowfin tunas (Thunnus albacares), little tunny (Euthynnus alletteratus), frigate mackerel (Auxis thazard) and dolphin (Coryphaena hippurus). It is therefore believed that the six-line system could result in a better productivity when the previous species are met. These species are gregarious, and this behaviour is certainly better exploited with numerous lines.

(b) The fish bait, maulo, was superior for wahoo fishing. No wahoo was caught with artificial lures, even if these were working at the same depth as the fish baits (see Annex 2). Barracudas and dolphins also indicated a rather strong preference for maulo bait. Other natural baits such as frigate mackerel and msbangu (Selar cremenophthalmus) had approximately the same results as the maulo for the three previous species although with less success. On the contrary, of the previous species, yellowfin tuna, little tunny and frigate mackerel indicated preference for artificial lures. The best of them were: (a) big octopus, 23 cm, brown, for big yellowfin tunas, marlins and other big fishes; (b) octopus, 10 cm, yellow or blue, for yellowfin tuna and frigate mackerel; (c) octopus, 6-8 cm, yellow or blue, for frigate mackerel; (d) nylon jig, 6.5 cm, with 20 gr lead, yellow and red, for frigate mackerel; and (e) feather, 13-19 cm, with 30 gr lead, white and red or yellow and red, for frigate mackerel (see Annex 2).

(c) The echosounders had poor performance (Annex 4) and did not permit an efficient location of mid-water schools. It was only during the last days of the programme that this situation could be slightly improved and permitted work on fish echoes located from 10 to 40 m below the surface (Figure 7). As soon as these echoes were observed the fishing effort was concentrated on them and captures were made, mainly frigate mackerels, yellowfin tunas and wahoos. The fishermen were greatly interested in these results.

(d) The systematic investigation of the coastal waters indicated a rather definite concentration of the species in the areas not yet exploited by the local fishermen, with the best ones being located to the east and northeast of Bonaire (see Figure 6).

(e) The exploration carried out in more distant waters to the northwest and southeast of Bonaire had no results. Only flying fishes were sighted (see Figure 6).

(f) It was visually observed that the 5 kg lead traditionally used by the local fishermen was sinking at a depth of about 6 m at a trolling speed of 3.5 to 4.5 knots. Heavier leads were experimented with but without apparent improvement of the catch. It seems that if deep-water trolling was tried in the future, planner type depressors should be used.

(g) The best trolling speed was found to be between 3 and 5 knots.

(h) The catch of bait fish, maulo, is rather irregular. The best fishing times are at daybreak and sunset. More irregular catches can take place from 06.30 to 10.00 hours and from 16.00 hours to sunset. No catches are made at night. The actual catching method with chumming and handline is good, but other techniques would be necessary to ensure a regular and sufficient production. Due to the lack of gear no experiments could be made. However, it seems that light gill-nets or lampara style nets in connexion with chumming or light attraction could have results.

5.3.2 Demersal Handline Fishing

It was observed that demersal species are little exploited in Bonaire and that this activity was generally carried out with: (a) light handlines with three hooks, (b) maulo bait, (c) in the 50-240 m interval, (d) mostly during daytime and sometimes at night, in periods of full moon, and (e) on very definite fishing grounds.

The investigatory effort was oriented on: (a) the use of hydraulic snapper reels, (b) the utilization of types of lines of current use in the rest of the Caribbean Sea, (c) the systematic use of the echosounder, (d) the exploration of the grounds little exploited by the local fishermen and (e) comparative fishing between day and night operation. Observations were also made as regards, (f) catch composition and sizes of red snappers, and (g) the catch of Venezuelan trap boats arrested in the local waters where they were illegally fishing.

The observations resulting from this work were the following:

(a) As stated in Section 5.2.2, the hydraulic reels could not be used due to constant breakdowns of the pump and hoses. They were transformed into manual reels.

(b) The typical Caribbean snapper line was found to be less effective than the local lighter type (Figures 4 and 5) which, after some comparative fishing, was adopted for the programme.

(c) In spite of its weakness and defects, the echosounder facilitated the positioning of the fishing effort in the good bathymetric interval, between 70 and 220 m. It also made it possible to obtain demersal echoes on

which the effort was concentrated, (Figure 8). These results strongly interested the fishermen.

(d) The exploration around Bonaire indicated that some fishing grounds were little known by the local fishermen, such as, for example, the southern coast of Klein Bonaire. It also indicated that this resource is distributed all around the island with, however, apparently better densities along the eastern and northeastern coasts (see Figure 9).

(e) Another important difference was observed between day and night catches, the latter being 32 percent higher. The hourly catches in kilos by line are given below:

	<u>Day</u> (kg)	<u>Night</u> (kg)
- red snapper	0.54	1.40
- grouper	0.60	0.50
- jacks	1.15	1.42
- shark	<u>0.00</u>	<u>0.05</u>
Total	2.29	3.37

These results were in accordance with those of a local boat mainly involved in the fishing of snapper and related species, which generally obtained average catches in the same ranges. However, it was observed that the local fishermen concentrate their effort during daytime. In view of the above figures, it would seem preferable to work during night time.

(f and g) The sizes of the red snappers were found to be generally small. The catches made during the programme, as well as those made by the Venezuelan boat arrested in Bonaire waters, and which was working with 17 fish traps of the Z-type, were checked and gave the following results:

<u>T r a p s</u>			<u>L i n e s</u>		
<u>Length</u>	<u>Circumference</u>	<u>Percentage</u>	<u>Length</u>	<u>Circumference</u>	<u>Percentage</u>
53 cm	41 cm	5	62 cm	48 cm	10
46	35	15	46	35	40
37	26	60	37	26	45
26	18	20	26	18	5

5.3.3 Longlining

Two attempts were made with shark longlines, 15 hooks each, anchored in mid-water during night time in 40-70 m to the east and west of Bonaire. No results were obtained.

5.3.4 Gill-netting

The bottom gill-net was worked during three nights in the Lagoen. The catches were approximately 5 kg for the first night and 20 kg for the

second, and consisted mainly of bone fish. No catches were made during the third night. This net was not sufficiently strong and suffered extensive damages from the floor, sharks and crabs. A better adapted type of net could apparently obtain better results.

5.4 Ichthyological Observations

5.4.1 Pelagic Species

Most of the wahoos were caught on the continental shelf and along its drop-off mainly in the 40-220 m. As mentioned above, the majority of them were found near the cape and, as was apparently demonstrated by the acoustic observations, around mid-water schools of smaller fishes. The best fishing hours for this species were found to be from 06.30 to 11.00 hours (see Annex 5).

The length of the captured wahoos was observed to be in the 90 to 180 cm range and their weight in the 6-31 kg range.

All of them were found to have one to five big leech-like parasites in their stomach.

Barracuda were caught generally between 07.00 and 12.00 hours (see Annex 5).

Yellowfin tunas were observed in the same areas as the wahoos, but nearly all of them were caught in the vicinity of acoustic fish echoes.

Smaller species such as little tunny, small yellowfin tunas and frigate mackerel were identified as the principal components of the fish acoustic echoes observed between 10 and 40 m below the surface (see Figure 7). These schools were apparently extending along a height of 10 to 16 m, which seem to indicate that rather important resources were possibly existing. The sizes were observed to be in the 25-65 cm range for the total length, and in the 14-43 cm range for the thoracic circumference.

5.4.2 Demersal Fishes

Red snappers were observed to have a more active behaviour at night (see Section 6.3.2). This species and the related ones were found to be in apparently weak densities. This could be the effect of a rather unsuitable environment, more particularly bottoms offering little coral and rocky outcrops.

Red snapper stomachs were observed to contain some shrimps, squillas and fish eggs.

