REEF FISHING

FISHERY LEAFLET 354

FISH AND WILDLIFE SERVICE

United States Department of the Interior

United States Department of the Interior, Oscar L. Chapman, Secretary
Fish and Wildlife Service, Albert M. Day, Director

Fishery Leaflet 354

Washington 25, D. C. December 1949

REEF FISHING IN THE PHILIPPINES

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Introduction

A superficial glance at a chart of the waters of the Philippines will reveal the great extent of the coral reefs. These vast, rough grounds have been of great value to Filipinos in that there have been derived from them fishes and other products that have contributed significantly to the national economy since prehistoric times. Today this great resource is in jeopardy. Ill-advised fishing by means of poisons and explosives has endangered the existence of these areas as producing units. If allowed to continue, such practices will probably exhaust them in the foreseeable future. It is the purpose of this paper to suggest means by which these places can be exploited and at the same time conserved for the future of the nation.

This leaflet was originally issued in limited edition and distributed throughout the Philippines by the Fish and Wildlife Service in cooperation with the Philippine Bureau of Fisheries and the United States Information Service.

The Reefs of the Philippines[1/]

Four kinds of reefs are found in the Philippines. The majority of them are along the outlying coasts of the individual islands and fall under the category of fringing reefs. These rarely exceed three miles in width and generally extend less than one mile from the shore.

Barrier reefs occur rather sparingly in the Philippines. They are exemplified by the Bohol Barrier Reef in the northwestern coast of Bohol and the Tawitawi Barrier Reef in the Sulu Archipelago.

Atolls are found mainly in the Sulu Archipelago and are small. The Sta. Cruz Banks located in the southern coast of Zamboanga Peninsula, the Apo Reef off southwest Mindoro, Peral Bank and Tumindao Atoll in the Sulu Archipelago are some of the important examples in the Philippines.

A fourth type of coral reef known as a "shoal reef" is also common in the Islands. It is characterized by being a patch of reef below sea level at variable distances from the shore and surrounded by water 20 to 40 fathoms in depth. This type is, in effect, a fringing reef of broad development on a shelf or submerged bank. Shelves such as the Polillo Shelf on the east side of Luzon, the Visayan Shelf between Panay and Masbate, the Palawan Shelf surrounding Palawan Island, the Leyte-Samar Shelf east of Leyte, and the Sulu Shelf west of Mindanao contain such reefs and are outstanding examples.

1/ 1931 Faustino, L. A., Coral reef of the Philippine Islands. Philip. Jour. of Sci. 2 vol. 44 291-307.

Comparative Volumes of Pre- and Post-War Landings of Reef Species

The Philippine reefs have long produced marine products of considerable value to the national economy. Chief among these are the fishes which include some of the most highly prized foods available from local sources.

Table 1 shows the relative importance of certain coral reef species of fish. Figures are compiled from the returns of commercial fishing boats to the Bureau of Fisheries. They represent hauls of motor propelled fishing boats of more than three tons gross and, therefore, do not include catches of boats of lesser size nor those catches made for sustenance (family use) fishing. It should be noted the the following figures are inaccurate since it is generally recognized that for purposes of tax evasion fishermen tend to underestimate their returns. The data indicate that over two and one half million kilograms of fish still remain to be caught each year from Philippine reefs in order to approach pre-war production levels. It is emphasized that these figures do not include the miscellaneous marine products wnich are also often gathered from reefs. In 1947 these miscellaneous items amounted to 1,219,560 kilograms and in 1946 to 1,159,304 kilograms and included shells, trepang, sponges, lobsters, and corals.

Table I

Catches of Coral Reef Fishes in Philippine Waters

Kinds	1947 Kilograms	1946 Kilograms	1940 Kilograms
Caesios	1,010,583	-	3,340,622
Groupers	251,501	173,585	96,747
Porgies	259,430	114,369	389,936
Snappers	307,618	95,270	146,032
Spadefish, Rudderfish, Runner	33,767	103,524	8,768
Surgeon fish	10,836	188,830	609,952
Total	1,933,736	675,578	4,592,057

Common Commercial Reef Species of Fish

The following is a list of the common commercial species of reef fishes which compose the bulk of the fishery resources found in these places:

English Name	Family	Species	Tagalog
Morays	Muraenidae	Echidna spp.	Malabanos
		Gymnothorax spp.	
Plotosid catfish	Plotosidae	Paraplotosus albilabris	
Gar	Belonidae	Tylosurus spp.	Kambabalo
		Ablennes hians	"
Soldier fish	Holocentridae	Holocentrus spp.	Baga-baga
		Myripristis murdjan	" "
Cavalla	Carangidae	Caranx melampygus	Talakitok
		Caranx sexfasciatus	"
		Gnathanodon speciosus	Garapeche
		Caranx stellatus	Talakitok
		Caranx ignobilis	"
		Seriola nigrofasciata	
		Hynnis momsa	Momsa
Mountain bass	Kuhlidae	Kuhlia rupestris	
Grouper	Serranidae	Epinephelus spp.	Lapu-lapu
		Plectropomus spp.	" "
		Cromileptis altiveles	Lapulapong manotchot
		Anyperodon leucogrammicus	Lapu-lapu
Catalufa	Priacanthidae	Priacanthus spp.	
Snapper	Lutianidae	Lutianus spp.	Maya-maya
		Aprion virescens	Bisugong laot
		Pristipomoides microdon	" "
		Macolor macularis	Ome
		Aphareus rutilans	Bisugong laot
Siganid	Teuthidae	Teuthis spp.	Samaral

English Name	Family	Species	Tagalog
Caesios & grunts	Pomadasidae	Caesio caerulaureus	Dalagang bukid
		Caesio chrysozonus	" "
		Caesio lunaris	" "
		Caesio cuning	" "
		Pinjalo typus	" "
		Plectorhinchus spp.	Labian
		Scolopsis spp.	Tagisang lawin
Lethrinid	Lethrinidae	Lethrinus spp.	Bitilya
Porgies	Sparidae	Monotaxis grandoculis	Malaking mata
		Sparus berda	Bakokong moro
		Argyrops spinifer	Mahuwana
Goatfishes	Mullidae	Upeneus spp.	Saramulyete
		Paraupeneus spp.	"
		Mulloidichthys spp.	"
Leaf-fishes	Acanthuridae	Acanthurus spp.	Labahita
		Naso spp.	"
Wrasse	Labridae	Chaerodon spp.	Maming
		Lepidaplois mesothorax	"
		Cheilinus spp.	"
		Cheilio inermis	"
Rudder fishes	Kyphosidae	Kyphosus lembus	Ilak
Parrot fishes	Scaridae	Scarus spp.	Isdang loro
Trigger fish	Balistidae	Balistes spp.	Papakol
		Balistapus spp.	"
Filefishes	Monocanthidae	Monocanthus chinensis	Pakol
		Cantherines spp.	"
		Stephanolepis spp.	"

Fishing Methods Employed

The important methods of fishing used in the Philippines to catch coral reef fishes vary from the illegal methods of fishing with explosives and fish poison to the expensive commercial muro-ami (Japanese drive-in-net).

1. Explosives and Poisons -- Dynamite is the most common explosive used in fishing. Large sums of money have been involved in illegal transactions in explosives and in addition, loss of human life is often incurred in its use. Many persons have been apprehended by law enforcement agencies and prosecuted for pursuing this illegal venture. Before the last global war, when dynamite was very difficult to obtain, various illegal methods of procurement were resorted to by these violators of the fishery laws.

In dynamiting on a small scale, only a small dugout is used, and the catch is collected by diving and either scooping the fish with a small dip net or simply picking them up with the hand. Some of the larger operators use fast sailing bancas and the catch is collected by the use of scoop nets or other similar gear. Some types of gear used in this connection also serve the added purpose of camouflaging the illegal operation. In the wake of the last war the dynamiting of fish assumed very large proportions, due to the abundance of left-over stocks of the many kinds of explosives for warfare.

Fish poisoning is the other illegal method of fishing employed on reefs. The common fish poisons are mostly of plant origin, although some of the criminally inclined use minerals such as arsenic and cyanide, chemicals not only harmful to fish but which also kill other animals including man.

2. Diving and Spearing -- Not a small amount of the supply of coral reef species are brought in by divers who spear the fish among the reefs. This is an especially common method used by the fishermen from Bohol and the Moros, who are probably the best Filipino divers. These people literally live in the sea. Many of them can stay the whole day swimming, diving, and spearing fish to the extent that they even forego taking time out on land for their meals which they manage to eat while in the water.

