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INTERREGIONAL PROJECT FOR THE DEVELOPMENT OF FISHERIES IN THE WESTERN CENTRAL ATLANTIC

# BAHAMIAN FISHERIES DEVELOPMENT MISSION FINDINGS AND RECOMMENDATIONS

UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WECAF REPORTS No. 13

Interregional Project for the Development of Fisheries
in the Western Central Atlantic

# Bahamian Fisheries Development
# Mission Findings and Recommendations

by

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DEVELOPMENT OF FISHERIES IN THE WESTERN CENTRAL ATLANTIC

The Interregional Project for the Development of Fisheries in the Western Central Atlantic (WECAF), which was initiated in March 1975, entered its second phase on 1 January 1977. Its objectives are to assist in ensuring the full rational utilization of the fishery resources in the Western Central Atlantic through the development of fisheries on under-exploited stocks and the promotion of appropriate management actions for stocks that are heavily exploited. 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 as the Executing Agency.

As in the initial phase, two series of documents will be prepared during the second phase of the Project to provide information on activities and/or studies carried out. This document is the thirteenth of the series WECAF Reports. The other series of documents is entitled WECAF Studies.

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## 1. Conclusions and Recommendations

### (a) Conclusions

There is no exact and complete assessment of the Bahamian fish resources. However, our present knowledge seems sufficient to identify very promising prospects for the development of the small-scale fishery industry.

For the near future these prospects are essentially based on the importance and variety of the exploitable standing stocks on the one hand, and on the numerous possibilities of rapid improvements in production and marketing on the other. The various elements of this situation are the following:

- the potential yield of spiny lobsters is probably about twice the level of present Bahamian catches;
- the potential yield of demersal fish is probably in the range of 20 000 - 200 000 t/yr while present catches are only about 1 000 t/yr;
- the possibility of improving actual catching techniques, more particularly as regards spiny lobster trapping;
- the possibility of improving commercialization of the spiny lobster by quality control, utilization of the cephalotoraxes in the tailing process and organization of the exportation of live lobster;
- the possibility of introducing measures for the protection of the Bahamian grounds against foreign fishermen;
- the decision of the Government to develop fishery activities by increasing the sea-going labour force through the technical upgrading of the actual fisherman's know-how and equipment, and through the training and equipping of men selected from the present unemployed active male population.

More remote development possibilities are supported by:

- the big and medium-size pelagic species of the deep waters on the vicinity of the banks; tunas, sharks, dolphins (Coryphaena hippurus), etc.;
- the same stock in more distant waters, more specially to the north and northeast of the banks;
- a possible deep water shrimp and fish stock in the 200-300 fathoms interval of the Bahamian zone of the Old Bahamas, Nicholas and Santaren Channels, of the Straits of Florida, of the northwest Providence Channel and Blake Plateau;
- the continuous upgrading of the fisherman's technical level and living standards.

(b) Recommendations

General

The Commonwealth of the Bahamas possesses good potential for fishery development: several exploitable standing stocks, and unsatisfied demand for fishery products on both the external and internal markets, the existence of a solid professional fishermen community, the existence of an important disposable labour force, the evident maritime character of the entire country, and the strong interest of the Government in fishermen training and upgrading, stock management and marketing improvements.

It is felt that, in such a propitious context, a practical and realistic form of assistance would obtain quick and positive results. It thus seems highly recommendable to envisage the possible establishment of a project for the development and demonstration of advanced small-scale fishing in the area.

Such a project could be included in the general programme of fisheries development in the country and would carry out two tasks at the same time: the identification, testing and demonstration of improved fishing methods for the exploited and unexploited stocks on the one hand, and the sea fishing training of the old-timer and newcomer fisherman on the other.

The basic tactics of this kind of project would be to work in a commercially minded way, i.e., to look only for immediate and visible results superior in productivity to those of the present fisheries. The fisherman's philosophy being only to believe what he sees, such a tactic is the most efficient in persuading him to move quickly to better techniques and to the exploitation of new stocks.

The basic means of action of such a programme being the vessel, great care should be taken in selecting a type suitable for ready adoption by the fisherman. In this connexion it is recommended to stick to the traditional breed of wooden boats produced in the Bahamas. These boats are well known to local fishermen, are perfectly adapted to the local marine conditions, are built in the country and can be adapted to practically any kind of fisheries (see general specifications in Annex 2).

Resources exploitation

It is recommended that the project described in the General Recommendations start immediately with testing, adaptation and productivity demonstration of the following fishing methods:

Spiny lobster

- traps on the banks
- traps on the upper slopes
- tangle nets on the banks
- set nets on the banks

Scale fish

- handlines with reels on the slopes
- traps on the banks
- traps on the slopes
- light attraction (small pelagic species) on the banks and upper slopes, and in connexion with circle, purseine or blanket nets

Pelagic fish

- troll lines at the edge and outside the banks
- "raft" attraction at the edge of the banks in connexion with purseine nets, essentially for dolphins

All these operations would be carried out on a commercial basis, so as to obtain practical and concrete results quickly. As soon as a technique would appear to be commercially productive, the project would start training the fishermen for its further application.

Hereunder more details are given on the reason why some of these operations are recommended and how they normally would have to be carried out.

Spiny lobster

The apparently most important task to be carried out at the very beginning of the project proposed concerns spiny lobster. This stock is actually the most promising economical possibility for the Bahamian fisheries. It is, however, underexploited and the actual catching techniques are damaging the environment and are not very efficient (Thompson, 1977).

Trapping is carried out practically only with the wooden Floridian trap with top funnel. It would be necessary to test the efficiency of other models, with emphasis on the following points: building material of the trap (wood or wire), building material of the funnel, (wood, wire, bamboo or "caña brava"), shape and location of the funnel, i.e., top or lateral, and size of the trap.

As regards trapping methods, emphasis should be put on testing the efficiency of traps worked in strings or individually, on finding the optimum trapping density, i.e., distances between traps and between strings, on finding the optimum soaking time and the optimum bait, (cowhide, fish or chemical). The existence and productivity of the deeper stock, possibly located in the 20-35 fath interval along the upper slopes (see section 3 (c) on Commercially Exploitable Potentials), would also be carefully tested.

Tangle nets are an effective harvesting method for shallow water tropical spiny lobster. This technique is of common use in the fishery of the "green spiny lobster" (Panulirus regius) of northwest Africa (Giudicelli, 1971). As indicated in Annex 4, such a gear will cost approximately US$ 1.75 per m. This means that, on the basis of the actual price of US$ 15 for a lobster trap of the type used in the Bahamas, 8.60 m of tangle net could be obtained.

The actual trapping vessels are using an average of 300 traps per boat, which represents the cost of 2 600 m of tangle net. On the basis of the existing fisheries in Africa, we can estimate that a Bahamiam vessel will work only 2 000 m of tangle net a day, the remaining 600 m serving as spare gear. In other respects, the equipping price of a vessel with tangle nets will be approximately the same as with traps.

It is recommended to test the efficiency of the technique just described with the typical lobster tangle net shown in Figure 8. During this work, particular emphasis would have to be put on the following points: mesh sizes and their effect on scale fish catches and damages by sharks, height of the net and damages by sharks, importance of the ballasting and buoyancy related to the current, mesh and twine sizes, and colours related to water transparency. It is to be noted that this technique takes advantage of the nocturnal wandering of the lobster.

Set nets (see Figures 9 and 10). This method is particularly efficient in areas where lobster "runs" are taking place. It is commonly used by Cuban fishermen (Bardella, S.V. and T. Mihara, 1971). It is then recommended to control its efficiency in Bahamian waters and more particularly around Bimini where strong lobster migrations are generally observed in October and November (Hernnkind, 1974).

Scale fish

Traps. In consideration of the actual methods used by the fishermen (see section 4 (d) on Fishing Methods), it is recommended to test other trapping techniques with emphasis on the same points as those remarked upon for spiny lobster trapping.

It is also recommended to find and test methods for fish reel lining and deep trapping along the slopes and down to about 150 fath. During the UN project (1972-1975), the M/V FREGATA did not have very good results with traps, due apparently to improper adaptation of the gear to the steep slopes, strong currents and nature of the floors. However, it is felt that trapping, which does not require any particular skill from the individual fisherman, could possibly obtain results superior to those of handlining. The essential points to take care of in this programme seem to be the sturdiness and heaviness of the traps, possible anchoring systems, markers of strong buoyancy and, also, research on suitable slopes.

Light attraction could theoretically have good results in the concentration of any species in the clear waters on the edges of the slopes.

Pelagic fish

Trolling is not a capital intensive operation. It should be then tested at the edges of the slopes and, also, slightly outwards. Emphasis should be put on the efficiency of operations carried out at the surface of the water, at various depths and with various types of gear such as those studied by Yesaki (1977).

The testing of "raft" attraction, which is a traditional commercial way of gathering pelagic species in the Mediterranean Sea, is particularly recommended. This technique could be tested at the edge of the banks by anchoring rafts made of palms or branches in the 20-200 fath interval (see Figure 11).

Resources identification

In a second stage, after completion of most of the objectives given in the section on Recommendations: resources exploitation, it is recommended to test and adapt the following catching methods and control their commercial productivity.

Scale fish

- tangle nets on the banks
- bottom long-lines on the banks and slopes

Pelagic fish

- drift nets near the edge at night
- floating drifting or anchored long-lines outside of the banks

Shark

- anchored floating lines at the edge of the banks and near the coast of the islands (see Figure 12)

Deep-sea shrimp

- trawling the 200-300 fath interval (in cooperation with a foreign institution)

These opportunities seem to have a more remote interest. This is why their control is recommended for a more distant future. Shark production, which is not a capital intensive operation, could produce interesting financial returns through export to the Caribbean islands.

As regards the deep sea shrimp potential (see section 3 (c) on Commercially Exploitable Potentials), it is recommended first to check the existing documentation. If nothing of practical interest exists, it would be advisable to obtain the cooperation of a foreign institution and carry out a short programme of commercially minded explorations aimed at finding the trawlability of the floors and the commercial productivity of the stocks.

Such a programme would have to be carried out with a trawl net of commercial size and design in order to produce a straighforward picture of the real economic value (see Figure 13). About 35 trawling stations would seem sufficient to give a good coverage of the area. On the basis of three trawling hours per station, this would give 105 h with the gear on the floor and a covered trawling length of 315 mi at a trawling speed of 3 kn. The time involved would be four hours per station, three hours trawling and one for shooting and hauling in the gear, i.e., a total time of 140 h. Steaming time would be approximately 111 h (1 000 n mi at 9 kn), and the total time for the entire programme 10 to 11 days.