5.4.3 Other Species

Few sharks were seen. About 25 sea turtles were observed at the entrance of Lagoen, two at the surface, the rest were observed during diving activities. Most of them were grazing on seaweeds. During the same diving operations, about 30 spiny lobsters were observed (see Figure 9).

5.5 Environmental Observations

5.5.1 The Sea

Weather conditions were good during the programme. Wind speeds were 17-25 knots until mid-October and then decreased to 5-10 knots. Ninety percent of the winds were from the east sector. The sky was generally cloudy 50 percent of the time and rain fall reached 48 mm.

Currents were observed to be stronger, in time of full moon and there was more seaweed and wooden pieces drifting at the surface.

5.5.2 Sea Floor

All around Bonaire, the 200 m line is found at less than one mile from the shore. The continental shelf is thus very narrow and its drop-off very steep. In such conditions, the 70-220 m interval, in which snappers and related species concentrate, is very narrow. Such a reduced surface cannot obviously sustain an important population.

On the east and northeast coasts, the continental shelf presents a gentler slope than on the western side. Visual observations during diving operations indicated that these eastern and northeastern floors are generally sandy and rocky and covered with sea grass. They offer some facilities for fishing with bottom gill-nets and bottom longlines. The western shelf on the contrary is rather rough and dominated by madrepores and corals.

5.6 The Fishermen

They were observed to possess a good degree of seamanship and a fair technical level within the techniques they are used to. Most of them are young and unmarried. This could explain their rather erratic behaviour and, for some of them, the lack of interest in working regularly at sea, every day of the week.

As all fishermen around the world, they look at new techniques with some circumspection but, if it can be proved to them that these techniques can improve their income per unit of fishing effort, it is believed they will not hesitate to assimilate them.

During this programme excellent contacts were made with them and it can be stated that they were strongly interested in: (a) the results of acoustic fishing for pelagic species (b) the same results for snapper fishing, (c) the advantage of numerous lines for tuna-like fishes.

Direct Effects on Fishing of Length of the Lines
Compositions of the Lines, Lead, Fish Bait,
or Artificial Bait

Due to the clearness of the water, to several changes of boat and crew and to the scarcity of the fish during this consultation, too many different trials were made. This did not permit obtaining statistical data for each kind of lines.

Some general conclusions and impression could however be obtained:

Trolling Lines

Number of fish caught: wahoo, barracuda, dolphin, yellowfin tuna and bonitos: 56

Number of days trolling: 22

Number of lines: 2 to 6.

Size and Kind of the Lines (see Figures 1 and 2)

1° Starboard: 40 fathoms braided line + 10 fathoms monofilament + 2 fathoms steel wire + artificial bait.

2° Starboard: 20 fathoms braided line + lead + 5 kg + 10 fathoms monofilament + 2 fathoms steel wire + artificial bait.

1° Stern: 24 fathoms braided line + lead 5.5 kg + 10 fathoms monofilament + 2 fathoms steel wire + fish bait.

2° Stern: 45 fathoms monofilament + 2 fathoms steel wire + fish bait

2° Port: 20 fathoms braided line + lead 4.5 kg + 10 fathoms monofilament + 2 fathoms steel wire + fish bait.

1° Port: 40 fathoms braided line + 10 fathoms monofilament + 2 fathoms steel wire + artificial bait.

Fishing Log

Date: 06.10.79 Trolling Line
Starting Time: 04.45 h
Returning Time: 12.00 h
Fishing Duration: 05.00 h
Fishing Zone: 1.2
Depth: 50-150 m
Sea-wind: Calm - 5-20 kn
Nebulosity: 3/4
Gear: 6 lines (3 artificial lures (A.L.), 3 fish bait (F.B.))
Strike: 0
Catch: 0
Observations:

Date: 06.10.79 Bottom Handline
Starting Time: 14.00 h
Returning Time: 19.00 h
Fishing Duration: 04.00 h
Fishing Zone: 1
Depth: 40-200 m
Sea-wind: Calm - 5-15 kn
Nebulosity: 3/4
Gear: 1 line
Strike: 0
Catch: 0
Observations:

Date: 07.10.79 Trolling Line
Starting Time: 14.00 h
Returning Time: 19.00 h
Fishing Duration: 04.00 h
Fishing Zone: 1
Depth: 40-200 m
Sea-wind: Calm - 5-15 kn
Nebulosity: 1/4
Gear: 5 lines (5 A.L., 2 Lead)
Strike: 0
Catch: 0
Observations:

Date: 08.10.79 Trolling Line
Starting Time: 04.15 h
Returning Time: 16.30 h
Fishing Duration: 10.00 h
Fishing Zone: 1, 2, 3 and 4
Depth: 40-200 m
Sea-wind: Choppy - 5-20 kn
Nebulosity: 3/4
Gear: 6 lines (3 A.L., 3 F.B., 3 Lead)
Strike: 5
Catch: 4 dolphin, 2 wahoo, 1 barracuda
Observations:

Date: 09.10.79 Trolling Line
Starting Time: 04.15 h
Returning Time: 15.30 h
Fishing Duration: 09.00 h
Fishing Zone: 1,2, 3 and 4
Depth: 50-200 m
Sea-wind: Calm - Choppy - 5-20 kn
Nebulosity: 3/4
Gear: 6 lines (3 A.L., 3 F.B., 3 Lead)
Strike: 5
Catch: 1 bonito, 1 yellowfin tuna, 2 barracuda
Observations:

Date: 10.10.79 Trolling Line Exploration
Starting Time: 04.30 h
Returning Time: 18.00 h
Fishing Duration: 11.00 h
Fishing Zone: 30 mi, ESE Willemstoren
Depth: 40-700 m
Sea-wind: Choppy - 15-20 kn
Nebulosity: 2/4
Gear: 6 lines (3 A.L., 3 F.B., 3 Lead)
Strike: 5
Catch: 1 barracuda, 1 wahoo
Observations: Poorness of this area during this period

Date: 11.10.79 Trolling Line
Starting Time: 04.20 h
Returning Time: 15.30 h
Fishing Duration: 09.00 h
Fishing Zone: 1, 2, 3 and 4
Depth: 30-200 m
Sea-wind: Calm, Choppy - 5-15 kn
Nebulosity: 2/4
Gear: 6 lines (3 A.L.)
Strike: 11
Catch: 4 bonitos, 1 barracuda
Observations: Great number of strike

Date: 12.10.79 Trolling Line / Hand Bottom Line
Starting Time: 04.30 h
Returning Time: 17.30 h
Fishing Duration: 11.00 h
Fishing Zone: 2, 3 12°18.0' N - 68°21.3' W
Depth: 30-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 3 lines (1 A.L., 2 F.B., 2 Lead) / 2 red snapper lines
Strike: 3
Catch: 3 bonitos, 5 red snappers, 5 groupers, 11 jacks
Observations:

Date: 13.10.79 Trolling Line Exploration
Starting Time: 04.30 h
Returning Time: 17.30 h
Fishing Duration: 11.00 h
Fishing Zone: 30 mi WNW Wekoewa Cape
Depth: 50-2 000 m
Sea-wind: Choppy - 5-15 kn
Nebulosity: 2/4
Gear: 6 lines (4 A.L., 2 F.B., 3 Lead)
Strike: 2
Catch: 0
Observations: Poorness of this area. Existence of flying fish

Date: 14.10.79 Maintenance of the Boat
Starting Time:
Returning Time:
Fishing Duration:
Fishing Zone
Depth:
Sea-wind:
Nebulosity:
Gear:
Strike:
Catch:
Observations:

Date: 15.10.79 Hand Bottom Line
Starting Time: 04.30 h - 10.30 h
Returning Time: 09.30 h - 16.30 h
Fishing Duration: 05.00 h
Fishing Zone: 1, 12°03.8' N - 68°19.5' W
Depth: 70-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 1/4
Gear: 1 red snapper line
Strike:
Catch: 4 red snappers, 3 jacks, 1 grouper
Observations:

Date: 16.10.79 Trolling Line
Starting Time: 04.30 h
Returning Time: 14.30 h
Fishing Duration: 08.00 h
Fishing Zone: 1, 2, 3 and 4
Depth: 40-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 1/4
Gear: 6 lines (3 A.L., 3 F.B., 3 Lead)
Strike: 4
Catch: 3 wahoo, 1 barracuda
Observations:

Date: 17.10.79 Trolling Line / Hand Bottom Line
Starting Time: 04.30 h
Returning Time: 16.00 h
Fishing Duration: 09.00 h
Fishing Zone: 1, 2, 3 12°14.9' N - 68°15.3'W
Depth: 40-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 3/4
Gear: 4 lines (1 A.L., 3 F.B., 1 Lead) / 2 red snapper lines
Strike: 4
Catch: 12 red snappers, 1 grouper, 1 jack, 1 barracuda
Observations:

Date: 18.10.79 Hand Bottom Line / Night Long Line
Starting Time: 17.00 h
Returning Time: 21.30 h
Fishing Duration: 03.00 h
Fishing Zone: 3 12°12.0'N - 68°11.5'W
Depth: 100-150 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 4/4
Gear: 1 red snapper line, 1 long line (15 hooks)
Strike:
Catch: 1 red snapper
Observations:

Date: 19.10.79 Hand Bottom Line
Starting Time: 05.30 h
Returning Time: 17.00 h
Fishing Duration: 06.00 h
Fishing Zone: 3 12°15.0' N - 68°17.5' W
Depth: 80-240 m
Sea-wind: Calm - 5-15 kn
Nebulosity: 4/4
Gear: 1 red snapper line
Strike: 5
Catch: 1 jack
Observations: Other boat 20 kg red snapper 200 m deep fishing

Date: 20.10.79 Hand Bottom Line
Starting Time: 09.30 h
Returning Time: 17.30 h
Fishing Duration: 06.00 h
Fishing Zone: 2 12°15' N - 68°25' W
Depth: 80-180 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 1 red snapper line
Strike:
Catch: 1 salvonechi
Observations:

Date: 21.10.79 Maintenance of the Boat
Starting Time:
Returning Time:
Fishing Duration:
Fishing Zone:
Depth:
Sea-wind:
Nebulosity:
Gear:
Strike:
Catch:
Observations:

Date: 22.10.79 Trolling Line
Starting Time: 04.30 h
Returning Time: 15.30 h
Fishing Duration: 09.00 h
Fishing Zone: 1, 2, 3 and 4
Depth: 30-220 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 3/4
Gear: 6 lines (3 A.L., 3 F.B., 2 Lead)
Strike: 2
Catch: 1 wahoo
Observations:

Date: 23.10.79 Masbangu Fishing / Longline Shooting
Starting Time: 05.00 h - 17.00 h
Returning Time: 11.00 h - 19.00 h
Fishing Duration: 05.00 h
Fishing Zone: 1 12°05' N - 68°17.3' W
Depth: 6-15 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: Sweep net (castnet) masbangu line / bonito line
Strike:
Catch: 26 kg masbangu (Selar Cremenophtalmus), 5 bonitos
Observations:

Date: 24.10.79 Trolling Line
Starting Time: 04.30 h
Returning Time: 15.00 h
Fishing Duration: 08.00 h
Fishing Zone: 1, 2, 3 and 4
Depth: 40-220 m
Sea-wind: Calm - Choppy - 5-20 kn
Nebulosity: 4/4
Gear: 4 lines (4 F.B., 2 Lead) / 1 bonito line (A.L.)
Strike: 8
Catch: 1 barracuda, 3 bonitos
Observations:

Date: 25.10.79 Trolling Line
Starting Time: 06.00 h
Returning Time: 15.00 h
Fishing Duration: 08.00 h
Fishing Zone: 4, 3, and 2
Depth: 40-220 m
Sea-wind: Calm - 5-15 kn
Nebulosity: 3/4
Gear: 2 lines (F.B.) 1 Lead
Strike: 7
Catch: 1 wahoo, 2 barracudas
Observations:

Date: 26.10.79 Look for two new boats in Curacao but
after checking, water in fuel
Starting Time:
Returning Time:
Fishing Duration:
Fishing Zone:
Depth:
Sea-wind:
Nebulosity:
Gear:
Strike:
Catch:
Observations:

Date: 27.10.79 Trolling Line
Starting Time: 06.00 h
Returning Time: 12.00 h
Fishing Duration: 05.00 h
Fishing Zone: 3, 4 (Boca Spelonk)
Depth: 40-220 m
Sea-wind: Calm - 5-15 kn
Nebulosity: 3/4
Gear: 2 lines (F.B.) 1 lead
Strike: 4
Catch: 1 wahoo
Observations:

Date: 28.10.79 Diving Survey
Starting Time: 06.00 h - 16.00 h
Returning Time: 12.00 h - 18.00 h
Fishing Duration: 07.00 h
Fishing Zone: 12°12.8' N - 12°07.5' N - 68°11.9' W - 68°12.0' W
Depth: 5-30 m
Sea-wind: Calm
Nebulosity: 2/4
Observations: Species met: snappers, jacks, groupers, caranx, barracuda,
lobsters, turtles, skate, Observed the existence of a
continental shelf available for shooting net.

Date: 29.10.79 Not any sailing due to lack of crew,
Starting Time: and boat fitting of echosounder on
Returning Time: boat No. 2
Fishing Duration:
Fishing Zone:
Depth:
Sea-wind:
Nebulosity:
Gear:
Strike:
Catch:
Observations:

Date: 30.10.79 Trolling Line / Hand Bottom Line
Starting Time: 06.00 h - 16.00 h
Returning Time: 11.00 h - 04.00 h (31.10.79)
Fishing Duration: 14.00 h
Fishing Zone: 3, 4 68°12.3' N - 12°13.7' W
Depth: 40-250 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 4/4
Gear: 2 lines (F.B.) 1 lead, 3 red snapper lines
Strike: 4 - 1 big shark
Catch: 1 barracuda, 37 red snappers, 15 jacks, 30 groupers
Observations:

Date: 31.10.79 Trolling Line / Hand Bottom Line Net
Starting Time: 06.00 h - 17.00 h
Returning Time: 10.00 h - 03.00 h (01.11.79)
Fishing Duration: 12.00 h
Fishing Zone: 3, 4 12°14.3' N - 68°16.7' W
Depth: 40-250 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 2 lines (F.B.) 1 lead, 3 red snapper lines, 1 net
Strike: 4
Catch: 2 wahoo, 45 red snappers, 15 jacks, 1 shark
Observations:

Date: 01.11.79 Trolling Line / Hand Bottom Line Net
Starting Time: 06.00 h - 16.00 h
Returning Time: 12.00 h - 02.00 h (02.11.79)
Fishing Duration: 13.00 h
Fishing Zone: 3, 4 12°01.7' N - 68°14.1' W
Depth: 40-250 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 2 trolling lines (F.B.) 1 lead, 1 net, 2 bonitos lines (A.L.)
3 red snapper lines
Strike: 6
Catch: 1 wahoo, 2 barracudas, 4 yellowfin tuna, 30 red snappers,
5 jacks, 3 groupers
Observations: fishing on fish detection

Date: 02.11.79 Trolling Line Net
Starting Time: 06.00 h
Returning Time: 13.00 h
Fishing Duration: 06.00 h
Fishing Zone: 3, 4
Depth: 40-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 2 trolling lines (F.B.) 1 lead
Strike: 7
Catch: 2 wahoo, 1 barracuda
Observations: Fishing of wahoo on echosounder fish detection