The gear used consists of two main parts - diving goggles and the spear gun, both home-made (fig. 1). The pair of goggles, smaller in size than the factory-made swimming spectacles, have wooden frames, carved by hand, which hold pieces of ordinary circular glass. A pair of framed glasses are joined to each other by a piece of rubber band adjusted to fit the ridge of the nose. The goggles are secured either by other pieces of rubber bands behind both ears, or are simply slipped over the head by a single piece of elastic. The spear gun has a wooden butt and barrel, the latter having a groove into which a well-tempered iron barbed blade or spear is slipped. The gun works on the principle of the bow and arrow. The energy is supplied by a stretched one-half-inch rubber band to which the blunt portion of the spear is fitted and which is released by means of a triggerlike device.

Before diving, the fisherman prepares his gear with the spear secured ready for action. When underwater, he aims the gun at the object of his search and by releasing the trigger lets go the spear with great accuracy. Some Jolo fishermen can take two big-sized cavallas with a single shot.

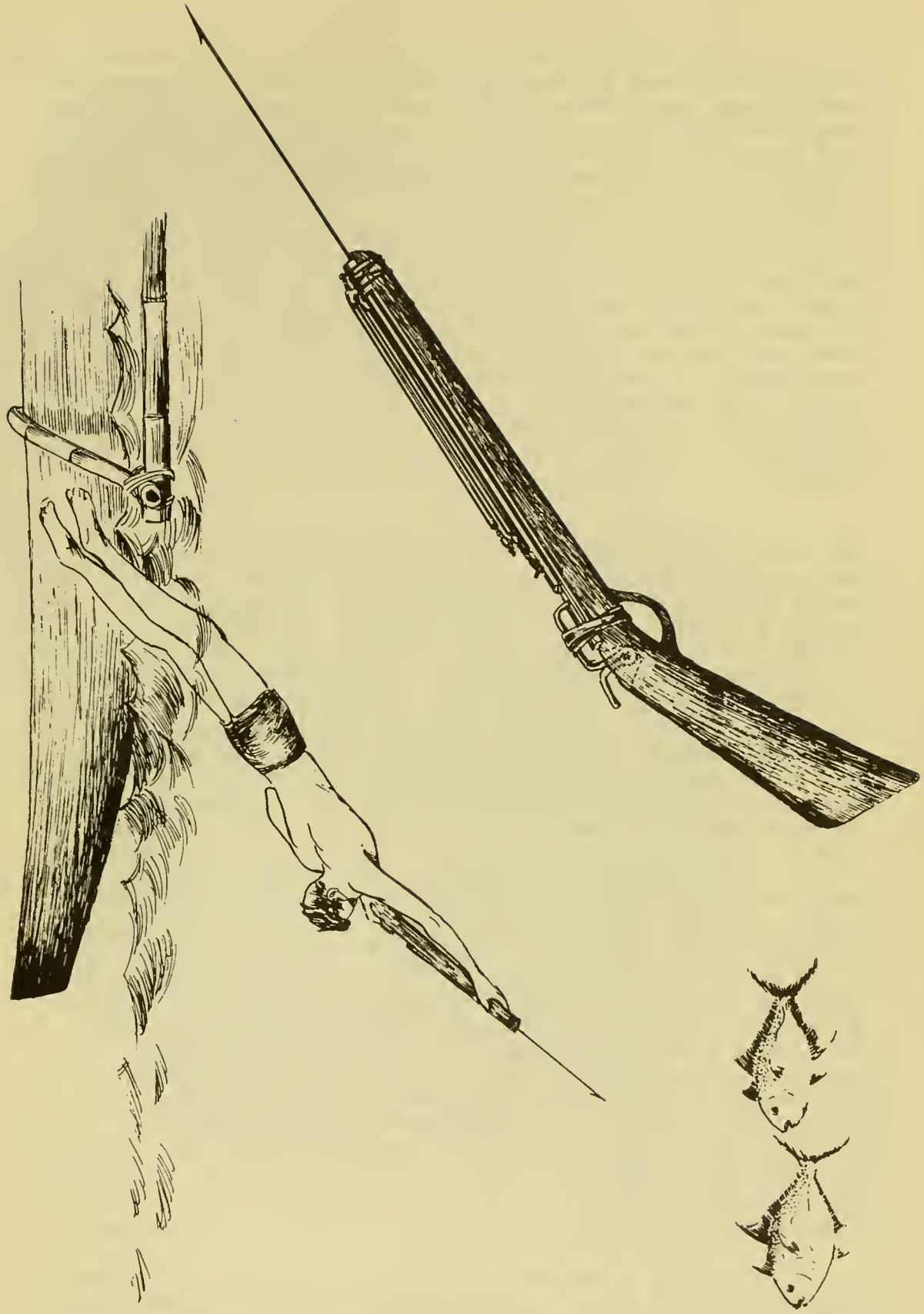


Figure 1

3. Fish Pots (Bubo) -- Fish pots of various shapes, sizes, and styles are used in many localities but especially around coral reefs. These are enticing devices made in the form of rectangular-ovoid receptacles, generally with a non-return valve designed for easy entrance but difficult exit (fig. 2). These contrivances are generally made of bamboo splints woven together or, more recently, of wire netting. In operation these traps are first baited with strong smelling substances such as meat or entrails of fowls, or sometimes, it is reported, with an empty, clear glass bottle. They are then sunk in some suitable location by means of stone or rock weights. After a period of some twenty-four hours or more they are hauled in by raking a hooklike, weighted device back and forth over the ground where they were set. The recovery of the gear is by trial and error aided by approximate fixes to visible landmarks. These contraptions are purposely left without buoys or markers in order to prevent their being stolen by poachers. When employed in respectable numbers, this method of fishing becomes a profitable commercial venture.

4. Lines -- Another method employed in catching coral reef fishes is the ordinary handline with single or multiple hooks. The specifications of this gear are many and varied, depending primarily upon the ideas and traditions of the fishermen in different regions of the Philippines. This gear also varies according to the size and species being fished. A great many handliners operate at night and employ artificial light on the theory that the bait fishes attracted to the light serve to attract larger species which can then be readily captured. While most fishermen operate individually on a sort of subsistence fishing basis, many pursue this type of fishing as a business. Often an investor engages fishermen on a type of collective fishing; the investor supplying the gear and supplies, and in turn, having a monopoly to buy the catch.

When operating at night the fishermen usually put out from shore individually or in pairs in a sailing canoe (banca) for the reef they intend to fish; timing their departure to enable them to arrive about sundown. At dusk the lights, generally one or two kerosene pressure lanterns of from 500 to 2000 candlepower each, are lighted and the canoe allowed to drift. Each fisherman is equipped with a small dip net and the first animals attracted are usually a few small squids which are dipped up for bait. The squids in turn are then affixed to a small hook on a light line and this arrangement is then put into operation and larger fish generally round scads and/or small mackerels are taken. This procedure continues until a dozen or so of the latter are hooked and these fish are used as bait for the species it is intended to take for market. Each bait fish is cut in half longitudinally and a bait consists of a half. The head, very often, is discarded.

Japanese fishermen, operating in the Philippines, also employed handlines before the war usually in waters as deep as 50 to 60 fathoms. They fished from motor-propelled vessels with all hands aligned along the gunwale with one handline each.