Resource utilization

It is felt that some other possibilities could be added to those given in the various studies made to date about the upgrading of fish utilization through the improvement of fish processing and marketing. The shark potential, for example, is not exploited but seems to offer possibilities of easy reach. It is therefore recommended to carry out a feasibility study of the shark export opportunities in the nearby Caribbean islands. This product could be processed frozen or salted/dried. The second type of processing presents two advantages: first of all, it requires considerable labour for its realization, which is a good thing in a country with a segment of its population unemployed; secondly, the product is easy to handle and cheap, and could be produced on remote islands without freezing facilities.

It is also recommended to study the possibilities of the higher revenues generally offered by the export of live lobster versus the export of frozen tails. In the feasibility study of this market the following principal points should be taken into consideration:

- production: costs
- processing: costs, location of the storage and processing facilities, packing, transport to airport
- airfreight: availability, reservation, duration of the trips, holding temperatures, special fares
- marketing: sales contracts, trial periods, mortality controls upon arrival, payment and compensation for eventual mortality
- contracts: it is particularly recommended to make contracts with specialized live crustacean importers, to avoid exclusivity contracts, to sell F.O.B. and to work on a basis of immediate payment by irrevocable and confirmed documentary credit upon presentation of the airway bill to the bank

As regards the storage of live spiny lobster, it is recommended to improve the boat wells in order to reduce mortality and improve the health and strength of the animal. This could be easily done by improving the water circulation and oxygenation of the well. Storage on shore could be realized in the way the live fish is actually stored in Nassau, in floating barges, or with simple floating cages. More sophisticated systems are, however, possible for mass exportations.

In order to avoid cannibalism and mass mortality, a careful study would be necessary to determine the storage density in relation to the variations of water temperature and oxygenation, and also with the seasonal variations of the physiological state of the lobsters themselves.

Training

The training aspect of fisheries development in the Bahamas is fully treated in a document concerning the future training programme (Kawaguchi, 1977). However some recommendations can be given relative to the incorporation of a subproject for the development and demonstration of advanced small-scale fishing in the overall programme.

First of all it should be avoided to use the project vessel recommended in section 1 (b) and described in Annex 2, only for training purposes. As seen in the preceding part of this report, the basic objectives of this programme is the amelioration of resources exploitation by the introduction of improvements in existing harvesting techniques, or by the introduction of completely new methods. This can only be realized by first obtaining tangible financial results, which is really the "demonstration stage", and then by transferring the better techniques to the fishermen, i.e., the "training stage".

The project vessel, which can take eight men on board, is operated by a permanent crew of five: a skipper (the masterfisherman), a mate and three deckhands. All of these men are fishermen and participate in fishing operations. All of them take care of the engineroom, under supervision of the skipper, and all cook, except the skipper. There are three extra bunks which can be occupied by trainees who also participate in all the duties.

The vessel can be exploited on the basis of an eight-day trip with seven days on shore for unloading, maintenance, preparation and weekend. This programme can produce 192 sea days a year, i.e., 24 trips and 576 sea days available for training (24 trips x 8 days x 3 bunks).

It is recommended to divide the trainees into two different groups: the old time fishermen who want to take training for a well specified fishing technique, and the trainees coming out from school. The old time fishermen would, in general, only need a short period of training, during approximately one trip. They should, however, have priority over the newcomers for the essential reason that they are confirmed and outright professional fishermen who show interest in upgrading themselves, and are a sounder investment for the fisheries.

The trainees coming straight from school could make a variable number of trips on board taking into consideration the type of course they went in for on shore. Because the skipper will be involved in experimental production fishing on a commercial basis, it would be very difficult for him to pay special attention to this category of trainees. Their stay on board would then be purely for practical training in fishing and seamanship. This supposes that the practical application of other topics of their courses on shore, for example navigation, would have to be carried out on the vessel especially assigned to the training unit.

## 2. Introduction

This report is the result of a study of the present fisheries in the Commonwealth of the Bahamas. Emphasis is put on the technical aspects of this activity. It is also put on the main apparent development possibilities and on some of the most practical ways to put this development in concrete form.

Obviously all the problems were not identified here and the recommendations given are not the only ones possible. It is felt, however, that thanks to the valuable help of the Fishery Department and to some direct contacts with the fishermen in Nassau, the recommendations made in this report are practical and could have a quick and strong impact on the production and productivity of Bahamian fisheries.

## 3. Background Information

### (a) Geographical Location and Communications

Geographical location and international communications are two important factors in the context of the Bahamian fisheries, the development of which essentially relies on the exportation of the most important part of the catches made, viz, the spiny lobster production (Panulirus argus).

In this connexion the Commonwealth of the Bahamas is in an excellent position. The biggest world consumer of lobster tails, the USA, is on the doorstep of the country. By air, Miami is 50 min from Nassau, and New York 2.5 to 3 h. On the other hand, an important consumer of lobster tails and the biggest of live lobster, the European market, and more particularly the French market, is easily connected to Nassau by numerous air flights. Direct flights to London take 9.5 h from Nassau or Freeport, and four weekly flights are available.

Finally, if one day the country should become an exporter of fish, more particularly for species not accepted on the internal market (sharks, for example), the proximity of the fish importing Caribbean islands could become another positive factor of development.

This good geographical location has, however, some adverse sides. The proximity of some countries without sufficient icthyological potentials causes envy and the poaching of the Bahamian fisheries' wealth is a common thing these days. This should impose an all important investment in a system of surveillance and protection in the near future.

### (b) The Marine Environment

In a fishery study directed toward the search of possible new potentials, as well as of the most productive ways to exploit the existing and possible potentials, it is important to have, first of all, a general picture of the natural environment. As regards fisheries, the following ten main points are to be noted in the Bahamian marine environment:

- the huge surface of shallow sandy banks, approximately 16 shelves with a total surface of 45 000 $mi^2$ and depths of 0 to 5 fath;
- numerous limestone and coraline islands, cays and reefs generally concentrated at the eastern edge of these banks and along a northwest/southwest axis 500 mi in length, including Great Inagua Island;
- a long and steep continental slope stretching along some 2 500 mi with slope angles of 10 to 40°;
- deep sedimentary plains at the foot of these slopes, with depths of 200 to 400 fath to the southwest, west and northwest, and of 200 to 2 000 fath along the rest of their surroundings, towards the Atlantic;

- very clear waters around and over this whole area;
- a geographical location at the northeastern limits of the Caribbean Sea with the Atlantic Ocean;
- a position between the strong northward currents of the Straits of Florida to the west and the deep open waters of the Atlantic to the east;
- weather conditions generally good with average monthly wind speeds of 7.1 to 9.4 kn in the northeast/southeast sector, periods of two to three days with 15 kn northeast winds from October to March and shallow waves in all seasons. The only exception to this positive situation is a possibility of hurricanes from June to November;
- weak tides with a mean tidal range of 2.6 ft;
- a certain fluctuation in water temperature with 23° to 25°C in February and 28° to 29°C in August, and with the possibility of stronger variations on the banks when extreme cold or hot local weather prevails.

(c) Commercially Exploitable Potentials

The spiny lobster potential estimated on the basis of the present harvesting rate of Little Bahama Bank, 163 kg per $mi^2$, is of 7 280 t (Thompson, 1977). The commercially exploitable part of this potential is estimated to be of 4 500 t which, after deduction of the actual catch of 2 400 t (1976), offers approximately 2 100 t for future development (Terminal Report BHA/71/512, FAO, 1977).

The shelf area of the Bahamas is very large, nearly 20 million hectares. Present yields of demersal fish in the Antilles are about 4 kg/ha, and it has been conservatively estimated that the potential is around 10 kg/ha (FAO, 1978). Even if the potential yield of the Bahamian banks is only 1 kg/ha, therefore, the total catch of demersal fish could be 20 000 t/yr. If the potential is as high as 10 kg/ha, the corresponding catch would be 200 000 t/yr, but this seems unlikely in view of the low primary productivity of Bahamian as compared to Antillean waters.

In addition to the stocks of the shelf proper, there are resources on the slopes. Since the slope area is small, the total potential here is relatively small - probably no more than a few thousand tons per year, but catch rates may be higher than on the shallow banks (Gonzalez-Alberdi, 1975).

The potential could be somewhat greater. The pelagic fish population located in the deep waters around the banks, along the "drop-off" and at certain distance outward from it, is not considered here. It is felt that some good commercial possibilities may exist with such species as tuna, dolphin and shark. In the same way, some deep-water demersal potentials have not been taken into consideration. A deep-sea shrimp commercial stock may, however, exist over a surface of 5 300 $mi^2$ of apparently trawlable floors located in the 200-300 fath interval in the western sector of the Bahamas, and more particularly in Old Bahamas, Nicholas and Santaren Channels, in the Straits of Florida, in the northwest Providence Channel and on Blake Plateau.

From past experience with tropical spiny lobsters of the Panulirus genus, it could be possible to find denser concentrations along the upper slopes of the banks, approximately in the 20-35 fath interval (Giudicelli, 1971, Giudicelli and Yesaki, 1971). To complete this general picture we have to note that a relatively good seasonal tuna potential seems to exist at some 200 mi north of Grand Bahama Island (Bogdanov, 1969).

(d) Present Status of the Fisheries

(1) General Aspects

The actual number of professional fishermen estimated from various sources is about 1 100. This represented approximately 2.3 percent of the entire active male population, employed and unemployed (47 604) in 1975. The first impression is that this figure is very low for an essentially maritime country such as the Bahamas.

The number of fishing vessels estimated from various sources is about 280 units, mostly 20 to 70 ft of various types: sloops, smacks, ex-shrimpers and shallow-draft speedboat-like vessels. About 150 of them are motorized, the others being sailing vessels. To this fleet we have to add an uncertain number of 12 to 18 ft dinghies, possibly between 500 and 800 units. Some of these open boats are powered by outboard gasoline engines, others by sails.

The shore infrastructure consisted of 34 spiny lobster processing plants in 1976, 22 of them being operational (Thompson, 1976). In Nassau the harbour facilities are sufficient as regards fish landing and vessel chandlering and bunkering. They will need a serious improvement when the development of the production is undertaken (see Annex 1).

Boat and engine repair workshops exist but, here again, fisheries development will require an increasing improvement of these facilities.

Consumption does not seem to present major problems at the moment or for the future. The export market for spiny lobster, frozen tails or live, shows a strong and steady demand. The situation is somewhat the same on the domestic market. Per caput fish consumption was of 9.4 kg/head/year in 1976 and the population's fondness for fish seems to offer a relatively important potential market.

Marketing does not seem to pose any problems as regards the present national distribution. More storage facilities would, however, be needed with the development of production. The export market, on the other hand, needs a much quicker and more energetic action (Early and McDonald, 1977).

(2) Production, Catch Rates and Prices

The average total yearly production of 1974 and 1975 was of 2 796 t (Kawaguchi, 1977). This catch consisted of 1 673 t of spiny lobster, 274 t of conch and 915 t of scale fish. This catch can be estimated to have been of about 3 400 t in 1977, 2 400 of them being spiny lobster and 1 000 scale fish and various other species.