Date: 03.11.79 Not any sailing due to lack of crew and boat
Starting Time:
Returning Time:
Fishing Duration:
Fishing Zone:
Depth:
Sea-wind:
Nebulosity:
Gear:
Strike:
Catch:
Observations:

Date: 04.11.79 Trolling Line / Acoustic Survey / Diving Survey
Starting Time: 07.00 h
Returning Time: 16.00 h
Fishing Duration: 04.00 h
Fishing Zone: 3, 2, 1
Depth: 5-80 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 2 bonitos line (ART. L)
Strike: 3
Catch: 10 bonitos, 1 caranx
Observations: Fishing of bonitos and caranx on echosounder fish detection

Date: 05.11.79 Trolling Line
Starting Time: 06.00 h
Returning Time: 11.00 h
Fishing Duration: 04.00 h
Fishing Zone: 3, 4
Depth: 40-200 m
Sea-wind: Calm - 5-10 kn
Nebulosity: 2/4
Gear: 3 trolling lines (3 F.B.) 2 lead
Strike: 9
Catch: 1 wahoo, 1 barracuda
Observations: Third boat; no detection due to deficient transducer.

The 8.40 m Fibreglass Boat
Modifications, Repairs and Maintenance

1. Hull and Boat in General

Some details are not well finished at construction level. These are:

- fish hold covers, the edges are quickly worn out;
- battery box cover, the edges are quickly worn out;
- draining holes, most of the time not at level with the floors, lacking in some places as the lateral deck shelves;
- bulkwarks: sharp angles;
- port holes and cabin hatches: not waterproof;
- wheelhouse: bad visibility and ventilation, requires sliding window on the starboard side.

2. Engine

In consideration of the difficulties met in the maintenance, more particularly the electrical circuits, it is strongly recommended to equip all engines with a hand starter. This would avoid boat losses in case of impossibility to re-start the engine while fishing to the windward of Bonaire, which is the most frequent case. This would also avoid dangerous drifting in open sea when the boat is fishing in deep waters off the south, west and north coasts.

3. Electric Installation

These installations burnt away on most of the boats actually in use. There is no switch to isolate the battery from the rest of the circuits. The battery box has no padlock. The switches are of bad quality and destroyed by sea water.

4. Fuel Oil System

The tank is not waterproof. Water enters maybe through the top window and surely through the inlet which is at floor level. This one has to be lifted. There is no efficient system for the drainage of the tank. A bronze hand pump should be installed.

5. Rudder

The limitator of rudder angles is not strong enough (plywood). This could bring a rupture in case of a hard turn on the wheel and thus damage the rudder and propeller. This limitator should be made of bronze.

6. Galley

The Primus-like burner is extremely dangerous in the way it is used by the crew. A propane burner, with the bottle installed on the wheelhouse deck, would be much better.

7. Echosounder

The echosounder actually in use has very poor performance. This state of affairs seems to be due to the type of equipment itself, and also to leaks in the circuits. Anyway, important information such as bottom discrimination and fish echoes cannot be obtained.

The basic characteristic of an adequate unit will be:

- depth ranges:

Shallow		Deep		Sounding rates PPM	Pulse Length M/Sec	Paper speed mm/min
1	0 - 80 m	1	70 - 150 m	186	1	5.5
2	0 - 160 m	2	140 - 300 m	93	2	2.8
3	0 - 320 m	3	280 - 600 m	46.5	2	1.4

- recording paper: dry, 150 mm width;
- transmitter output: 125 w, reduced 10 w;
- frequency: 50 kHz
- transducer: 50 kHz, 28°, 3 dB;
- power on/off;
- selector;
- white line control;
- gain control;
- zero line shift;
- TVG control (time and level);
- power supply: DC 12 V
- power reduction switch (125 and 10 w).

Annex 4

Pelagic Fishes -- Relation Between Catches and Time of the Day

DAY	05	04	03	02	01	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06
HOUR																															
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19																															

W = Wahoo
 B = Barracuda
 b = Bonitos
 D = Dolphin
 y = Yellowfin Tuna
 Starting or Ending Time of Fishing Operations
 Repairs = Defect of the Boat
 Demersal = Demersal Hand-line Fishing Operations
 ADS = Acoustic and Diving Survey

Exploitation Sheet

- Date
- Boat No.
- Skipper's name
- Number of crew members
- Starting and ending time of fishing operations
- Area fishing
- Fishing technique
- Number of fishing units
- Fish number and weight by species

Wahoo Barracuda Dolphin Yellowfin Little tunny Frigate Mackerel

Marlin Other Pelagic Red Snapper Grouper Jacks Other Demersal

- Reason of non-exploitation
 - no hiring
 - lack of crew
 - bad weather
 - lack of fish
 - holiday
 - breakdown (details)
 - others

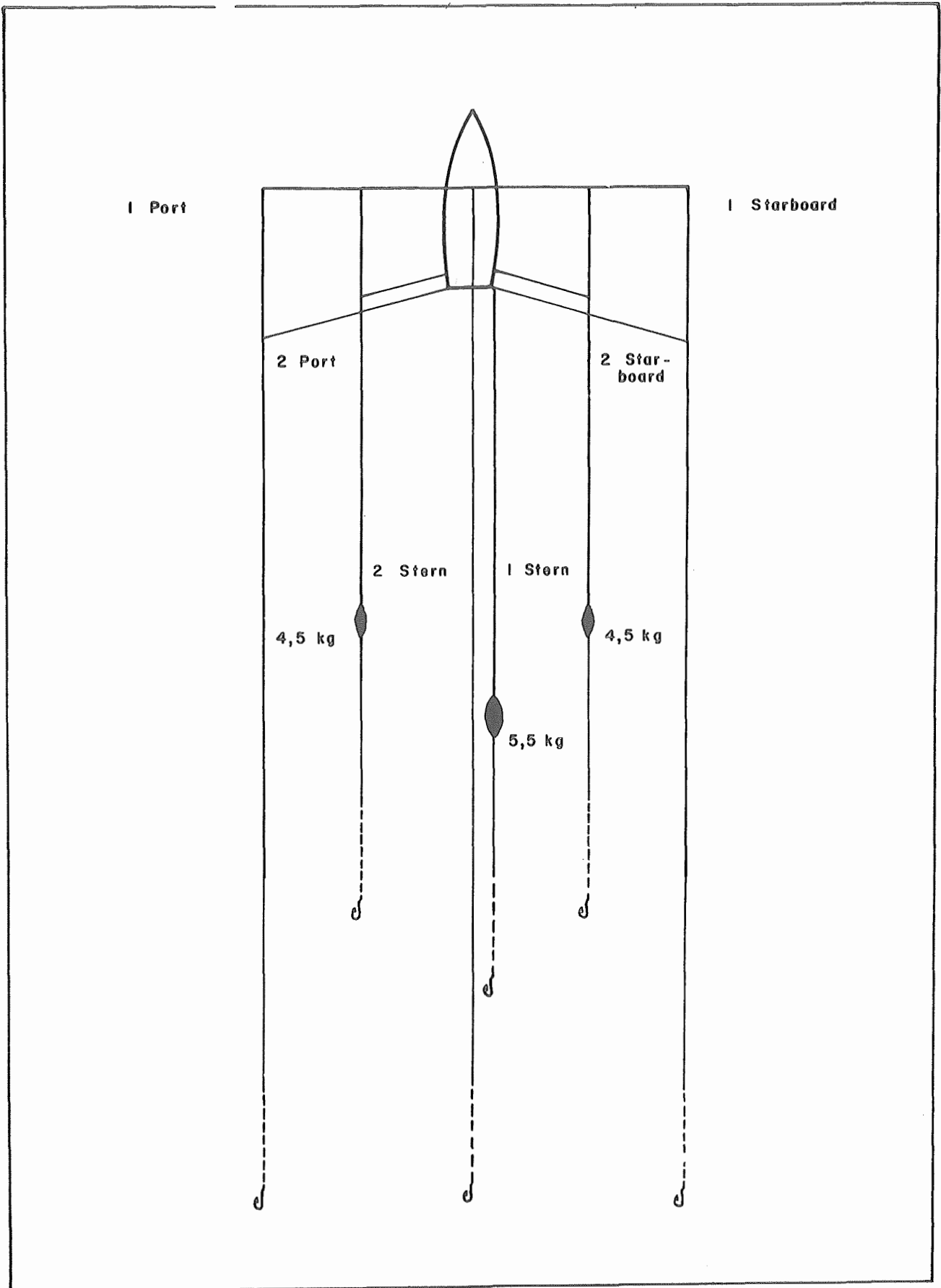
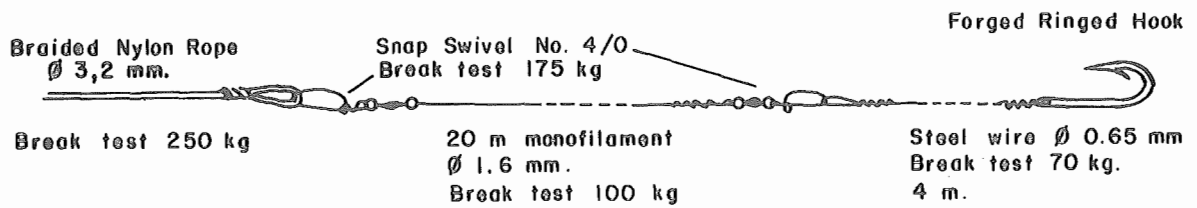