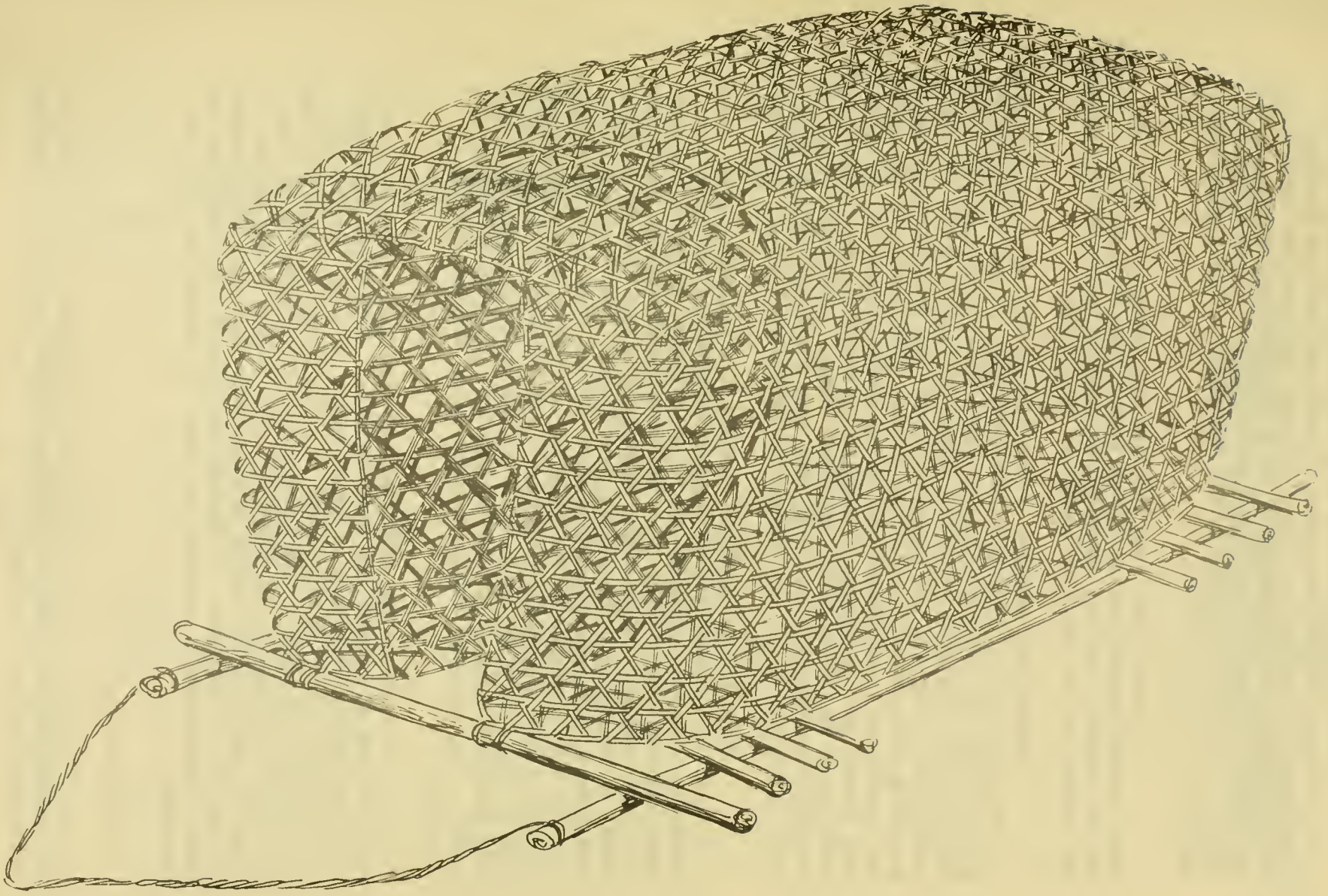


Figure 2

Their gear consisted of a gut mainline about 6-8 mm. in circumference, to the bottom end of which was hitched a small, loosely tied stone weight. At a distance of about one meter from the weighted end was attached a No. 2 snooded hook carrying a bait. The hook was very much bent, the point being directed inward to reduce the distance between it and the shank to the minimum consistent with effectiveness.

In actual operation the line was lowered and when the stone weight touched bottom it was jerked free from the line. Without the weight, the line carrying the hook gradually floated upward and generally the fish were hooked at that stage.

Before the outbreak of the Pacific War the Japanese drive-in-netters in the Philippines often supplemented the take of their muro-ami gear by using a multiple handline 2/ for catching coral species. This gear was employed when they failed to find a sufficient concentration of caesios and surgeon fishes, the two principal species sought by them, to warrant making a set. While scanning the reefs for schools of these fishes they often found attractive, large-sized food fishes such as snappers, porgies, lethrinids, etc. which they could catch by this type of handline. When a good-sized school of caesios, for example, was found, the same fishermen took in their lines and began to pay out their more effective muro-ami gear.

The multiple handline consisted of a weighted cottom mainline to which was attached at regular intervals a series of wire spreaders. To each spreader there was attached in turn a snooded hook carrying a bait (fig. 3). The mainline ordinarily consisted of 10/198 hardlaid cotton twine varying in length from 40 to 200 meters depending upon the depth to be fished. The wire spreaders were made of ordinary galvanized wire 3.2 mm. (1/8 in.) in diameter and they were attached to the mainline at intervals somewhat greater than one meter (generally four feet). The snoods or leaders were made of piano or steel music wire and the hooks attached to them were generally size No. 2 with a much bent point and provided with a barb. The line was sunk by a stone which weighed about 2.5 kilograms.

To increase the efficiency of this gear, chumming (scattering chopped fish bait) was also employed. According to reports it was sometimes customary to catch squids or other forms which were chopped very fine and placed in a light cottom bag. This bag of bait was then tied to the extreme end of the mainline so that the sinker was immediately above it. The chum was then caused to spread by allowing the weight to repeatedly fall upon it. Catches as great as 800 kilograms of marketable fish per day have been reported being taken by two men from reefs 90 fathoms deep by this procedure.

2/ The specifications of this gear contained in this paper are only approximations based on memory, no actual written description having been kept of the gear.

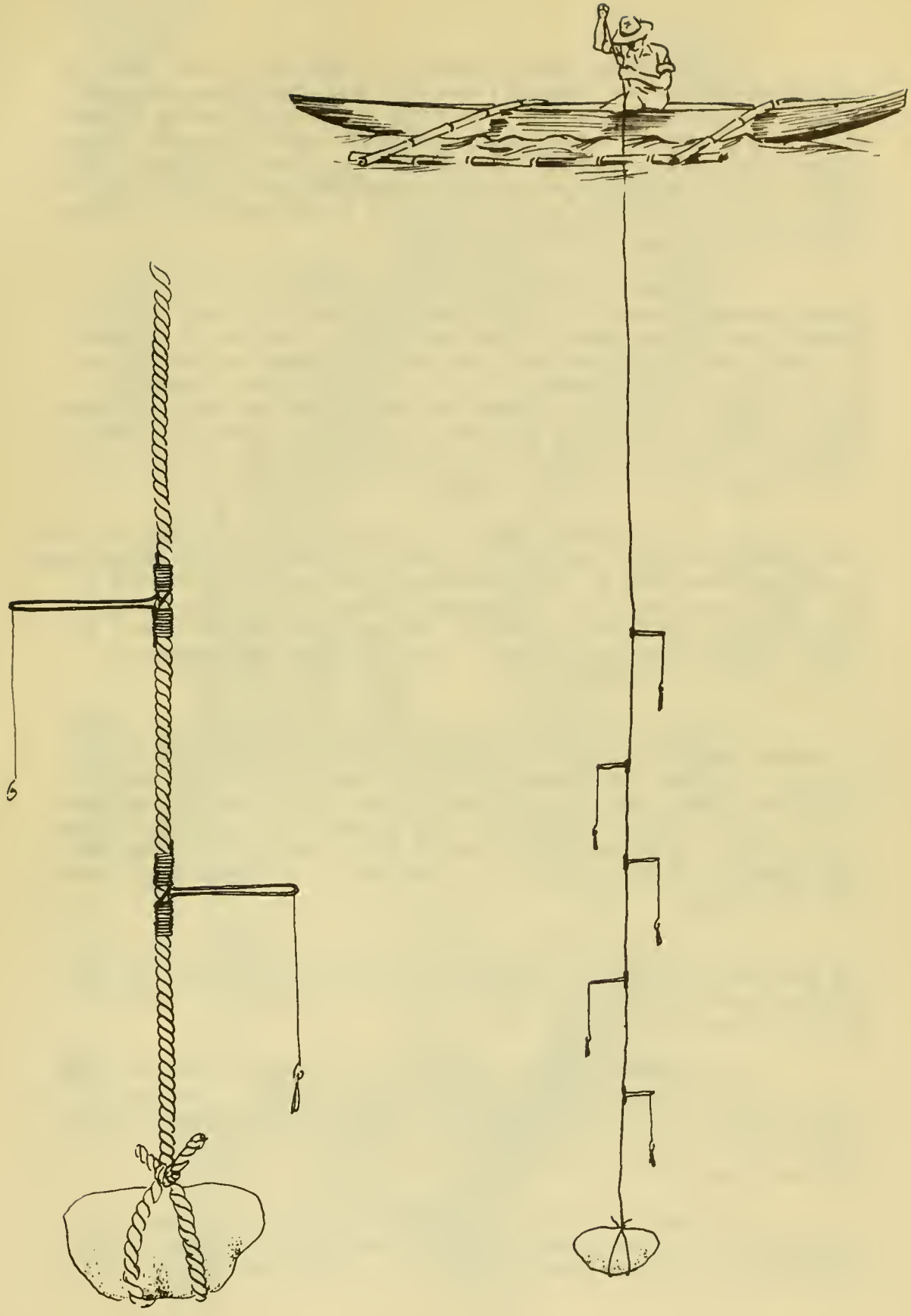


Figure 3

5. Reef Drag Seine (Ligkop) -- This is a seine (fig. 4) dragged over coral or rocky bottoms with the floatline submerged below the surface of the sea. The net, which is of Manila (abaka) twine with a mesh of 1 1/2 inches stretched, has a finished length of from 180 to 300 fathoms. The corkline is floated as usual with wooden floats while the groundline is weighted with either lead or stone sinkers. The free end of each wing is provided with a bamboo brail about one and a half fathoms long.