Using this 1977 estimate as a basis, the yearly catch was of 3 t per fisherman and 12 t per fishing boat, excluding the dinghy fleet.

In 1976 the average prices of exported products were US$ 5.76 per lb for spiny lobster tails and US$ 1.1 for whole fish. The average retail price of fresh scale fish on the national market was US$ 1.17 - 1.49 per lb, as compared to the price of livestock meat which averaged US$ 1.40 -1.74 per lb.

(3) Position of the Fisheries Community in the National Economy

In 1975 the export of fisheries products was valued at US$ 2.917 million of which US$ 2.826 million, or 97 percent, were the result of spiny lobster exports. This represented 2.50 percent of total export (US$ 116.5 million) excluding petroleum products. On the other hand, the imports of fisheries products in 1976 were 975 t with a value of US$ 2.140 million. It can be roughly estimated that the extraction of the entire commercially exploitable potentials would sharply modify these figures to the advantage of the country. Fish imports could decrease to practically nothing, while spiny lobster exports could increase by some 100 percent.

This development would have, however, two other very important impacts. The one would be the possible absorption of a part of the unemployed active male population; 7 952 men in 1975, 16.7 percent of the active male population at present. The other would be the improvement of the fisherman's present standard of living.

(4) Present Status of the Fisherman

Actually most of the fishermen seem to be the owners of their means of production and living. This is, of course, a positive factor for fisheries development. Their average income seems, however, to be lower than the average wage of general artisans; US$ 416 per month (Kawaguchi, 1977).

(5) Human Potentials for Fisheries Development

The unemployed active male segment of the population is young; 70.37 percent of it is under 35 and 25 percent is in the 14-19 year old class. It seems then that recruitment could be relatively easy and its results positive if a good training programme was applied and followed up by active financial aid and a rational stock management policy.

## 4. Technical Observation and Findings

### (a) Fishing Grounds and Fishing Conditions

The Bahamian fishermen concentrate nearly their entire fishing effort in the shallow clear waters on top of the banks. Except for recent snapper lining operations of limited extent along the slopes, operations which started after the work of the UN vessel FREGATA in 1972-1975 (Thompson, 1977), the bulk of the effort is carried out in the 0-10 fath interval.

The other characteristic of these operations is their concentration in areas of hard beds, principally along the edges of the banks. The area in the south and southwestern sections of Great Bahama Bank is less exploited. This is apparently due to two essential factors: the longer distance from ports, and the greater depths of water on the bank. From Nassau, for example, the south and southwest sections of the Great Bahama Bank lies at a distance of 120 to 220 mi (see Figure 1). As for the depths of this area - generally 3 to 6 fath versus 0 to 3 fath for the rest of the bank - they make lobster diving operations difficult and thus discourage the fishermen. Another factor which possibly makes this region less exploited is also the fact that it offers less protection from the dominant winds of the northeast/southeast sector.

The central portions of the banks offer generally less potential and are less exploited. The pelagic and demersal stocks along the edges are only slightly exploited. The deep water pelagic stock remains practically untouched and the demersal stock of the deep beds, in the 200-300 fath interval, remains unknown.

To give a "visual" idea of the actual intensity of the exploitation, we can add that each fisherman possesses in actual fact the opportunity to exploit a bank surface of 41 $mi^2$ and a slope length of 2.2 mi.

(b) The Boats

(1) The Traditional Fleet

The Bahamas possesses an original breed of wooden boats perfectly adapted to local marine conditions and more particularly to the shallow water frequently found over the numerous reefs of the area. Their draught is reduced by a shallow depth under deckbeam and, principally, by a relatively important increase of the maximum width. This width is generally equal to 35 to 40 percent of the overall length versus 30 to 35 percent in other vessels. The other effect of this wide flattened hull is to preserve a stability which could be lost by the decrease of the draught.

These boats can be divided into two categories, the dinghies and the smacks or sloops. The dinghy is an all purpose round-bottomed boat 12 to 18 ft long, powered by a main sail or an outboard engine or oars (see Figure 4). The dinghies used for fishing are generally equipped with a fish well amidship. Flat-bottomed dinghies also exist in some parts of the Bahamas, more particularly in Eleuthera.

All these dinghies are used in all kinds of fishing, individually or in groups of two to six units connected with a smack used as a mothership. Their normal crew consists of two to three men.

The smacks or sloops are round-bottomed and fully decked boats 20 to 60 ft long, powered by a mainsail or mainsail and jib, with or without auxiliary propulsion by internal diesel (see Figure 5). These engines range from 10 to 150 HP, according to the size of the vessel. The tendency is now to get rid of the sails, to build a big cabin on deck and to acquire more powerful engines of up to 200 HP.

These vessels have generally a fishwell amidships and ice boxes on the deck. Some of them have fish holds with ice, while some others have freezing units and cold storage holds or deck containers. High pressure hydraulic pot haulers and reels are also starting to appear on the vessels potting for spiny lobster or lining for deep water snappers. These vessels are also commonly used as motherships with a group of dinghies in fish trapping and lobster diving operations. In this case the dinghies are generally carried on the decks during the trip to and from the fishing grounds. Depending on their type of fishing, the sloops or smacks have a crew of 8 to 15 men.

The quality of the construction of all types of vessels is high. The hulls are finely built but stout. Vessels 20 to 30 years old are not exceptional.

(2) The Imported Fleet

Imported boats are generally ex-shrimpers or speedboat-like fishing vessels of Floridian origin. Their general length ranges from 40 to 70 ft and their power from 200 to 300 HP. They are used in the same way as the smacks.

(c) Fishing Gear

The Bahamian fisherman uses a relatively great variety of gear and techniques. Spiny lobster fishing is based on skin diving with spears, bully-netting with a glass-bottom bucket and a tickler, and trapping (see Figure 6). Grouper is one of the most highly prized demersal fish species and is essentially caught by trapping (see Figure 7). This species is also fished by spearing or handlining. On the banks other bottom fish are caught in the same way as groupers, but purse-seining and beach-seining are also used in these operations. Turtle fishing is carried out with fixed tangle nets or with shooting circular steel framed nets with slip meshes. Conch is caught by diving or with a long handle double hook used in connexion with a glass-bottom bucket. Snapper fishing on the slope of the banks is carried out with lines and hydraulic or manual reels.

(d) Fishing Methods

Fishing methods are essentially determined by the shallow fishing depths and the high transparency of the water; most of the techniques are based on the direct visual observation of the prey. This is particularly true of spiny lobster spearing or bully-netting, as well as in grouper trapping or fish purse-seining operations. This is also perhaps one of the reasons why, until now, the Bahamian fisherman has not been very attracted by waters too deep for visual observation of the fish and gear, i.e., the bank slopes and the deep waters. This is also a possible reason why he apparently does not seem to "feel at home" with directly uncontrollable gear such as lobster traps, long-lines and drift nets, for example. (For a description of spiny lobster catching methods with traps or by diving, see Thompson, 1977.)

(e) Technical Level of the Fishermen

The duration of the visit to Bahamas did not make it possible to be in full contact with the fisherman at work, at sea and on his vessel. It was, thus, not possible to judge fully his present technical level, as well as his interest and capabilities for a future transfer of technology and experience. From some brief contacts in the port of Nassau, and also from the observation of the degree of "shipshapeness" of some vessels in the same port, it is however possible to make some positive observations.

First of all the vessels were found to be generally well maintained and kept in good order. Gear is well maintained and stored. Contact with the fisherman is direct and easy. He likes to talk about his job, his techniques, his fishing grounds and his findings. He is trained to spend long periods of time away from his base and his family and considers his vessel his second home.

All these are positive factors for a high probability of success in any well organized and supported development effort.

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Annex 1

Fisheries Aspects in the Bahamas
(extracted from Kawaguchi, 1977)

1. General Background

1.1 Population - 218 433 (estimate for 1977 - Statistical Abstract, 1975)

1.2 Tourist visits - 1.38 million visitors, average days spent - 7 days/visit with a total of US$ 319 million from visitors' expenditures (Statistical Abstract, 1975)

1.3 Area of lands - 5 353 $mi^2$

1.4 Trade (1975) - imports US$ 295 million (excluding bullion and specie, crude petroleum and residual fuel oil)

exports US$ 116.5 million (excluding petroleum exports)

1.4.1 Food and live animals - imports - US$ 59.7 million
Food and live animals - exports - US$ 3.3 million
(plus US$ 0.1 million - re-exports)

1.4.2 Marine, Agriculture and Forestry - exports

| | | |
|---|---|---|
| Marine products | - US$ | 6.94 million |
| Agriculture | - " | 0.11 million |
| Forestry | - " | 0.83 million |
| | US$ | 7.88 million |

1.4.3 Marine products - exports

| | | |
|---|---|---|
| Salt | - US$ | 4 027 000 |
| Crawfish | " | 2 826 000 |
| Conch shell | " | 40 000 |
| Turtle shell | " | 30 000 |
| Sponge | " | 21 000 |
| | US$ | 6 944 000 |

1.5 Unemployed economically active population in 1975 (Statistical Abstract, 1975)
Employed active males - 39 652 (females - 26 766)
Unemployed active males - 7 952 (16.7%) (females - 9 918, 27%)
Unemployed active males
Under 35 years of age -

| | | | |
|---|---|---|---|
| 14-19 | years of age | - | 1 980 (24.9%) |
| 20-24 | " " | - | 1 551 (19.5%) |
| 25-29 | " " | - | 1 201 (15.1%) |
| 30-34 | " " | - | 859 (10.8%) |
| | Total | | 5 591 (70.3%) |

1.6 Average wage of workmen, draftmen, mechanics, etc. - US$ 2.17/h or approximately US$ 416 per month.

2. Fisheries Background

2.1 Total area of banks shelf - 44 700 $mi^2$ (Little Bahama Bank 6 700 $mi^2$ plus Great Bahama Bank 38 000 $mi^2$)

2.2 Number of fishermen (estimated from various resources) - about 1 100

2.3 Number of fishing vessels (estimated from various resources) - about 280 (150 motorboats and 130 sailing boats)

2.4 Crawfish processing plants (Thompson, 1976) - 34 (22 operational in 1976)

2.5 Crawfish export licence holders (Thompson, 1976) - 50 holders in 1976

2.6 Fish production (average of 1974 and 1975) - total 2 896 t
Crawfish - 1 673 t (58%)
Conch - 274 t (9.5%)
Scale fish - 915 t (31.5%)

2.7 Imports of fisheries products in 1976 (Department of Statistics) - Total - 975 t (US$ 2.14 million)

| Classification of imported products | Quantity lb | Value B$ |
|---|---|---|
| Fish and live shrimp for use as bait | 40 100 | 39 500 |
| Fish - fresh or frozen 1/ | 270 900 | 297 100 |
| Fish - dried, salted, smoked 1/ | 66 800 | 108 200 |
| Canned, pickled and other way prepared Fish | 1 117 100 | 834 200 |
| Crustacea and Molluscs | 36 800 | 84 600 |
| Other crustacea and molluscs | 206 500 | 537 300 |
| Crawfish | 40 800 | 242 900 |

2.8 Per caput fish consumption - 9.4 kg (21 lb)/head/year

2.9 Catch per fisherman - 2.6 t (5 792 lb)/year

2.10 Catch per fishing boat - 10.3 t (22 660 lb)/year

2.11 Average price of fish

Crawfish - tails (exported) US$ 4.71 per lb (1976)
" - whole fish (exported) US$ 1.62 per lb (1976)
Scale fish - fresh retail US$ 1.17 per lb (New Providence, 1975)
" " " US$ 1.49 " " (Grand Bahama, 1975)
Livestock meats - average US$ 1.40 per lb (New Providence, 1975)
" " " US$ 1.74 per lb (Grand Bahama, 1975)

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1/ Many of these species may be replaceable with local products

2.12 Fishing harbour facilities

(a) Fish landing spaces - fish landing wharves of 100 yd long to the east and 75 yd long to the west with 2.2 to 4.1 m deep water on the south coast of Potters Cay for larger fishing vessels and about 110 yd long jetties with more than 2 m deep water on either side of the road from Nassau to the Potters Cay for smaller fishing boats. There are water and electricity supply facilities but no landing shed, fuel supply pipe nor ice supply system on the wharves.