FIGURE 1.- GENERAL DISPOSITION OF THE MULTIPLE TROLLING LINES

Fish Bait Trolling Line (See also Figure 3)



Bonitos Line

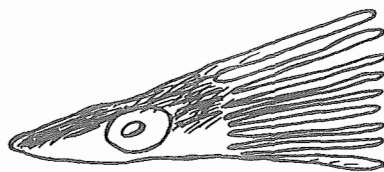
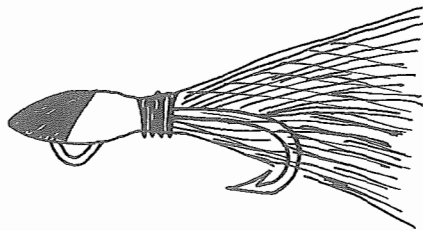
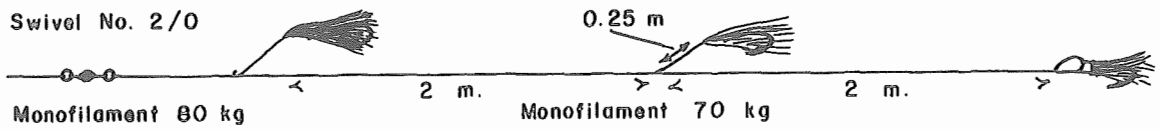