In operation the net is payed out where a good-sized concentration of reef fishes has been located. The fish are surrounded and the net made to fish to bottom as deep as 10 fathoms by sinking the whole gear with the aid of 3 bamboo poles held by men on board 3 small bancas. The two wings are then gradually pulled towards the shore by means of pull ropes and the whole gear hauled in the manner of an ordinary beach seine except that in this operation, the bottom line is continually under the surveillance of several divers who free or disentangle it from snags.

6. Drive-in-net (Bahan) -- Another common method of coral reef fishing employed by the fishermen from Samar is the bahan which is nothing more than an abbreviated drag-seine with or without a bag. The seine proper is of sinamay (abaka cloth) which is the portion that serves as the bunt or landing piece of the gear. A pair of coconut leaf scarelines, from which the term bahan is derived, serve as the wings.

The seine proper has a finished length of 21 fathoms and a maximum depth of 3 fathoms, tapering toward the two ends to a depth of 1 fathom. The head and foot of the net are each hung to a 1/2-inch abaka rope after providing them with a two-mesh selvage strip of 1 1/2 inches stretched. The entire length of the corkline is provided with wooden floats, while the groundline is weighted lead sinkers. On the free end of each wing is a bamboo brail about five feet long.

The scareline is a pair of 1 to 2-inch manila ropes about 100 fathoms in length to which coconut leaves are tied by the midribs with rattan. The midribs are split to produce two separate units from one leaf.

In operation the net is payed out somewhat seaward with the two wings toward the shore enclosing the school. The entire gear is then pulled toward the shore, the winglike scareline serving to drive the fish into the bunt where they are impounded. The fish are then brailed into the canoes.

7. Bohol Drive-in-net (Kayakas) -- This is a type of Filipino drive-in-net commonly used by the Bohol fishermen in coral reef fishing in waters ranging in depths from three feet to three

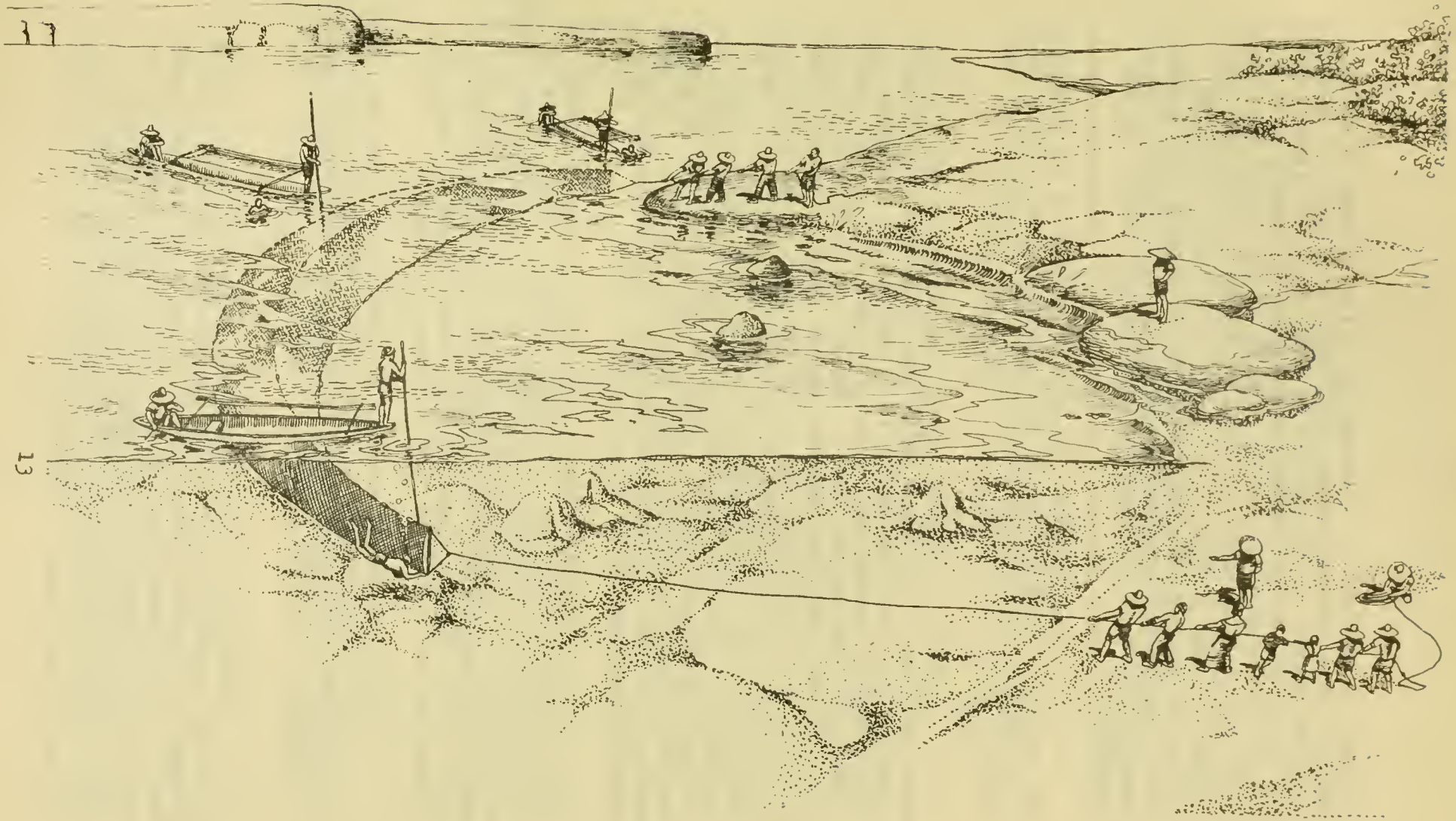


Figure 4

fathoms. It consists of a rectangular net of sinamay or cotton netting with a finished length of 30 feet and a depth of 16 feet. It may be floated on the corkline by means of bamboo floats and sunk toward the bottom line by rock weights; or made up as a push-netlike affairs supported on two sides by bamboo frames that cross at the basal end forming a somewhat triangular baglike net. The operation is very similar to the bahan of the Samar fishermen. The fish are driven into the baglike net by means of a long scare-line of coconut leaves strung together with small bamboo floats at intervals. From 10 to 16 men and 4 bancas are employed in the operation.

8. Japanese Drive-in-net (Muro-ami) -- Of the fishing gear employed before the war in the exploitation of the reef fishes in the Islands, the muro-ami ranked first in importance from the viewpoint of initial investment and success in operation.

An outfit consisted of one large-sized, power-propelled mother boat and four smaller-sized fishing bancas. The former loaded the catch and transported it to market, and the latter were the working or fishing boats proper. Table 2 is a list of the different muro-ami mother boats in actual operation in the Philippines in 1939. They were Japanese sampans used for carrying fish to market and to carry supplies and provisions for the fishermen on their return trip from Manila or other marketing centers. These fishermen did not return regularly to their home ports. Rather they stayed in "stations" on shore in the immediate vicinity of the operating grounds ready to begin fishing the moment the mother boat was in condition to take fresh fish into her holds. In their shore station the 15 to 25 fishermen lived in rented houses or in makeshift shelters when no houses could be found.

The four smaller bancas were open boats about 15 feet in length, 3 feet in width and 1 1/2 feet in depth. They served as the fishing boats on which the nets were loaded and which the fisherman employed in the actual setting or laying out operations of the gear. These boats were either towed by the mother boat from the station to the fishing ground or were loaded on board in case the distance was too far and the sea too choppy or rough.