(b) Other facilities - boat and engine repair and maintenance facilities, fishing gear and deck and engine supplies are available but the majority are limited in the variety and quantity for sport fishing.

Annex 2

## General preliminary specifications for the fishing boat recommended

- type: multi-purpose fishing vessel for fish and spiny lobster with traps, nets and lines, with or without dinghies;
- material: wood;
- dimensions (approximate): 50 ft long with a maximum bearm of 18 to 19 ft, a depth of 5 to 6 ft and a maximum stern draught at full load of 5 ft;
- propulsion: diesel engine 150 hp driving a controlable pitch propeller, 24 or 32 V generator, deck and bilge pump, fish hold compressor and high pressure hydraulic pump;
- auxiliary: diesel engine 5 hp driving a spare generator and a spare bilge pump;
- cold storage: one compressor for 0°C temperature in fish hold, driven by a main engine;
- deck arrangement: cabin located on rear of midship and shifted to portside for better deck working space, containing wheel house, galley, toilets and two bunks; one hydraulic capstan for anchor and general purpose and one mast with one or two sails;
- fish hold: 16 $m^3$;
- crew quarters forward for six men;
- fuel capacity: sufficient for eight days at full speed;
- speed: 7 to 8 kn;
- electronic equipment: two vertical echo-sounders with range of 350 fath, one radar with 24 n mi range, one Loran A-C.

Annex 3

## Cost comparison between spiny lobster wooden trap and tangle net

Prices of tangle net material were taken in the Atlantic and Gulf Fishing Supply Corp., Miami, 1977 catalogue

No customs duties are applied as normally fishing items are duty free in the Bahamas

The tangle net studied here is the one illustrated in Figure 8

1. Imported material F.O.B. Miami

| | |
|---|---|
| - Webbing: 160 mm stretched mesh, twine PA Rtex 620 (1 600 m/kg) 4 by 500 meshes at US$ 7.70 per kg | US$ 3.13 |
| - Hanging twine: PA Rtex 1120 (890 m/kg) at US$ 7.70 per kg | " 1.64 |
| - Lines: PA Ø 8 mm, 84 m at US$ 0.18 per m | " 15.12 |
| - Lead: 60 g x 166 at US$ 1.32 per kg | " 13.14 |
| - Floats: 33 of Ø 6 x 3 cm at US$ 0.120 a piece | " 3.96 |
| Total | US$ 36.99 |

2. C.i.f. Nassau

| | |
|---|---|
| - Insurance and freight, approximately 20% of f.o.b. price | US$ 7.39 |
| Total | US$ 44.38 |

3. Labour

| | |
|---|---|
| - 120 hangings per h at US$ 3.00 an h | US$ 25.00 |
| - Total price of a 40 m tangle net | US$ 69.38 |

Comparison with trap

| | |
|---|---|
| 1. Price of one trap, 8.70 m of net | US$ 15.00 |
| 2. Price of 1 m of tangle net | US$ 1.73 |

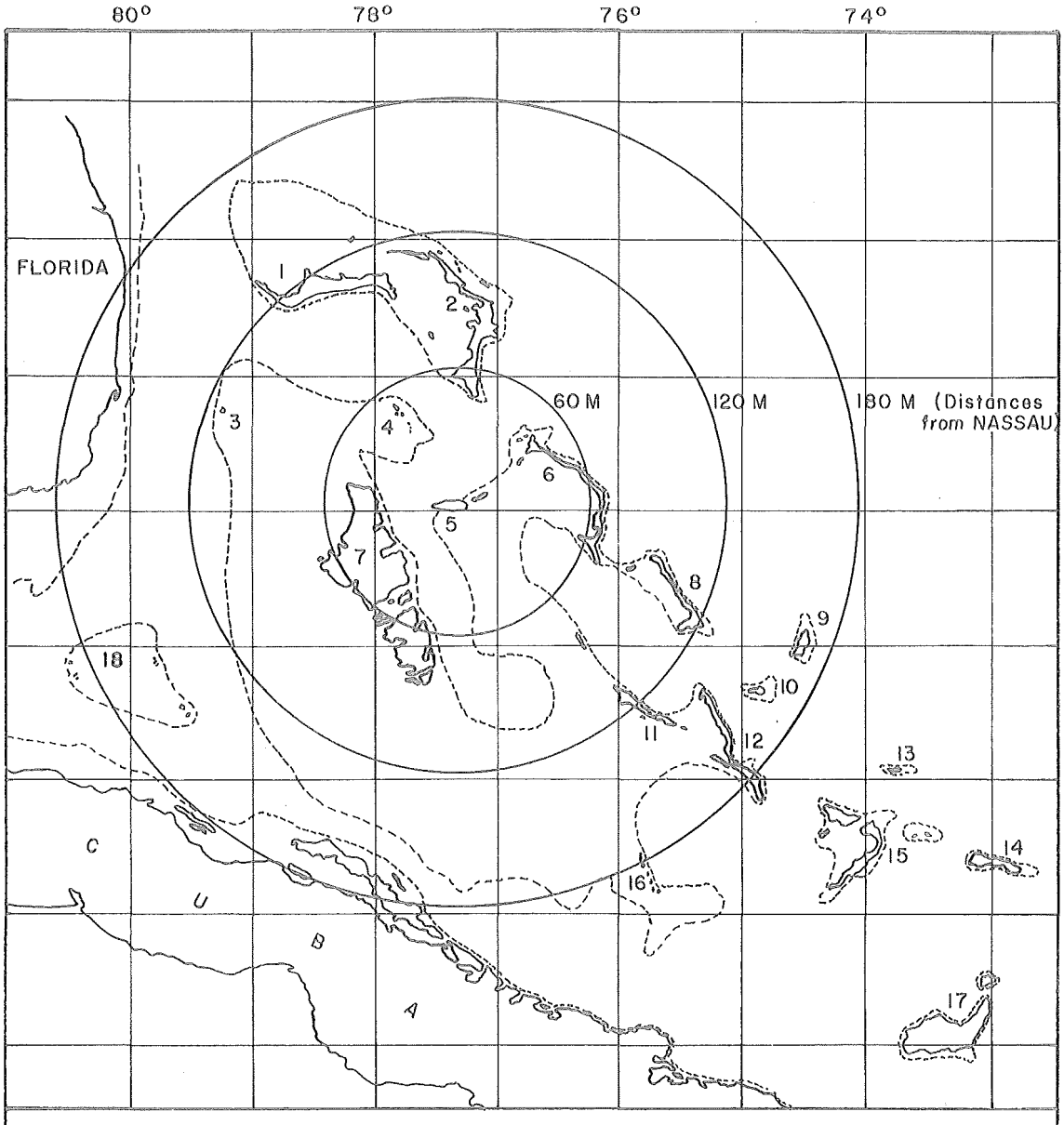



FIGURE No. 1 - The Bahamas, general map with distances from Nassau.

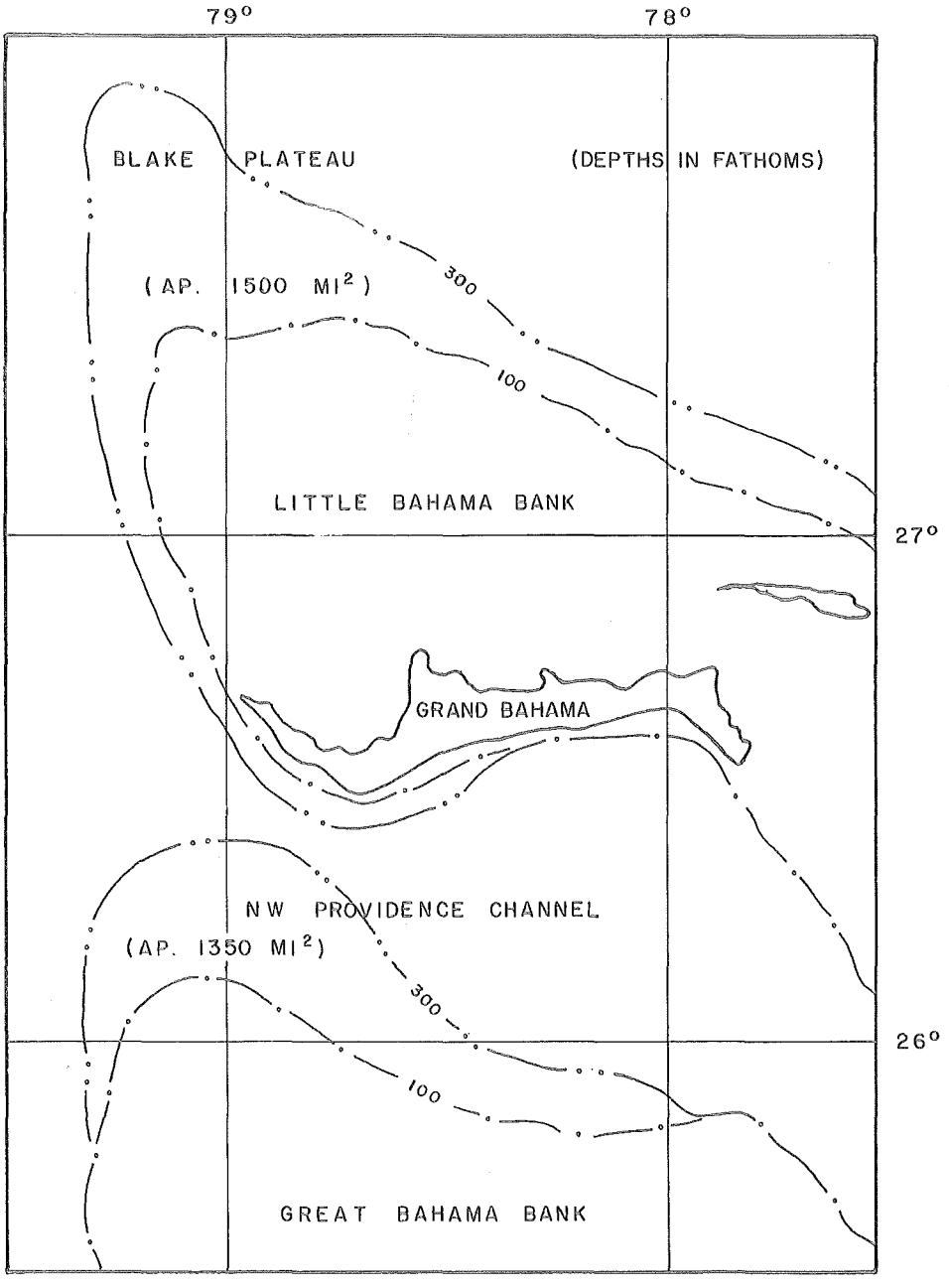



FIGURE No. 2 .- The Bahamas, potential deep sea trawling grounds to the northwest of Great Bahama Bank and Little Bahama Bank