FIGURE 2.- LEADERS FOR FISH BAIT AND ARTIFICIAL BAIT TROLLING LINES

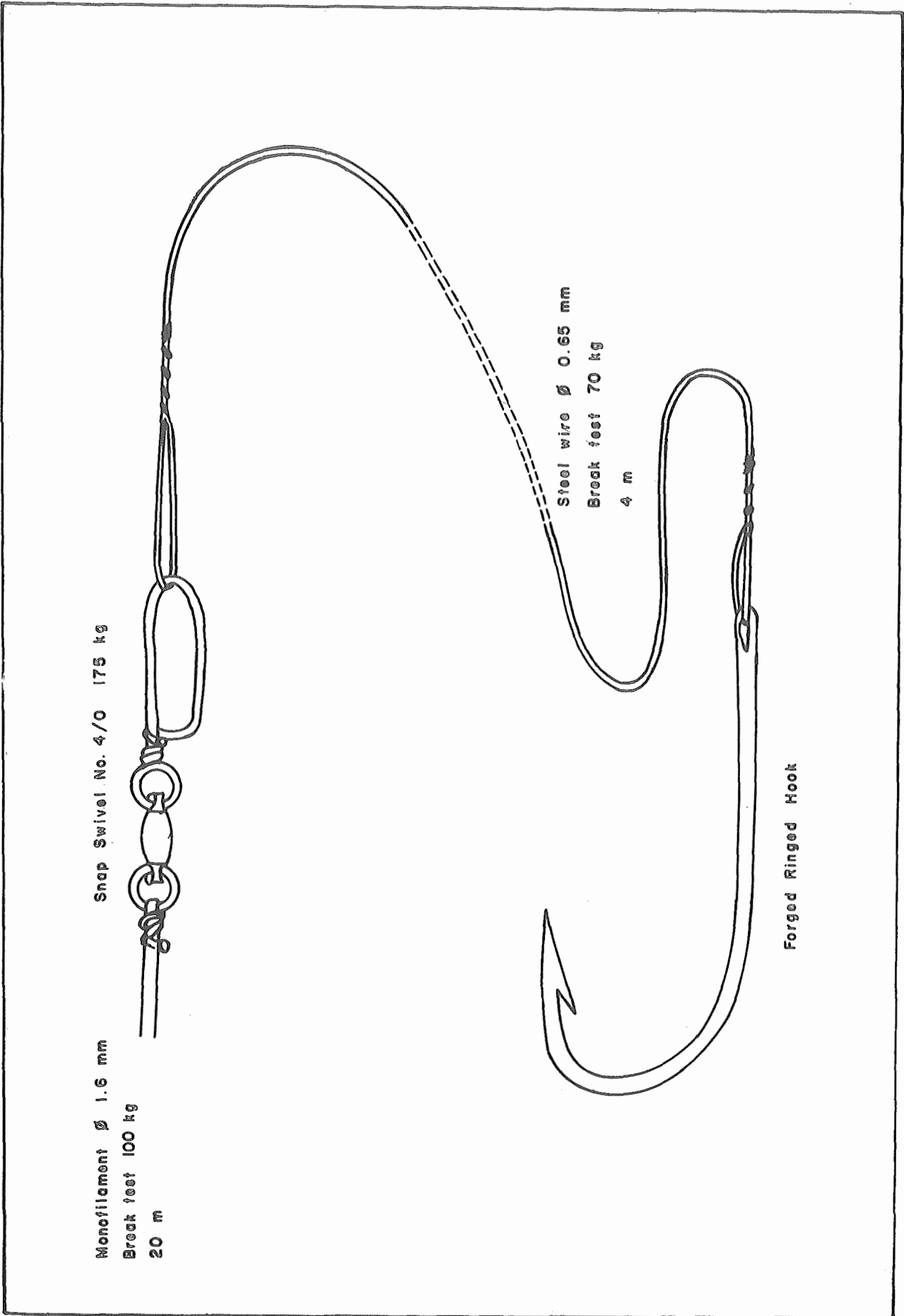


FIGURE 3.- DETAILS OF THE LEADER FOR FISH BAIT

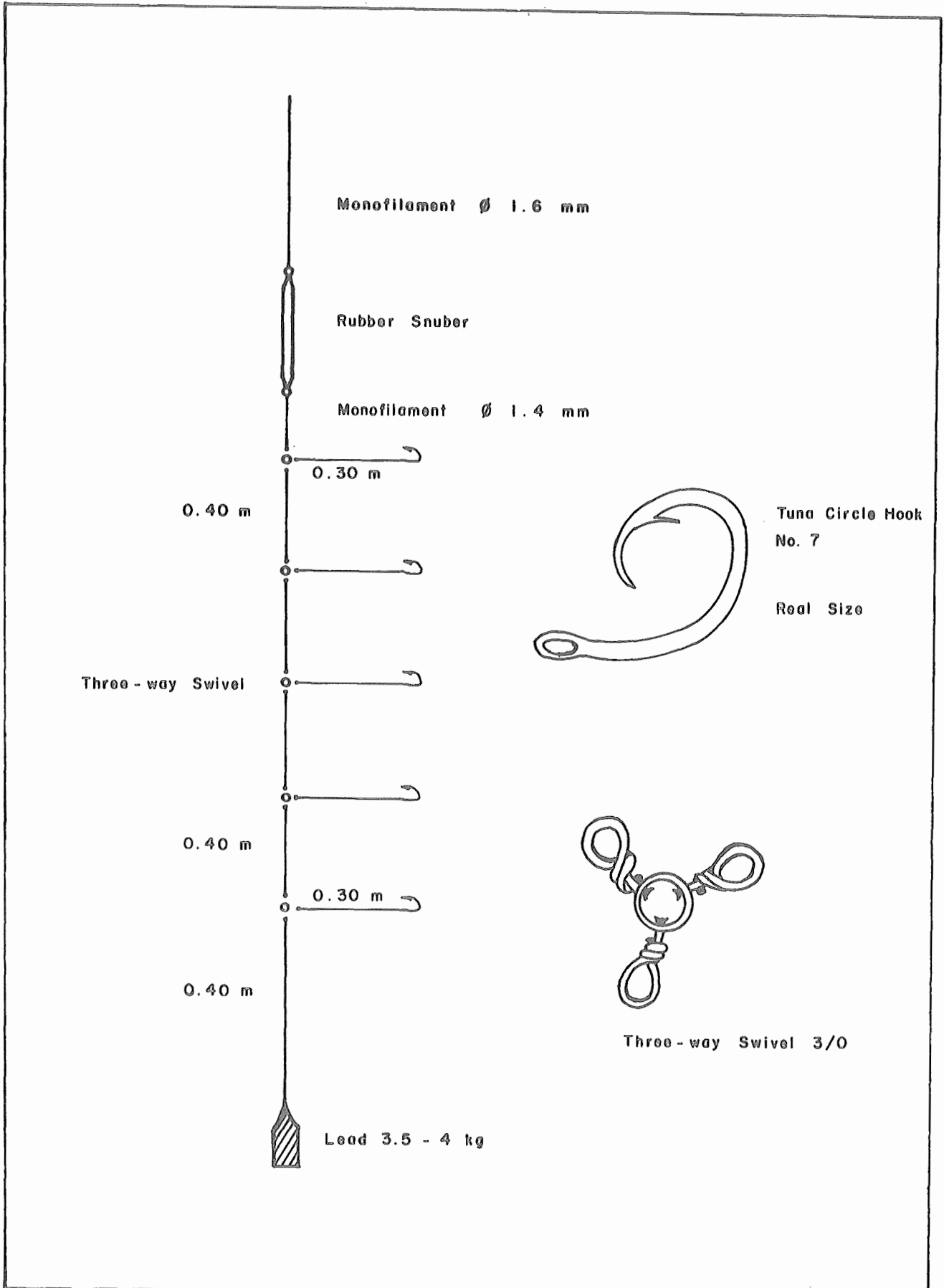


FIGURE 4.- TYPICAL CARIBBEAN LEADER FOR SNAPPER FISHING

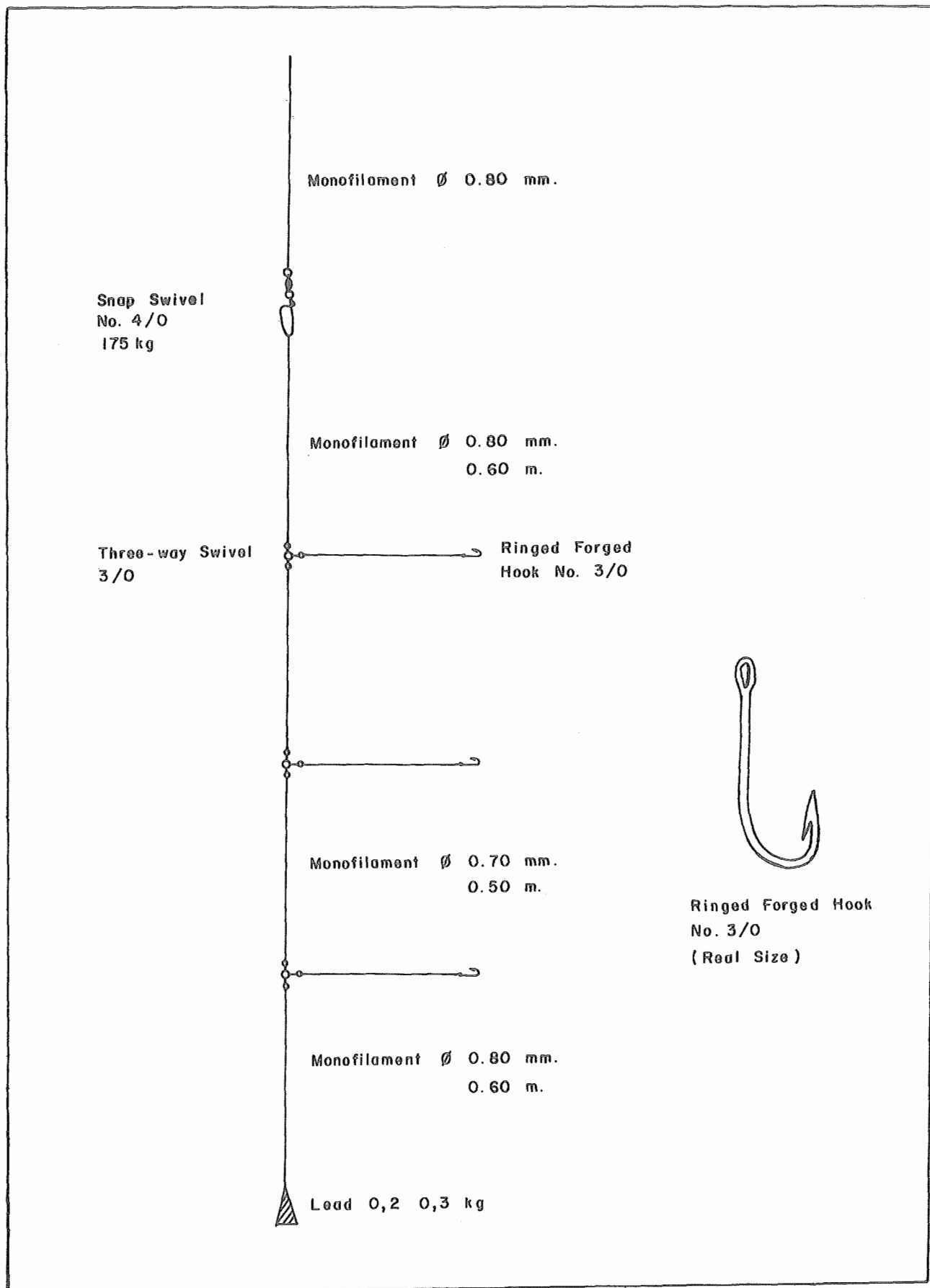


FIGURE 5.- LOCAL LEADER FOR SNAPPER FISHING

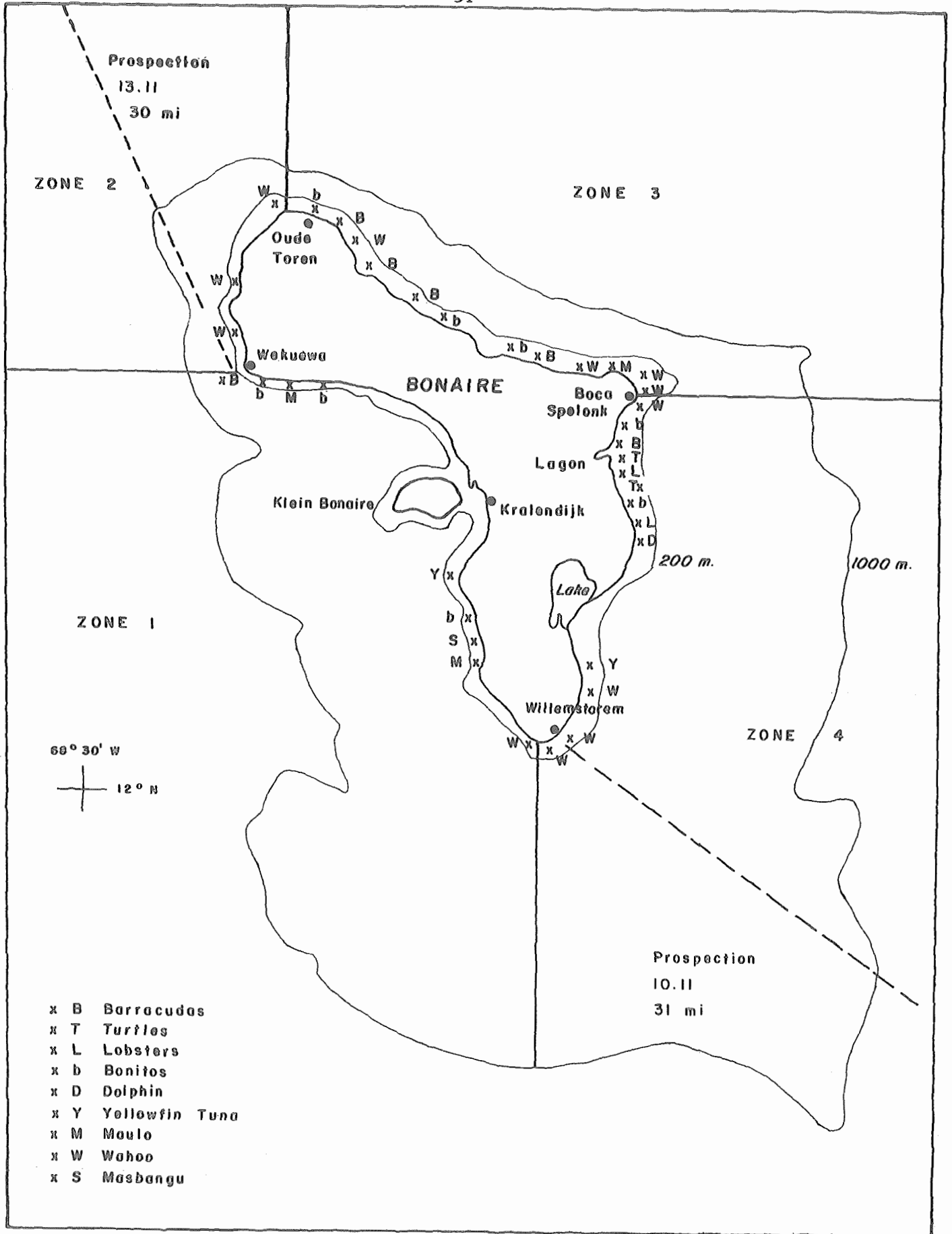


FIGURE 6.- DISTRIBUTION OF THE FISHING EFFORT IN BONAIRE

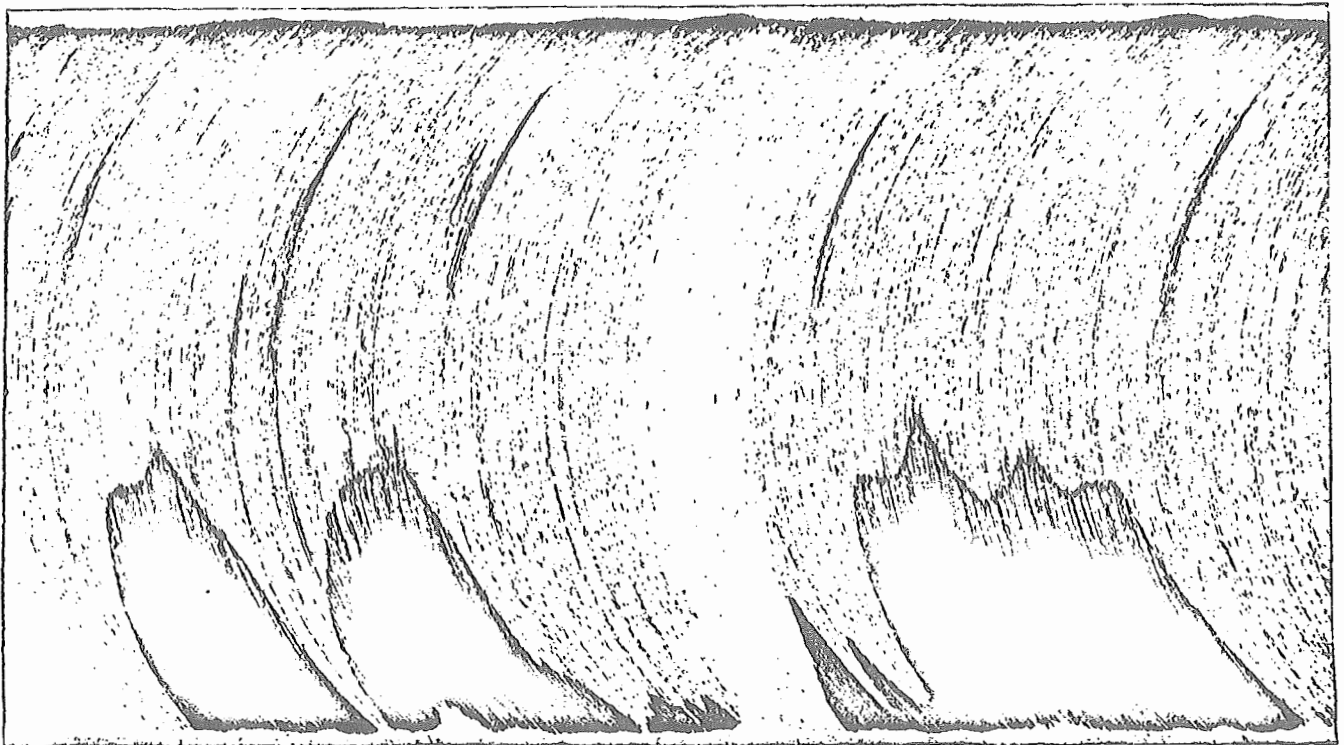


FIGURE 7.- ECHOES OF MID-WATER PELAGIC FISHES CONCENTRATIONS



FIGURE 8.- ECHOES OF SNAPPER AND RELATED SPECIES CONCENTRATIONS

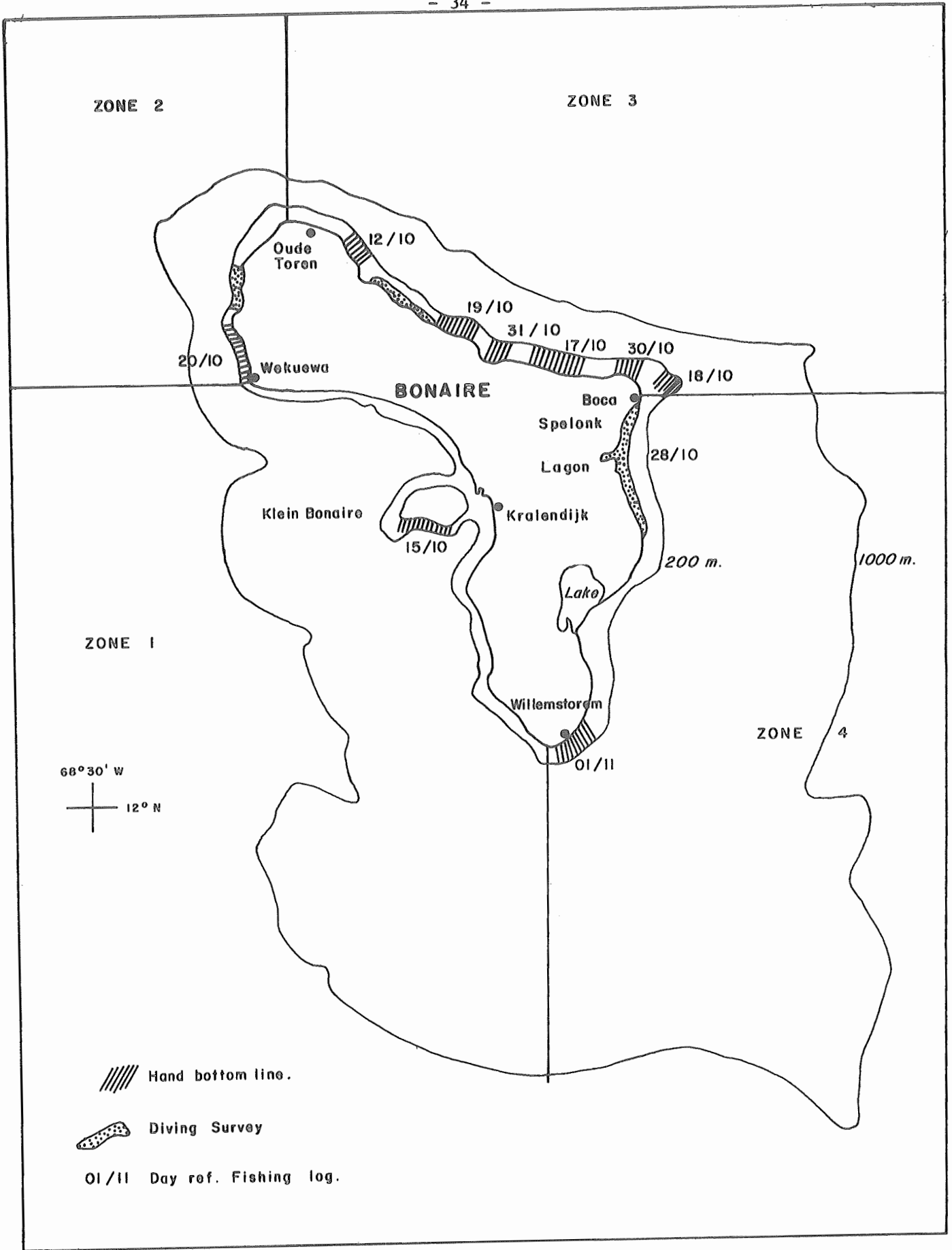


FIGURE 9.- DISTRIBUTION OF SNAPPER FISHING AND DIVING SURVEY

WECAF Reports

1. Fishery Training Needs in the Western Central Atlantic by R.C. Cole. 1976 (restricted distribution).
2. Review of Status of Fishery Statistics and Fishery Research Capabilities in the WECAF Project Area by L. Villegas. November 1978.
3. Shark Fishing in the Western Central Atlantic by S. Springer. March 1979.
4. Report of the First Session of the Executive Committee of the WECAF Project, 18-20 May 1978.
5. Aspectos Técnicos de la Pesca Artesanal en la República Dominicana y Recomendaciones para su Mejoramiento y Desarrollo por M. Giudicelli. Junio 1979.
6. Report on Fish Handling, Processing and Quality Control in Jamaica by C.A.M. Lima dos Santos. July 1979.
7. Programme of Fisheries Development and Diversification in Jamaica by M. Giudicelli. July 1979.
8. La Pesca Artesanal Marítima en la Costa Caribeña de Colombia: Su Situación, sus Posibilidades y sus Necesidades para el Desarrollo por M. Giudicelli. Agosto 1979.