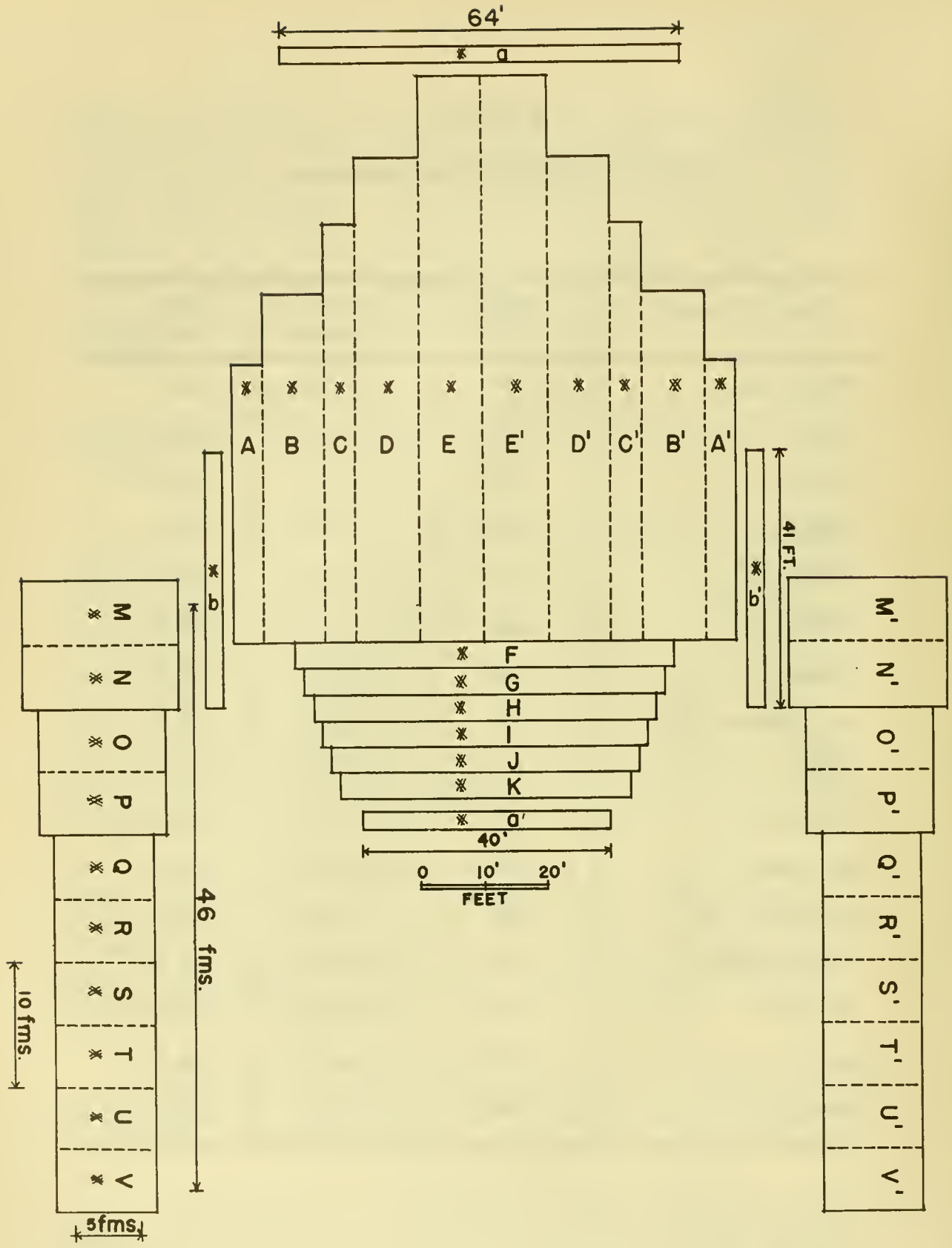
The muro-ami net was made of cotton, the structural design of a typical one being shown in figure 5 and the corresponding specifications in Tables 3 and 4. A perspective view of the gear in operation is shown in figure 6.

The floatline was composed of two Manila ropes; an outer 2 1/4-inch, right-laid rope and an inner 2-inch, left-laid rope. Attached to the 44-foot floatline of the bag were circular wooden floats 5 inches across the disk and 1/2 inch thick. These floats were seized very close to each other at the center but spaced farther apart at the outer portions to as far as 4 inches. On the wings similar floats were spaced at 6-inch intervals at the after end, and 12 inches apart at the fore end.

Table 2

List of Muro-Ami Boats in Operation
in 1939

Name of Vessel	Engine H.P.	Gross Tonnage	Net Tonnage
Armado II	100	48.31	26.63
Cuyo	80	23.91	15.18
Cuyo No. I	80	40.35	21.69
Guzman I	80	46.26	29.47
Guzman II	50	23.91	15.90
Guzman V	120	40.63	19.58
Guzman IX	120	37.15	19.58
San Nicolas VII	120	32.28	20.11
Arbo	100	44.73	23.33
Azucena I	70	38.76	20.93
San Diego I	100	34.47	21.84
San Diego II	60	21.29	16.48
San Ildefonso	80	26.84	15.07
Ambulong	80	37.87	18.27
Apo	130	34.12	18.87
Belen II	120	37.13	19.26



STRUCTURAL DESIGN OF MURO-AMI

Figure 5

Table 3

SPECIFICATIONS

	Parts	Symbols	Material: Kind	Material: Twine #	Width of Mesh in inches	Width in Meshes	Depth in: Feet	Depth in: Fathoms	Remarks
BAG	Bag proper	A	Cotton	20/15	1.25	50	44'6"		The 800 meshes (A-E & E'-A') at the head is hung to a 64' corkline after joining same to selvage (a). A & A' (66'6" deep) is laced to 17' lacing line after joining same to salvage (b & b'). F-K (24' deep) is laced to 24' lacing line after attaching selvage. The 500 meshes at the foot (K) is hung to 40' bottom line after joining same to selvage (a').
		B	"	20/15	1.25	100	55		
		C	"	20/15	1.25	50	66		
		D	"	20/15	1.25	100	77'4"		
		E	"	20/15	1.25	100	90		
		E'	"	20/15	1.25	100	90		
		D'	"	20/15	1.25	100	77'4"		
		C'	"	20/15	1.25	50	66		
		B'	"	20/15	1.25	100	55		
		A'	"	20/15	1.25	50	44'6"		
		F	"	20/15	1.25	600	4		
		G	"	20/15	1.25	580	4		
		H	"	20/15	1.25	560	4		
		I	"	20/15	1.25	540	4		
		J	"	20/15	1.25	520	4		
		K	"	20/15	1.25	500	4		
	Selvage	a	Cotton	20/24	2.0	400	2'6"		
		b	"	20/24	2.0	30	41		
		a'	"	20/24	2.0	400	2'6"		
		b'	"	20/24	2.0	30	41		
WING	Left wing	M	Cotton	20/24	2.5	200		13	The 2000 meshes at the head and foot M-V are hung to 46 fms. each of corkline and lead line with 1 mesh selvage of twine No. 20/30, 3" stretched. The 8 fms. at tip of V is laced to 5-fm. marginal line.
		N	"	20/24	2.5	200		13	
		O	"	20/24	2.5	200		10	
		P	"	20/24	2.5	200		10	
		Q	"	20/24	2.5	200		8	
		R	"	20/24	2.5	200		8	
		S	"	20/24	2.5	200		8	
		T	"	20/24	2.5	200		8	
		U	"	20/24	2.5	200		8	
		V	"	20/24	2.5	200		8	
	Right wing	M'	Cotton	20/24	2.5	200		13	Hanging and lacing in right wing (M'-V') similar to left wing. Q-V & Q'-V' may be of No. 20/30 twine with a mesh of 3" stretched.
		N'	"	20/24	2.5	200		13	
		O'	"	20/24	2.5	200		10	
		P'	"	20/24	2.5	200		10	
		Q'	"	20/24	2.5	200		8	
		R'	"	20/24	2.5	200		8	
		S'	"	20/24	2.5	200		8	
		T'	"	20/24	2.5	200		8	
		U'	"	20/24	2.5	200		8	
		V'	"	20/24	2.5	200		8	

Table 4

Ropes and their Attachments in the Construction of the Muro-ami

Part	Attachments		Material	Circumference in inches	Length in feet	Number of pieces	Remarks
BAG	Floatline	Outer	Manila rope	2-1/4	64	2	Right-laid
		Inner	Manila rope	2	64	2	Left-laid
BAG	Bottom line	Outer	Manila rope	3	40	1	Right-laid
		Inner	Manila rope	2-1/4	40	1	Left-laid
WING	Floatline	Inner	Manila rope	2-1/4	276	2	Right-laid
		Outer	Manila rope	2	276	2	Left-laid
WING	Bottom line	Inner	Manila rope	3	276	2	Right-laid
		Outer	Manila rope	2-1/4	276	2	Left-laid

The bottom line was likewise made of 2 Manila ropes; an outer 3-inch, right-laid and an inner 2 1/4-inch, left-laid ropes. To each end of the 40-foot bottom line of the bag was tied a 25-pound stone weight with no other leads or sinkers in between. To the bottom line of the wings, 2-pound stone weights were tied at 6-foot intervals.