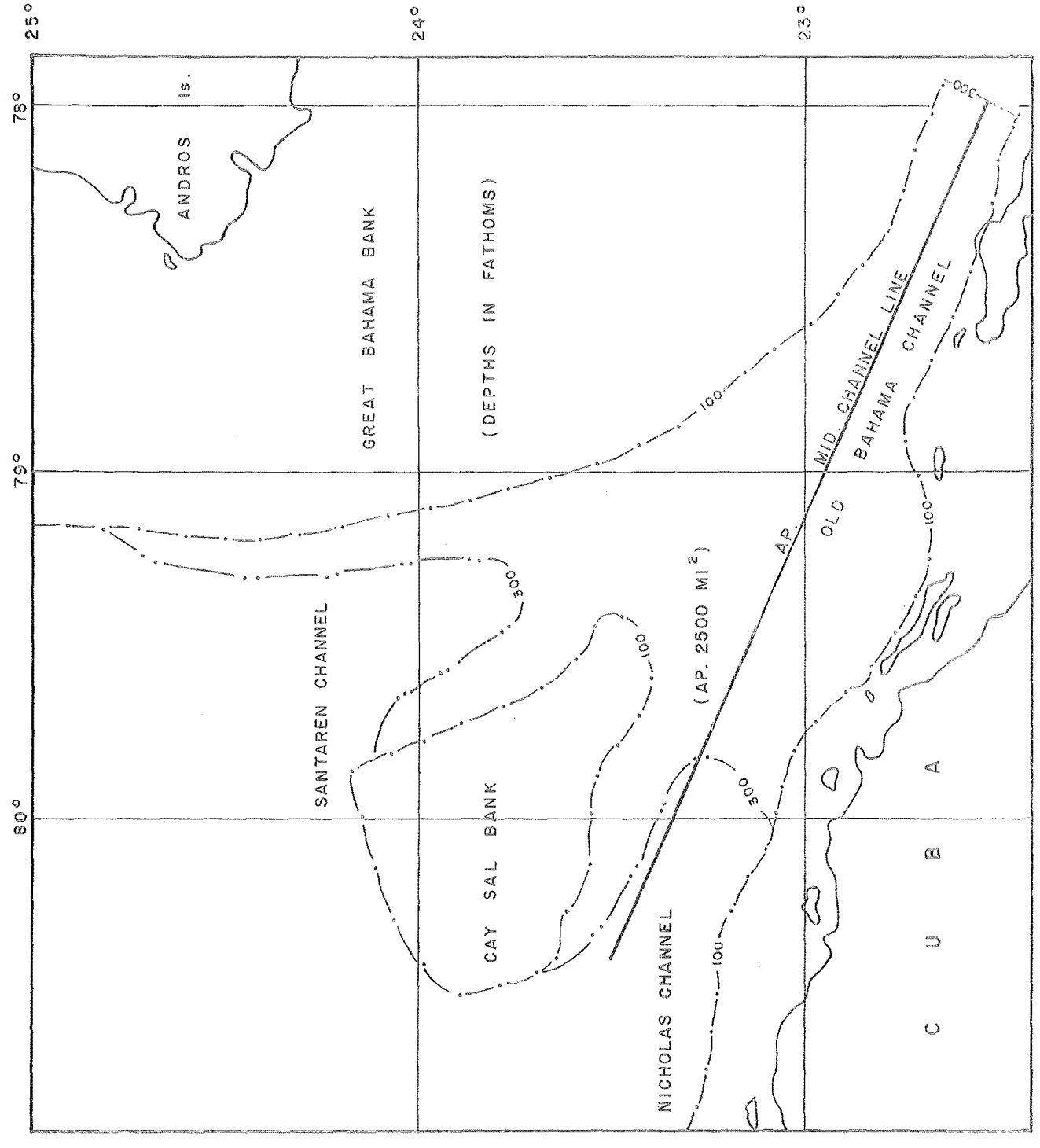



FIGURE No. 3 .- The Bahamas, potential deep sea trawling grounds to the southwest of Great Bahama Bank.

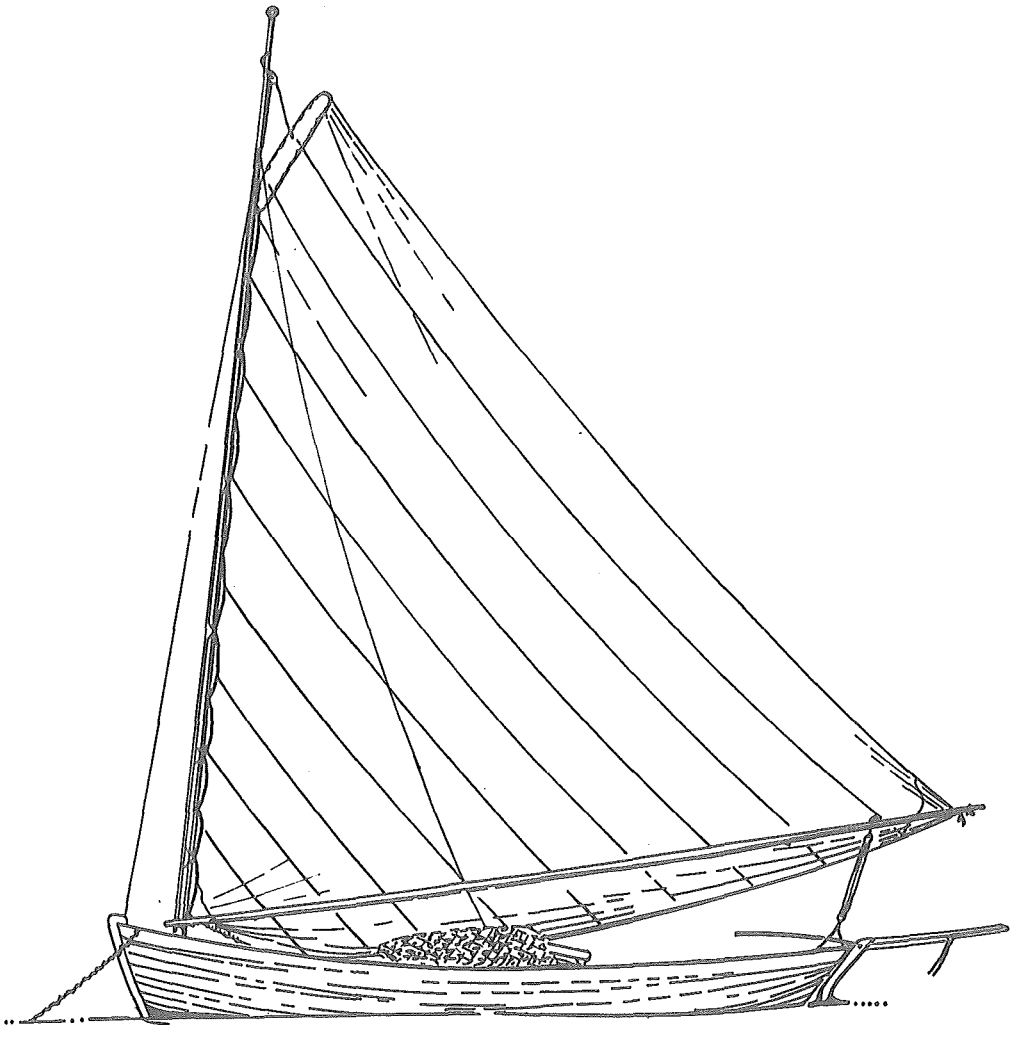


FIGURE No. 4 .- The Bahamas, dinghy locally built.
(extracted from Johnson, 1976)

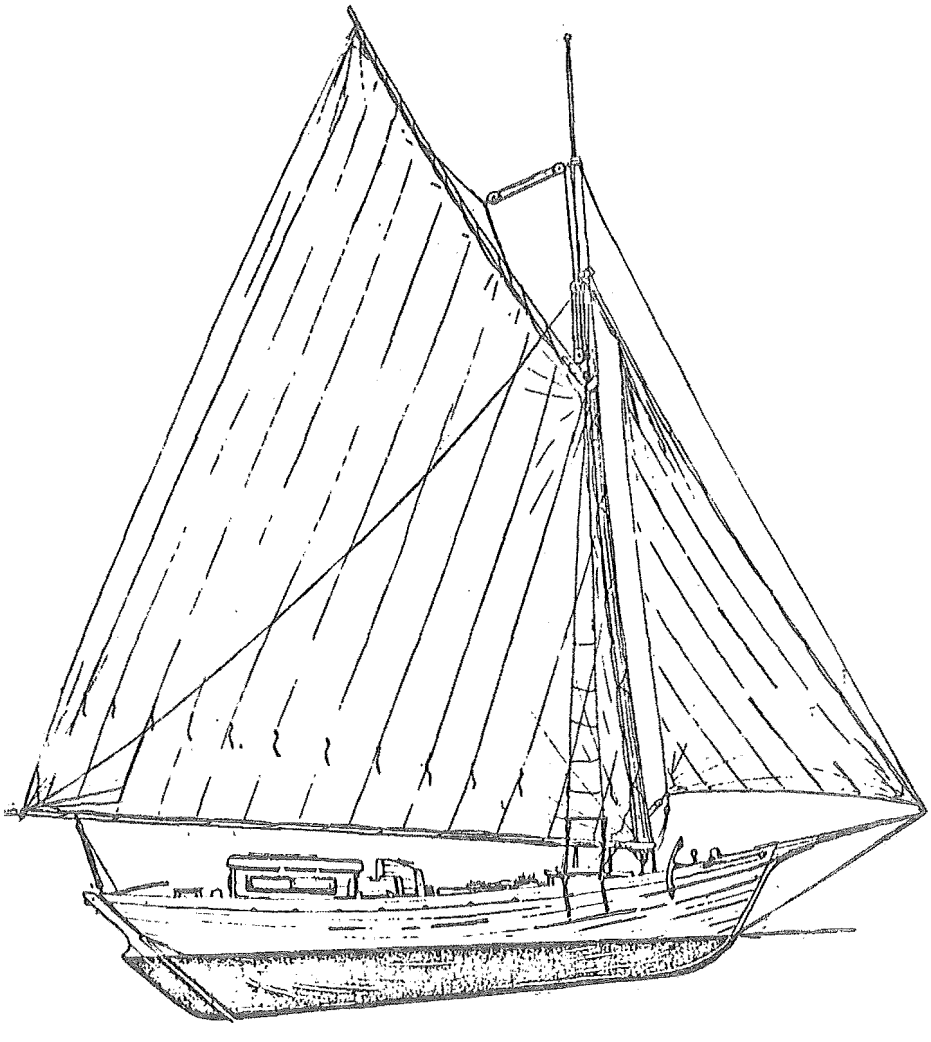


FIGURE 5.- THE BAHAMAS, LOCALLY BUILT FISHING SMACK
( Extracted from Johnson, 1976)