9. Report on Mission to Suriname to Evaluate a Fishermen's Training Proposal by E. Oswald. June 1978.
10. Report on Mission to Antigua, Barbados, Dominica and St. Lucia by R. Kreuzer and E. Oswald. June 1978.
11. Fisheries Situation in Dominica by D.A. Lintern. June 1978.
12. Informe de la Misión a Nicaragua para Prestar Asistencia en las Operaciones de Pesca Parguera Exploratoria y Experimental por M. Giudicelli. Agosto 1978.
13. Bahamian Fisheries Development Mission, Findings and Recommendations by M. Giudicelli. June 1978.
14. Investigación Preliminar sobre las Condiciones Higiénico-Sanitarias y Tecnológicas del Manipuleo, Procesamiento, Comercialización y Control de Calidad de Productos Pesqueros en Nicaragua por C.A.M. Lima dos Santos. Agosto 1978.
15. Purse Seining Demonstration and Training in Montserrat and Study of Adequate Technologies for Fisheries Development in the Country by M. Giudicelli. September 1978.
16. Informe sobre el Tratamiento de Pescado en República Dominicana Incluyendo Sugerencias Referentes a Programas de Extension por W. Brownell. October 1978.
17. Asistencia a INDERENA en su Programa de Introducción de Redes de Arrastre para la Producción de Pescado en Colombia por M. Giudicelli. Octubre 1978.

18. Marine Artisanal Fisheries in Northeast Brazil and Some Suggestions for the Improvement of the Extension Programmes by W. Brownell. October 1978.
19. Extension Training of Artisanal Fishermen and Other Fisheries Personnel in the WECAF Region by W. Brownell. October 1978.
20. Grenadian Fisheries Development Mission, Findings and Recommendations by M. Giudicelli. November 1978.