Accessories to the operation of this gear were water telescopes for spotting submerged concentrations of fishes, water goggles and vertical scarelines or "pendants" used by each individual swimmer in the act of driving the fish into the bag. These pendants consisted of a line of strung buri or coco-palm leaves, weighted at the bottom end and floated at the top end.

The fishing operation consisted of locating a good-sized school of reef fishes, especially caesios, in waters of from 5 to 10 fathoms. This was done with the aid of a water telescope. The direction of the current was noted, and the bag was payed out opposite its direction. In the meantime, from five to six fishermen

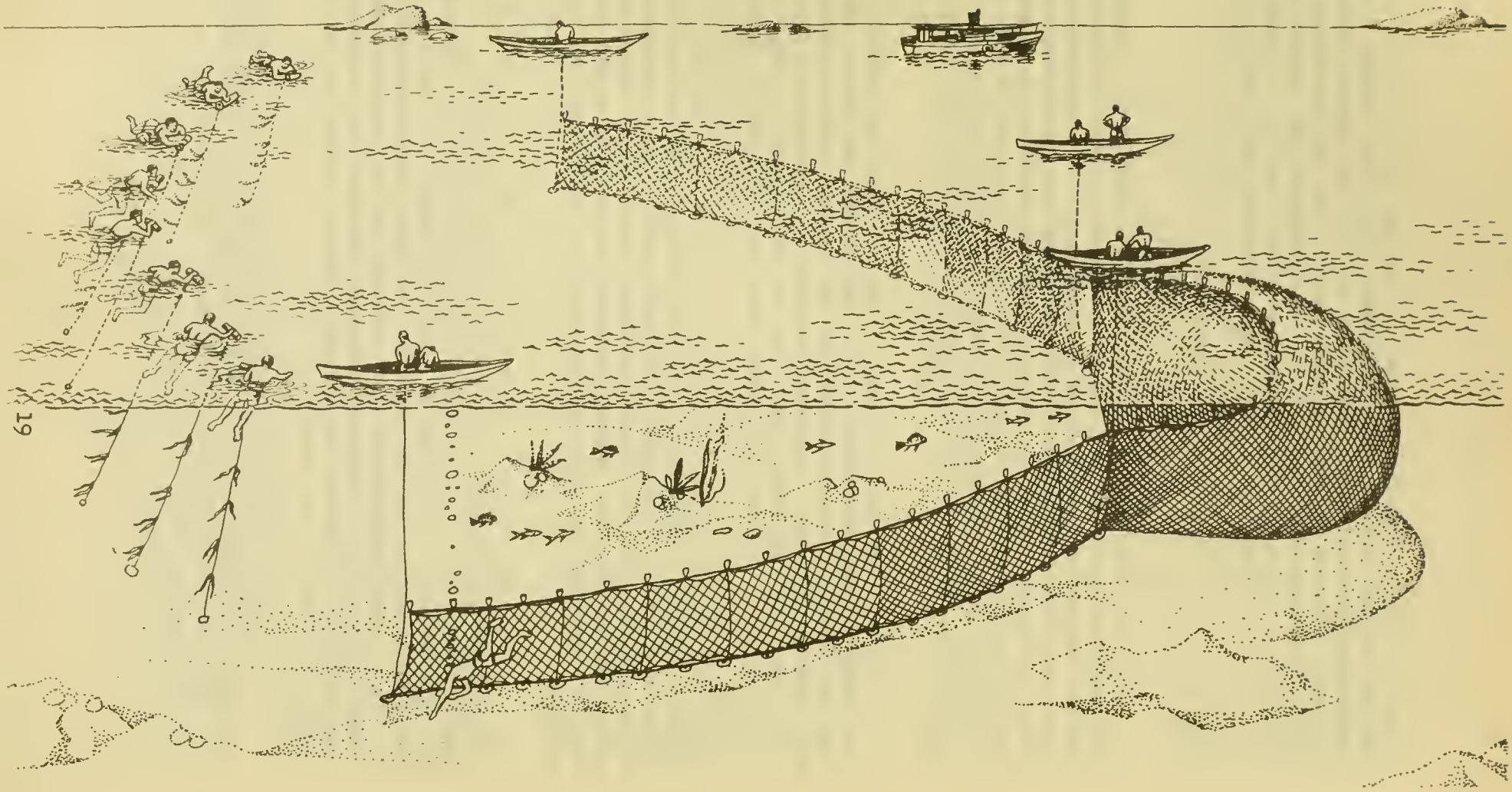


Figure 6

jumped overboard to hold the mouth of the bag so as to allow the pressure of the water to spread it open to its full extent. The two 25-pound stone weights were then tied to each end of the bottom line at a distance of about 40 feet apart. Each of these stone weights was provided with a retrieving line, the free ends of which were held by a man in each of two bancas anchored at the opening of the bag. In laying out the bag under adverse fishing conditions such as lack of current or when it had to be payed out with the direction of the current, stone weights or anchors tied to the closed end of the bag were employed to keep it distended.

When the bag was finally set, fishermen in two bancas, each carrying one wing, set out to a distance of about 46 fathoms from the bag and about the same distance apart. The wings were payed out until the school of fish was impounded in the enclosure formed by the two wings of the bag. The length of wings payed out was governed by the topography of the ground, especially the nature of the coastline. One wing might be considerably shorter than the other as long as the fishes could be impounded with the aid of natural factors such as irregularities of the reef.

With the bag and wings all set and the fish impounded, the fishermen boarded another set of two bancas and paddled for the open edge of the trap toward the tip of each wing. Equipped with water goggles and a pendant (scareline) they jumped into the water and swimming in the form of an arc or semi-circle, they began to drive the fishes from this wide, open area towards the mouth of the bag by making as much commotion as possible by jerking their scarelines up and down. Sometimes they had to dive in order to prevent fish from escaping from the enclosure. When at a short distance of about 30 feet from the mouth of the bag, from four to six men boarded the two bancas previously anchored at this spot and hauled in the two stone weights attached to the bottom line of the bag. In the meantime, the rest continued to drive the fish into the bag.

Once the bottom line was lifted to the surface the fishes were completely impounded in the bag. All fishermen helped in the hauling, the work being done in between the two bancas. The catch was then brailed out into another banca by means of large dip nets, the latter banca taking the catch to the mother ship anchored not far away. Here they were unloaded on deck for sorting and finally stored in the hold in alternate layers of crushed ice. Meanwnile, the rest of the fishermen busied themselves in hauling in the wings preparatory for another operation.

In some instances the wings were used to drive the fishes into the bag by pulling them toward each other, thus obviating the work of swimming and driving them with the scarelines.

Often times a haul could be made in less than one hour with a maximum catch of 2,000 kilograms (two tons). With large catches per haul, some three to four hours fishing would net a load sufficient for the mother ship to make a trip to market. The mother ships averaged two trips per month from the ground to the market with loads of from 30,000 to 36,000 pounds (15-18 tons) of fish.

Discussion

As can be ascertained from the foregoing description of methods, fishing on coral reefs presents some problems that are unique to the fishing industry. Chief among the considerations is the limitation imposed by the nature of such an environment - the rugged bottom terrain, plus the variable depths, both of which conspire to make reef exploitation hazardous to any type of gear. Yet in tropical countries where the productivity of the sea is limited, such areas often offer the only opportunity for fishing on a commercial scale; and in many places in the world, the only animal foods available for the people.