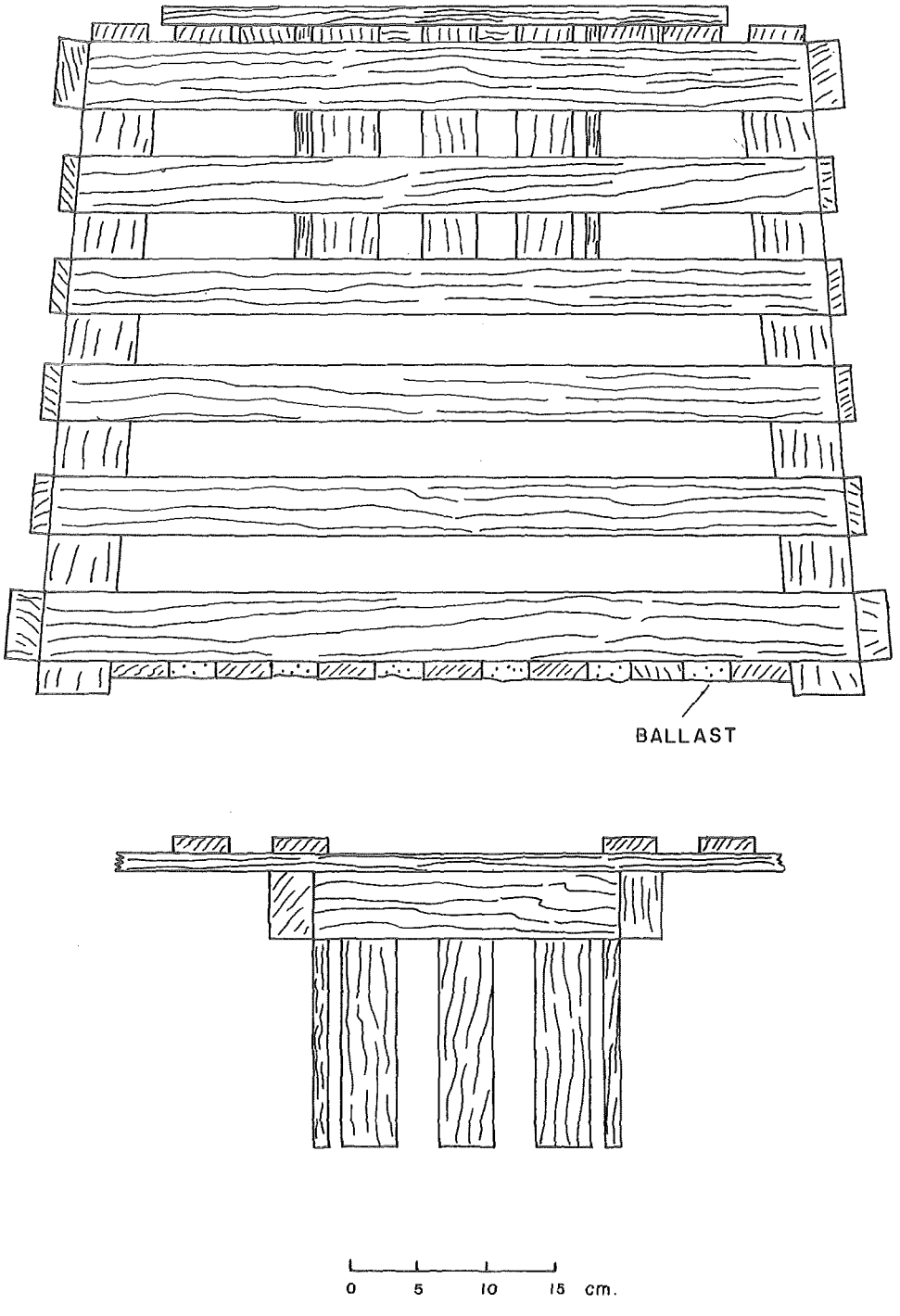
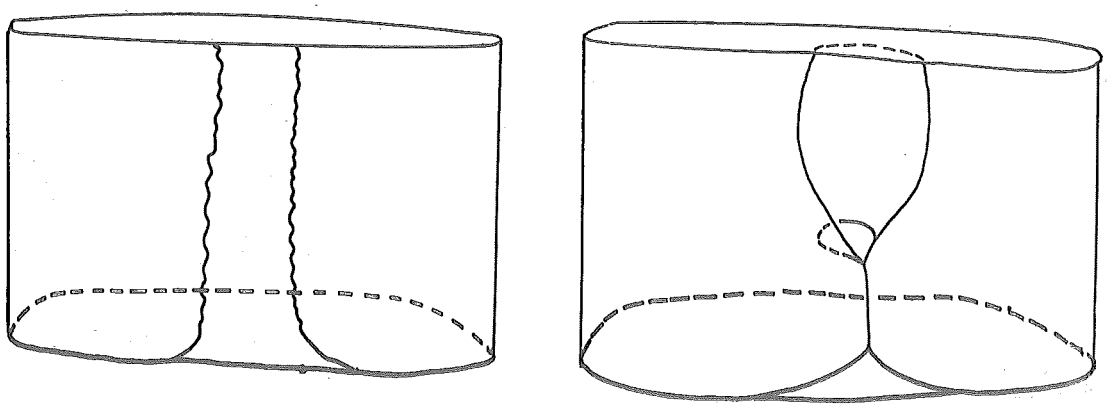


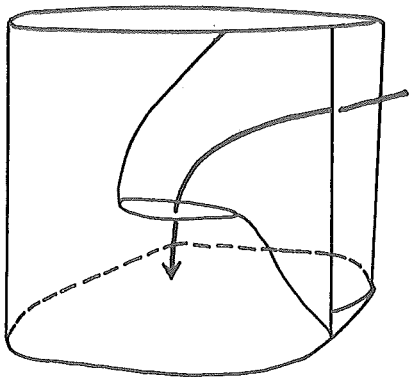

FIGURE No. 6 - The Bahamas, Floridian spiny lobster trap of the type used in the country.



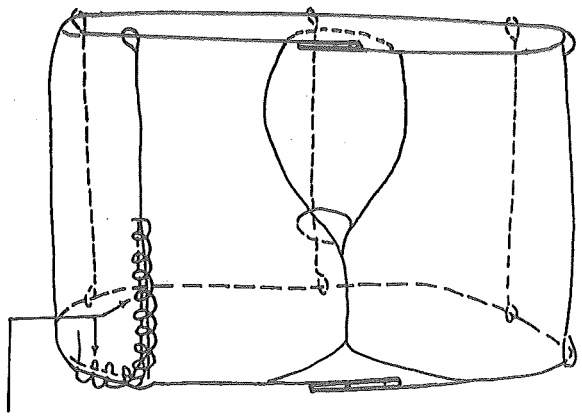
a.
Assembly of top, bottom and side

b.
Trap with funnel in place

Assembly of trap

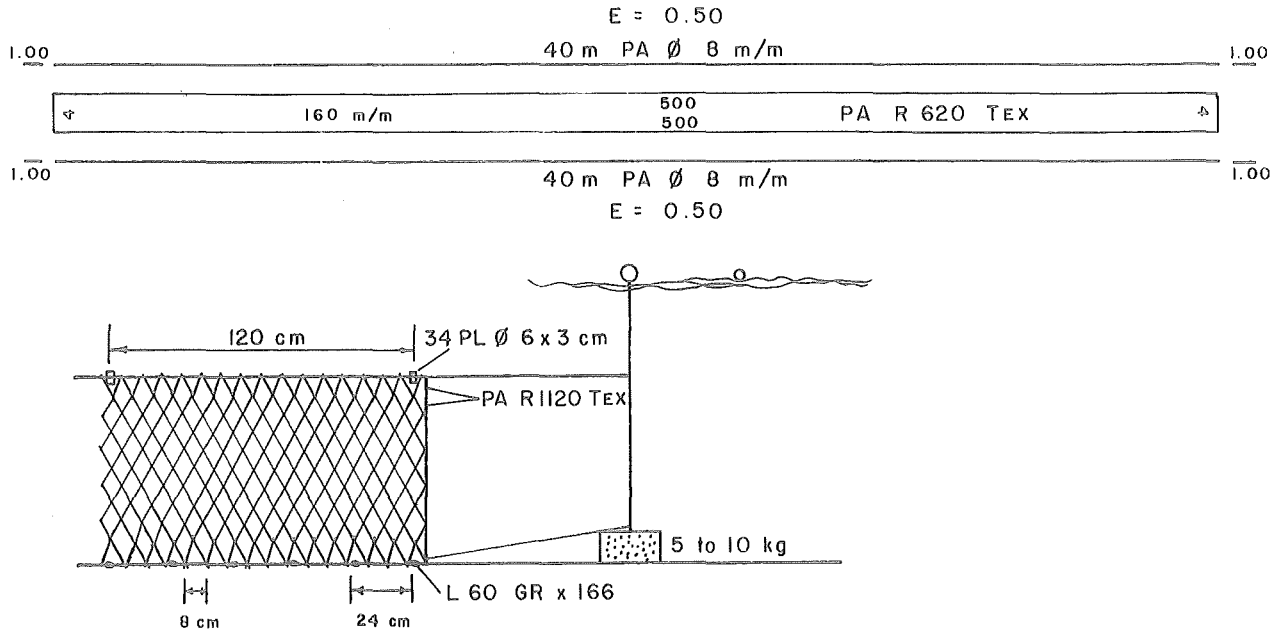


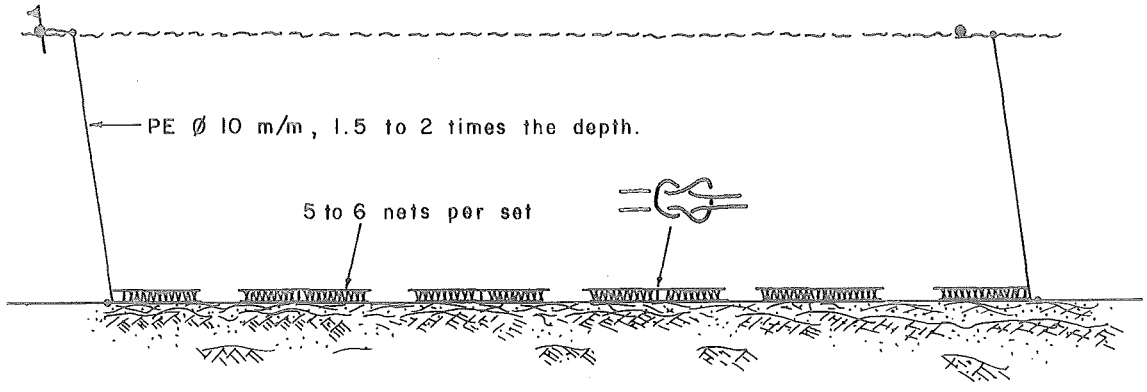
c.
Side view of trap at b




d.
Finished trap with strengthening rods

FIGURE No. 7 .- The Bahamas, most common trap used in grouper fishing (extracted from Thompson, 1977)