21. Report on the Demonstration and Training in Fishing for Red Snapper in Belize and Identification of Fisheries Development Opportunities by M. Giudicelli. January 1979.
22. Programa de Desarrollo y Diversificación de la Pesca de Arrastre en Venezuela por M. Giudicelli. Abril 1979.
23. Programa para la Investigación y Evaluación Comercial de los Principales Potenciales Pesqueros Marítimos de Honduras por M. Giudicelli. Mayo 1979.
24. Report on Mission to Grenada by M. Peña and A.J. Wirth. June 1979.
25. Programa Preliminar para el Desarrollo de la Pesca Artesanal en la Región de San Andrés y Providencia, Colombia por M. Giudicelli. Agosto 1979.
26. Informe de la Misión a Honduras con Relación a Diversas Posibilidades de Desarrollo Pesquero en el País por M. Giudicelli y A.J. Wirth. Setiembre 1979.
27. Proceedings of the Working Group on Shrimp Fisheries of the Northeastern South America. Panama City, Panama, 23-27 April 1979. Report of the Meeting. National Reports.
28. Proceedings of the Working Group on Shrimp Fisheries of the Northeastern South America. Panama City, Panama, 23-27 April 1979. Report of the Meeting. Contributions.
29. User's Guide to Exploratory Fishing Data for the WECAF Project Area by H.R. Bullis, Jr. August 1980.
30. Report on the Training Course in Fishery Statistics held in Castries, St. Lucia, West Indies, 19 November-1 December 1979.
31. Report of Mission to St. Lucia by C.R.C. Carleton and A.J. Wirth. August 1980
32. Programme for Fisheries Development and Diversification in Southern Netherlands Antilles: Aruba, Curaçao and Bonaire by M. Giudicelli. August 1980