Reef fishing among primitive people poses no problems as a rule, since the take is small and the demand modest. Indeed, one of the so-called undesirable methods, the use of poisons, is a development of people of elementary culture. But when the supply of food for a tropical nation has to be provided for, reefs and their management become matters of basic importance.

Fishing by means of explosives has long been frowned upon all over the civilized world. The conception of the undesirability of this type of effort stems from sports fishing, in all likelihood, and it is easy to see where, in the limited area of inland streams and lakes, such activity would be detrimental in the extreme. In the bays, estuaries, and coves of the sea it is also quite probable that continued use of heavy charges would, in time, seriously deplete, if not entirely denude such areas of their fish life.

It seems reasonable that the use of explosives probably has three serious consequences. The first of these is its inordinate wastefulness. Fishermen generally agree that only a small proportion of the fish killed are ever recovered. There are no true estimates available but it is often indicated that less than half of the marketable fish are ever shipped from the mass of fishes killed in a dynamiting operation. This is probably more true in reefs, where many fish are caught up in pockets and holes, than in any other type of environment. Another possible effect that causes consternation is the killing of the young and eggs of the resident species. It is doubtful if the fishes inhabiting a reef ever migrate far and it is very likely that many of them live through their entire life-history on a single reef. In such cases the almost complete elimination of fish from a reef for many years is a distinct possibility. This could be compounded easily with a third effect, viz. the

destruction of the reef as an environment for fish. The changes brought about in the structural characteristics of reefs by subjecting them to repeated blasting must be of considerable proportions.

Thus the wasteful nature of explosives when used in reef fishing together with the effect on the young and the alternation of the environment are the chief objectives raised to this kind of exploitation and all of them seem reasonable and logical. There are certain other disadvantages and limitations that need, however, to be pointed out. Fundamentally it is possible that in a more nearly normal market than exists in the Philippines at present time such fishing could be very expensive due to the handling of each individual item. It is difficult to see how a fish that is dived for, picked up by hand, placed in a canoe, transferred to a mother ship, packed in ice and shipped to market could ever be sold at a reasonable price. Only the cheapest kind of labor could be used in such operations in ordinary times or localities.

On the other hand there are advantages in that, at present, explosives are easy to obtain, are therefore cheap, and the capital investment is kept at a minimum. There is no outlay for expensive, expendable nets and other gear. And finally the skills required are the most elementary imaginable.

It is probably true that the prevalence of this type of fishing effort, more than any other factor, is hampering the development of the Philippine fishing industry. No ingenuity, no exploration, and very little legitimate capital is going into the industry at present. Also, the extent of the shallow reefs is such that they might support the volume of illegal effort now being employed for some years to come. But this much is certain, when the currently exploited reefs are depleted, as surely they will be in not too long a time, then other grounds and other methods will have to be utilized.

The alternative methods here described have advantages that need to be emphasized. These have mostly to do with the conservation of the resource and the perpetuation of the reef as a producing unit. In the light of the foregoing discussion such arguments are obvious. Thus no fish killed need be wasted, no eggs or young need be destroyed, and the reef be kept intact to produce in perpetuity. It is said that net fishing can be overdone on a reef and intensive effort by such gear can result in overfishing. Such an effect is temporary, however, and in a year or so it is possible, by refraining from exploiting the same reef for that time, to come back to it and harvest it again.

Recommendations and Suggestions

The handline fisherman sitting in his banca over a reef either by day or night, is a familiar sight in the Philippines and he is the one who suffers most from the intensive exploitation of his fishing grounds by explosives. Still by his very good citizenship he is the man who needs to be encouraged. He is the unit of

the industry that will go on and on, producing moderately on the same grounds, supplying fish for the nation. There are many localities where sustained production by handline fishermen has been the economic mainstay of the community for many years. Communities established for this type of fishing, equipped with a moderate-sized ice plant and visited regularly by "buy boats" would be real contributions to the development of many, now partially inhabited shores -- places now, but occasionally, occupied by the camps of dynamiters.

Fishing with small traps or pots is also a venture to be recommended for continuous, sustained production. Traps of the bubo types are found in many tropical waters and have been used on the same grounds for years without seriously depleting the resource upon which they depend. The primary problem in the use of such gear in the Philippines is theft prevention so their extensive use demands continuous watch to patrol the sets. Other suggestions involve fishing the gear in "strings," that is having the traps tied to hauling lines which in turn are attached to a long "main" line. Units of 12 to 15 traps could then be kept under guard and locating one trap would insure getting the others. Having a buoy on one end of the main line lying just under the surface in a well-fixed spot should not be too difficult to keep under observation. Such an arrangement should be kept out of the lanes of powered vessels, however, and to avoid entanglement and to facilitate hauling more than one trap at a time, the distance between traps should be a fathom or so greater than the depth at which the trap is placed. It is customary in some parts of the world to buoy similar traps individually with submerged floats such as an empty, sealed beer bottle.

To maintain such a patrol it is suggested that two sailing craft and bancas be employed as a unit. The operational plan would be somewhat as follows: One craft would proceed to the banks with the bubos, as many as 100 to 150, which they would bait and put out. This vessel and its bancas would stay with the "set" keeping watch for twenty-four hours. Near the end of the twenty-four hour period this craft would be joined by the second craft which would bring out fresh bait and would aid in lifting the traps and resetting them. The first craft would then return to shore with the catch to be back at the end of the next twenty-four hour period.

In addition to other possible methods of reef fishing which can be tried by the fisherman there are, more than likely, improvements that can be made on the described methods. Two suggestions for improvements that come to mind are a sort of a set, bottom longline which may be adapted to capture reef fishes. Also, in view of the difficulties and hazards encountered in the operation of the muro-ami in which swimming is needed in order to effect the impoundment of the fishes, a semi-mechanized method of drawing or pulling the scareline might be devised. The individual pendants carried by the fishemen could, for instance, be tied to a floated mainline and the whole device drawn towards the bag from on board two boats employing either a powered winch or a simple hand gurdy.

Another modern method of fishing which might prove practical in the coral reefs is the trammel net. The trial of this gear in Philippine waters is highly recommended.

The following description of the gear and its operation may have to be modified to suit local conditions and is appended here merely as a guide and basis for the initial stages of its trial operation: 3/

The vessel for this gear averages 35 feet in length, has a beam of 8 to 10 feet, and an average tonnage of from 4 to 5 net. Each is powered with a gasoline or small Diesel engine located amidship below the deck. Sleeping accomodations for two or three men and cooking apparatus on deck, or in the small pilot house should be provided. A small skiff is carried on deck, usually amidship beside the pilot house. The nets, buoys, anchors and lines are usually piled on the afterdeck.

Trammel nets (fig. 7) are made by hanging three webs to a single top and bottom lines. There are two outside webs or walls (this netting is called "walling" or "guard" mesh) and in inside web of small mesh. The outside webs are larger-sized mesh, generally three times the size of the mesh of the center net but usually eight inches square and made of cotton. The inside web, which hangs loosely in the middle between the walls, is of smaller mesh, the size depending upon the fish to be caught and is made of either cotton or linen. The nets are so constructed that a fish striking either side passes through the larger mesh, hits the small-meshed net, through which it cannot pass, causing the loose, small-meshed net to go through one of the openings of the opposite outer webbing to form a sack in which the fish is entrapped. The weight and struggles of the fish cause the open end of the bag to rest against the twine of the wider guard mesh, closing the opening (fig. 8).

The principle of this net is such that it must be made with the inside web very full, so there will be enough webbing to pocket all the fish that come along. If the inside web is scant, as soon as a few fish are trapped, the inside netting all around the pocket is stretched tight and no more fish can "pocket." It is, therefore, very essential that the inside web be very full, that is, it must be very much longer and wider than the two outer meshes. The usual practice is to hang 24 inches or even 30 inches of web on 12 inches of cork and leadline.

An outfit carries from 10 to 50 pieces of trammel net. A piece varies in length from 35 to 40 fathoms (210 to 240 feet); and from 25 to 30 meshes deep, measured on the wall (outside) nets.

3/ Fish Bulletin (1931) No. 32, pp. 14-18, Division of Fish and Game of California, Bureau of Commerical Fisheries.