- A string is composed of 5 or 6 nets.
- The basic method consists in surrounding patches of reef or rock and in shooting on the sandy floors adjacent to the hard grounds.
- These nets work better at night and generally give optimum results in period of new moon with strong winds.
- They are normally hauled every day.

FIGURE No. 8 .- The Bahamas, recommended spiny lobster tangle net.

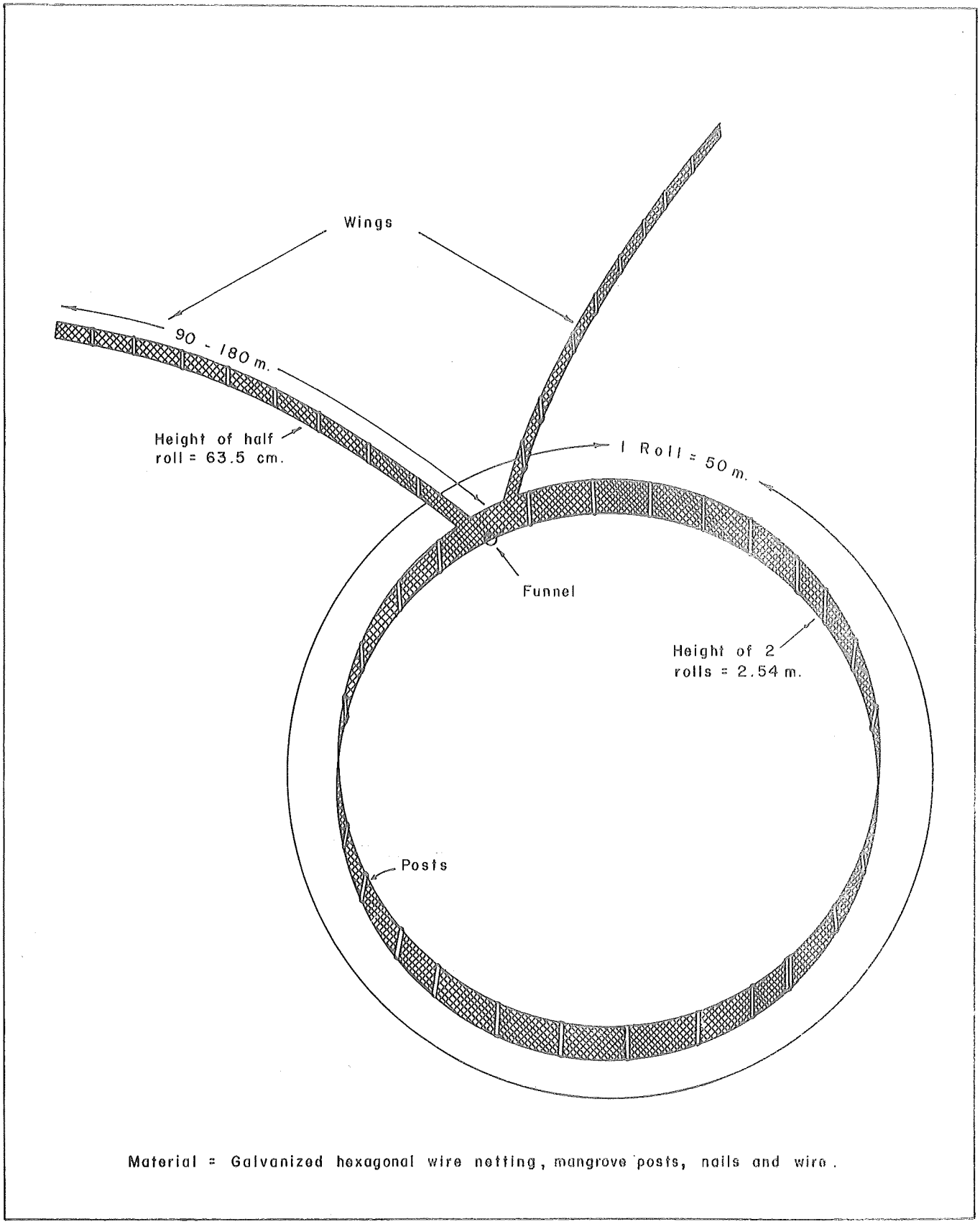



FIGURE No. 9 .- The Bahamas, recommended set net for spiny lobster fishing (extracted from S.V. Bardella and T. Mihara, 1971)

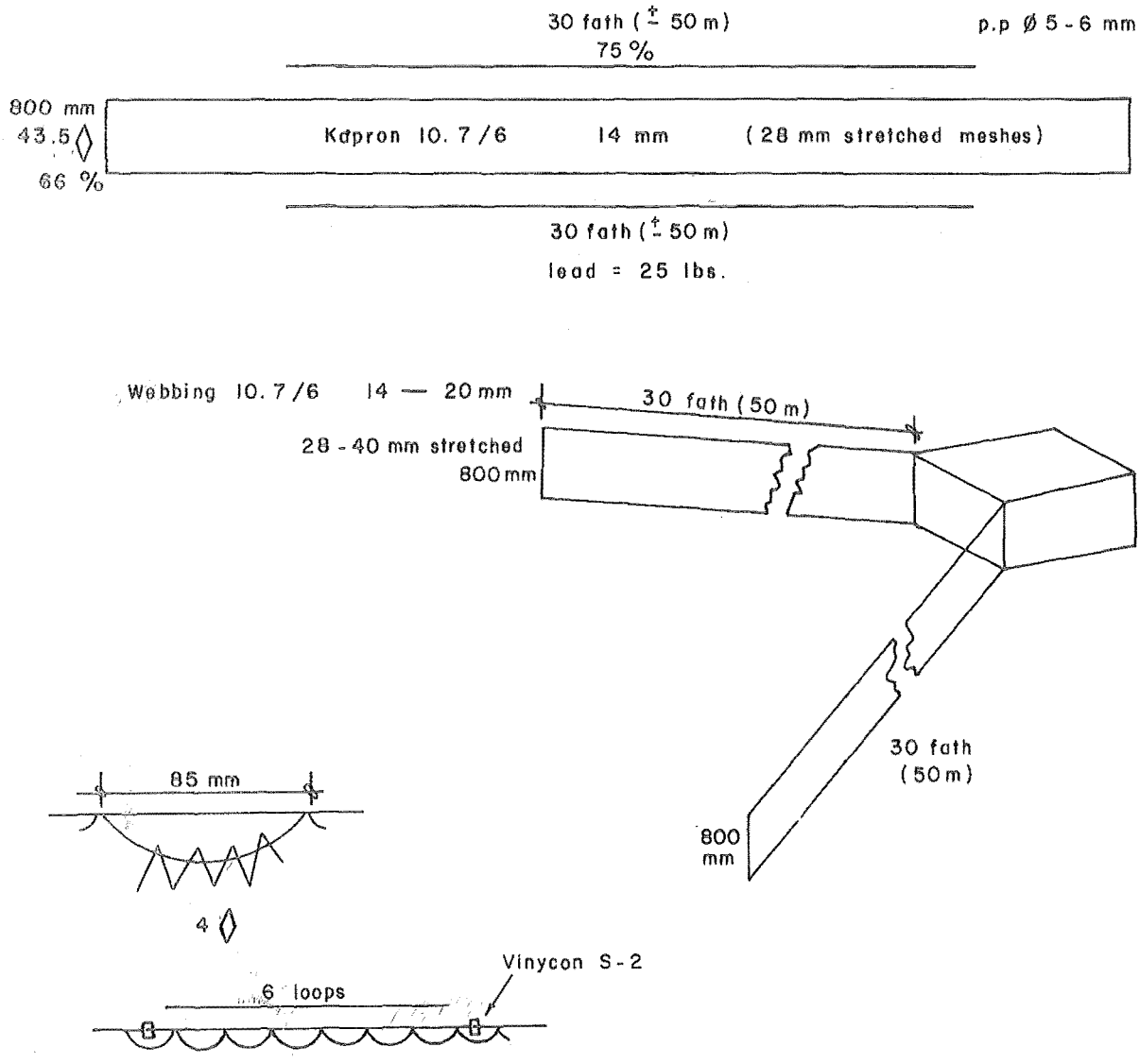



FIGURE No. 10 .- The Bahamas, recommended set net for spiny lobster fishing (extracted from S. V. Bardella and T. Mihara, 1971)

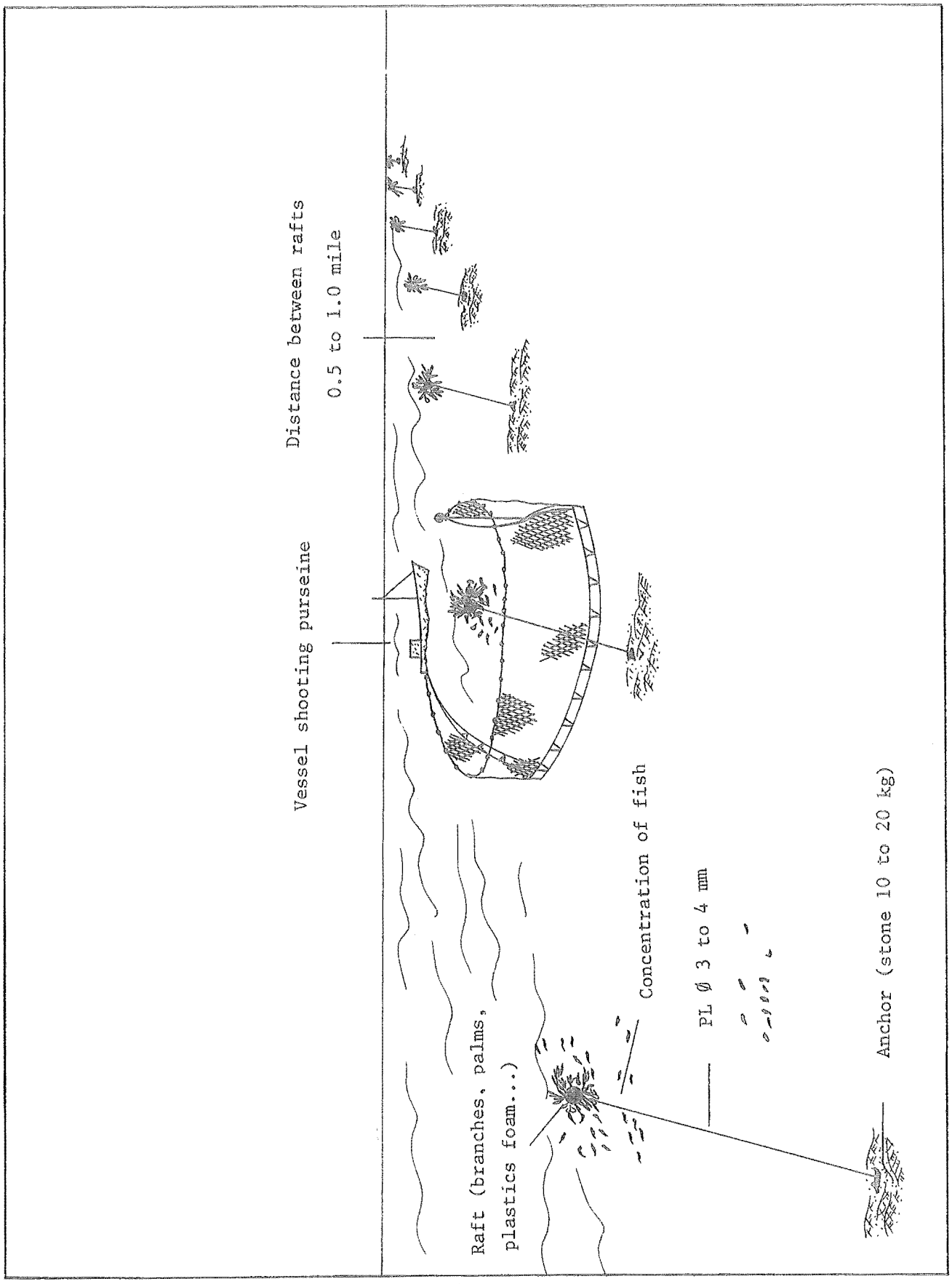



FIGURE 11. THE BAHAMAS, RAFT ATTRACTION FOR PELAGIC SPECIES

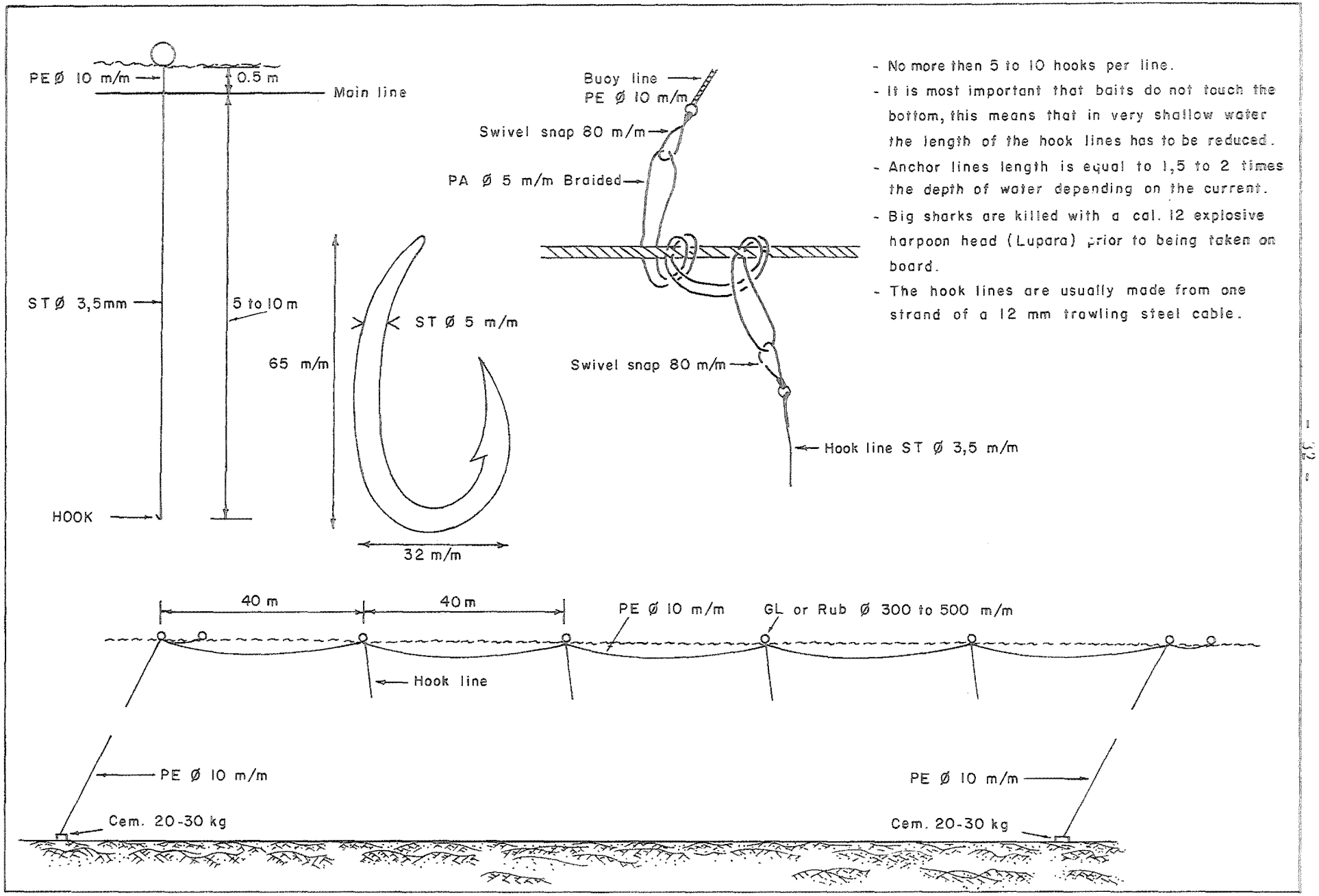
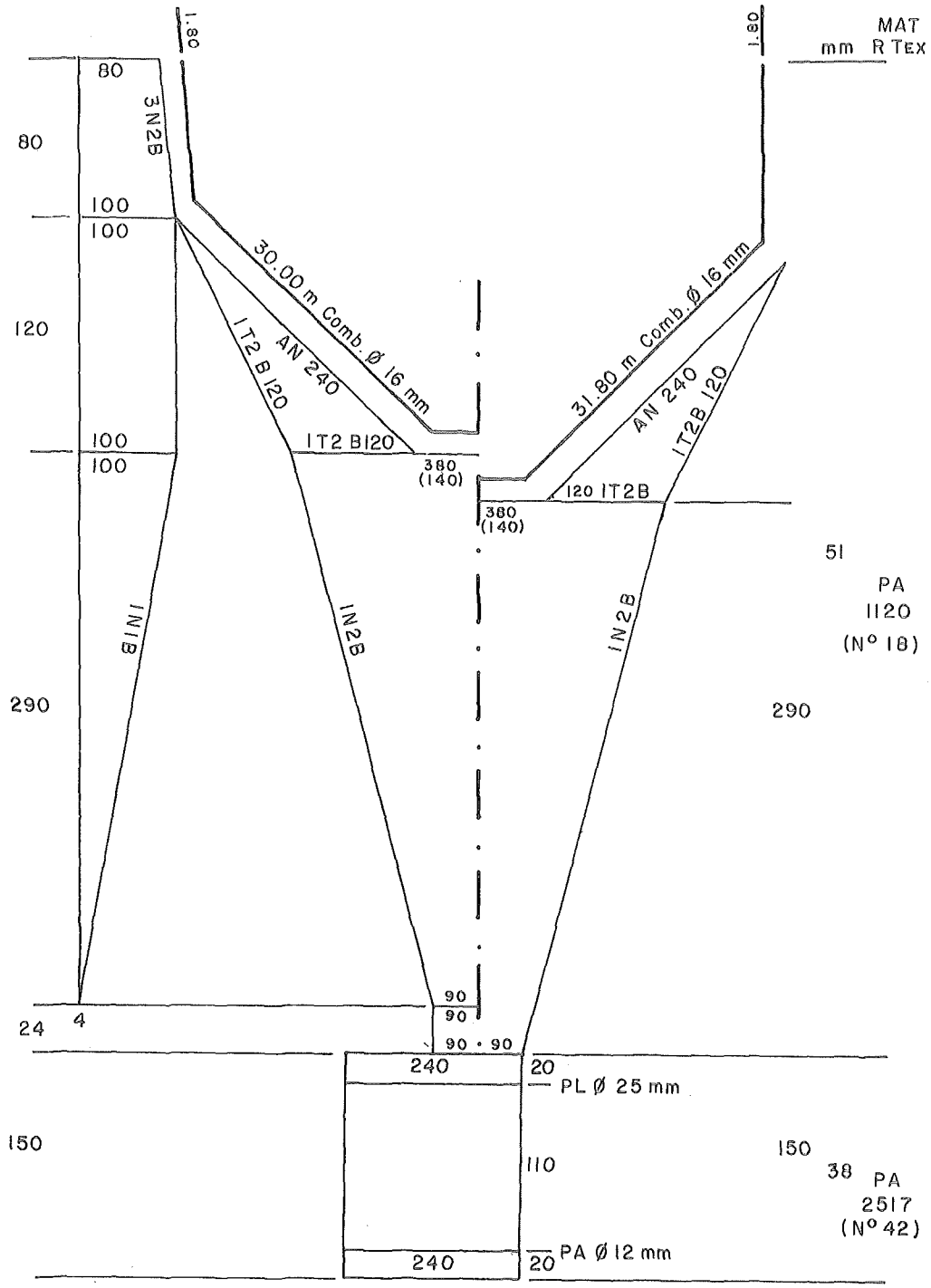



FIGURE No. 12.- The Bahamas, anchored floating shark line.




Chain : 75 to 90 kg in loops all along the foot rope.

Floats: 7 AL Ø 8", 3 in the square and 2 along each triangle.

FIGURE No. 13 . The Bahamas, deep sea shrimp trawl for 350-400 HP vessel, single rigging

WECAF Reports

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