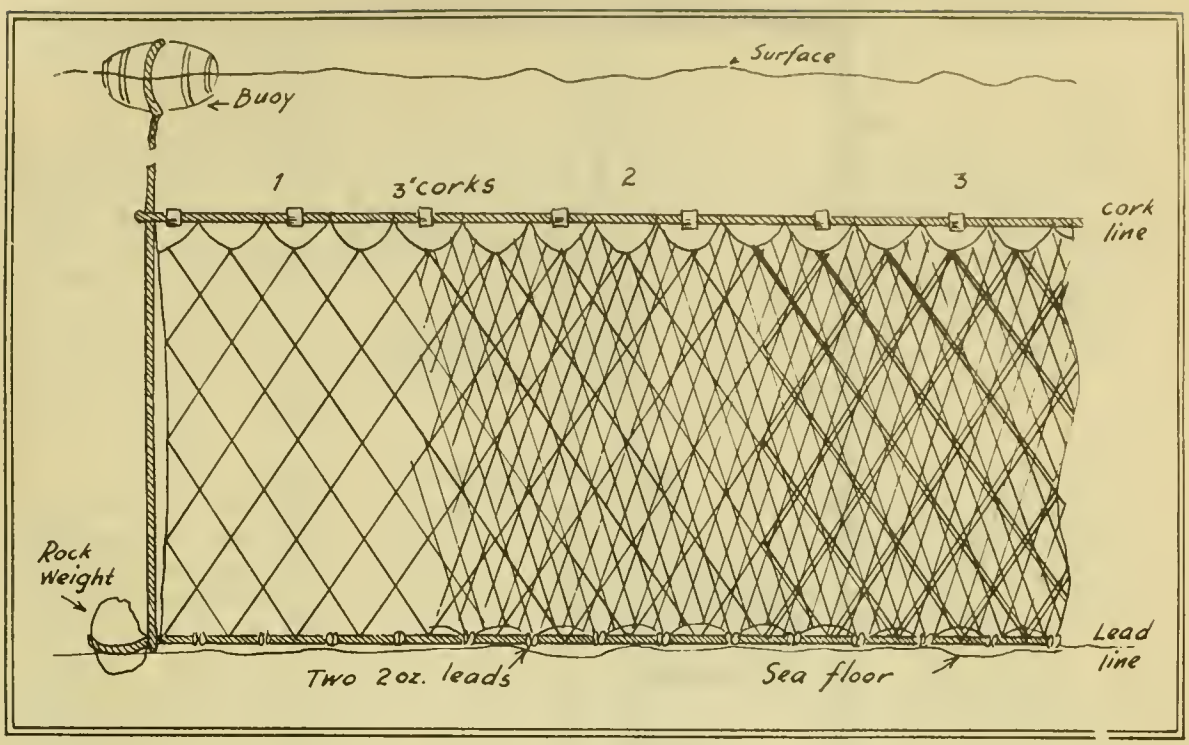

Surface
Buoy
1
3'corks
2
3
cork line
Rock weight
Lead line
Two 2oz. leads
Sea floor

Figure 7

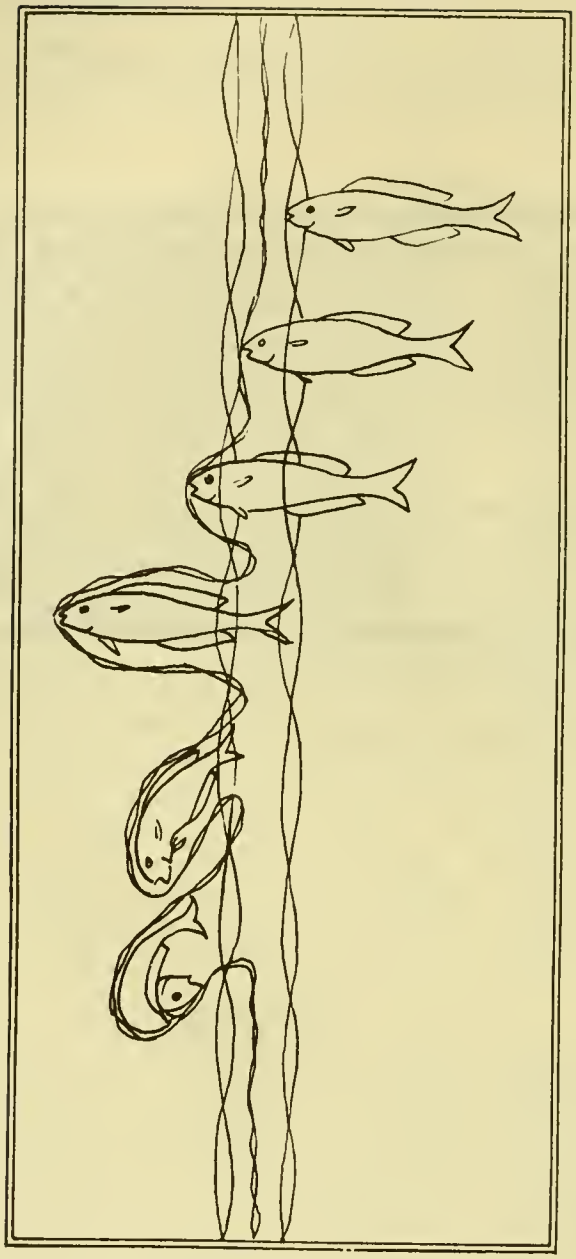


Figure 8

As reef fishes in general tend to seek shelter, only those coasts which are not exposed to the prevailing wind can be considered. Schools are spotted with the aid of a water telescope as in many kinds of reef fishing.

Upon locating a good fishing ground, the gear is set. The best fishing time is in the early morning and in the evening, as the fish seem to be more active at these times. Nets are put out in gangs of five to seven pieces of trammel tied end to end to form a unit. To the two ends of the gang and tied to the corkline and then on down to the leadline, are anchor ropes to which are fastened heavy anchors or weights to keep the net from drifting. From this same stringer, a line at each end of the gang extends to buoys or floats at the surface used primarily as markers. Each gang is set in water seldom over 20 fathoms (120 ft.) deep, and against the tide.

When a gang of nets is being set, one end is put out with an anchor and a buoy attached; then the nets are paid out gradually, keeping the lead and corklines separate to prevent entangling. As the nets are payed out, the boat travels along at a low speed. Thus the nets comprising one gang are stretched out in a long line. Finally the last end of the gang is anchored and a terminal buoy secured. Usually the nets are left in their respective locations within a few miles of each other for a period of from 12 to 24 hours before they are inspected for fish unless sharks are abundant when, of course, they have to be inspected more often.

In hauling the net, a fisherman takes hold of the buoy and heaves that end of the net and anchor on board. While he hauls in the corkline, another man brings in the leadline, while a third picks the fish from the webbing. If the catch has been good, the gang is set in the same ground, otherwise a new location is sought. This operation can be handled mechanically if desired.

The nets are brought ashore after two or three trips for drying and mending. Nets are always tanned before being used, and later at intervals are treated with preservatives to insure longer usefulness.

Trammel nets may be fished by setting, as described, or by drifting. This type of net may also be run around a spot where fish are working, leaving one end close to shore and running the other end out in deeper water around the fish and back toward shore, making several "s" turns with this end. This set can be made to conform to the reef contour if necessary. Fish are frightened by the fishermen pounding on boat and splashing the water and driving them into deeper water, where they strike the net. The fish usually lead along until they come to a turn, where they would have to lead back to shallow water towards the driving that frightens them thus they generally start diving into the net at the turns. Sometimes several big fish will be found in one pocket, where they have followed each other like sheep.

Summary

There are four kinds of reefs in the Philippines which have produced as much as 4.5 million kilograms of more than 50 kinds of fish per annum but reported production from these areas was less than half of that volume in 1947. At the present time most reef fishes brought to market are taken by means of explosives and poisons although some are captured by divers with spears and some are taken by handline. Four kinds of nets have been used successfully in the past; a reef drag seine and three kinds of movable drive-in-nets. The most highly developed and widely used drive-in-net is the muro-ami of the Japanese. This net is described and specifications are given for its construction.

The effects of fishing with explosives seem to be: (1) It is wasteful in that only a fraction of the fish killed are recovered. (2) Eggs and young are killed. (3) It also seems logical that the reef itself, when subjected to repeated blasting, would also be profoundly affected and perhaps rendered inoperative as a fish producing area. Fully as important is the fact that the widespread use of explosives is hampering the legitimate development of the industry as a whole.

It is suggested that lines and pots be more extensively employed and that there are modifications of line and net fishing that could be developed such as trawl lines and mechanized scarelines. The trammel net is also suggested as a type of gear that might be used in reef fishing and this gear is briefly described.