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Trap Fishing Explorations for Snapper and Related Species in the Caribbean and Adjacent Waters

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ABSTRACT—Pot or trap fishing is a recognized method for catching snapper and other demersal species from the inshore waters of most of the areas of the Caribbean. The Caribbean Fishery Development Project has extended its use to conduct explorations on the offshore banks of the Caribbean and the continental shelf off northeastern South America.

Explorations were concentrated on banks lying south, southeast, and southwest of Jamaica; north of Hispaniola; in the northern Leeward Islands; the Windward Islands; Barbados; and along the South American continental shelf from Venezeula to French Guiana.

The indigenous West Indian "Z" pot was compared primarily with the Australian "D" pot and to a lesser extent, with the "O" pot and a space saving nesting pot made to project design. Various sizes of pots, mesh sizes, baits, soaking periods, and fishing depths were compared.

"Z" pot catch rates averaged about 15 pounds each time a pot was lifted. This average was maintained on the Jamaican Banks, north of Hispaniola, and off Venezuela, Guyana, and Surinam. Higher catch rates of about 40 pounds per lift were obtained in the northern Leeward Islands and off French Guiana. The lowest averages of about 5-10 pounds per lift came from the Windward Islands.

The greatest proportion of the catch from the Jamaica Banks were grunts, triggerfish, squirrelfish, and porgies taken as a group. North of Hispaniola, snappers and groupers contributed about evenly to the catches. Nearly 75 percent of the catch in the northern Leeward Islands, the Windward Islands, and on the South American shelf was snappers.

The "Z" pot outfished "D" pots at a ratio of about 2:1 and the other pots by a much greater ratio. Larger pots and small mesh sizes displayed a greater catch rate. Atlantic herring, spanish mackerel, and West Indian "robin" (scad) baits all produced the same catch rate which exceeded that of flyingfish and sprats. The best overall catch rates were obtained from pots soaked for 1 day or less. The average size of snappers was greater with a larger sized mesh.

There is good potential for trap fishing in the Caribbean. Although ciguatera poisoning is a deterrent to catching demersal species north of Hispaniola and in the northern Leeward Islands, the silk snapper, which has constituted between 70 and 90 percent of the catch from 60-100 fathoms, has been found ciguatera free.

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Fishing with traps or pots[1] has been traditional in the West Indies for many years. According to Munro, Reeson, and Gaut (1971) fish traps made of native materials have probably been in use for centuries, but the fish pot which is presently most widely used, namely that of a wire mesh enclosure strengthened with wooden sticks, has been in use for only the past 50 years. Although many styles of fish pot are in use in the West Indies, the "Z" shaped pot appears to be the most universal. This style of fish pot is used by inshore canoe fishermen from Jamaica to Trinidad and along the coasts of South America.

During Phase I of the Caribbean Fishery Development Project (November 1966 to August 1969), the highest proportion of the exploratory fishing effort had been placed on the resource of snappers and jacks in the project region (Interim Report No. 1, UNDP/FAO Caribbean Fishery Development Project, 1969). Most of this effort utilized handlines or mechanical reels, either hand-cranked or electric motor assisted, as the fishing method. While this method was found to be highly productive for the larger species, it was felt that traps would catch a greater size range of fish with a consequently greater number of species and also be more familiar to West Indian fishermen. Some experimental settings of fish traps during early exploratory handline cruises produced a significant positive result. Accordingly, during the project's second phase (September 1969-August 1971) a further intensive effort on the snapper-and-jack type of demersal resources was initiated using the fish pot. This effort was to complement handline exploratory efforts, both having taken place and proceeding concurrently. Very intensive coverage of certain areas would be included in an attempt to determine seasonal abundance.

EXTENT OF EXPLORATIONS

The project region extends from Central America eastward along the Greater Antillean Arc, turns south along the Lesser Antillean Arc to Trinidad, and then further southeastward to the border of French Guiana and Brazil. It also includes the Caribbean and that portion of the Atlantic lying east of the Lesser Antilles and north of the Guianas.

Regional Coverage

The areas explored with pots within the project region shown in Figure 1 are generally the same as those explored during handlining operations, since the results of handlining were used to help determine where empha-

[1] The terms trap and pot are used synonymously in this paper.

sis in pot fishing explorations would be placed. Specifically excluded from pot fishing explorations were the continental shelf areas east of Central America as this area is within the study area of the UNDP/FAO Central American Fishery Development Project.

Area Coverage

In the northern half of the project region explorations were conducted on banks south, southeast, and southwest of Jamaica, north of Hispaniola, and in the northern Leeward Islands. Coverage of these three areas was relatively intense and consisted of periodic cruises to determine seasonal abundance wherever possible. Thirteen cruises were expended here.

Once-only coverage (with some overlap) was given to the continental shelf from French Guiana west to Blanquilla Island north of Venezuela during three cruises. Grenada and St. Vincent in the Windward Islands along with Barbados were covered during portions of two cruises.

Jamaican banks

Pedro Bank, covering an area of nearly 2,400 square miles and lying about 60 miles southwest of Jamaica, is the largest of this group. Also included are the much smaller Albatross Bank, Salmon Bank, Decca Ridge, Mackerel Bank, Eight Mile Bank, Rosalind Bank, Serranilla Bank, and Alice Shoal, all lying southeast to southwest of Jamaica. Exploratory cruises to this area were made in February, April, July, and November of 1970.

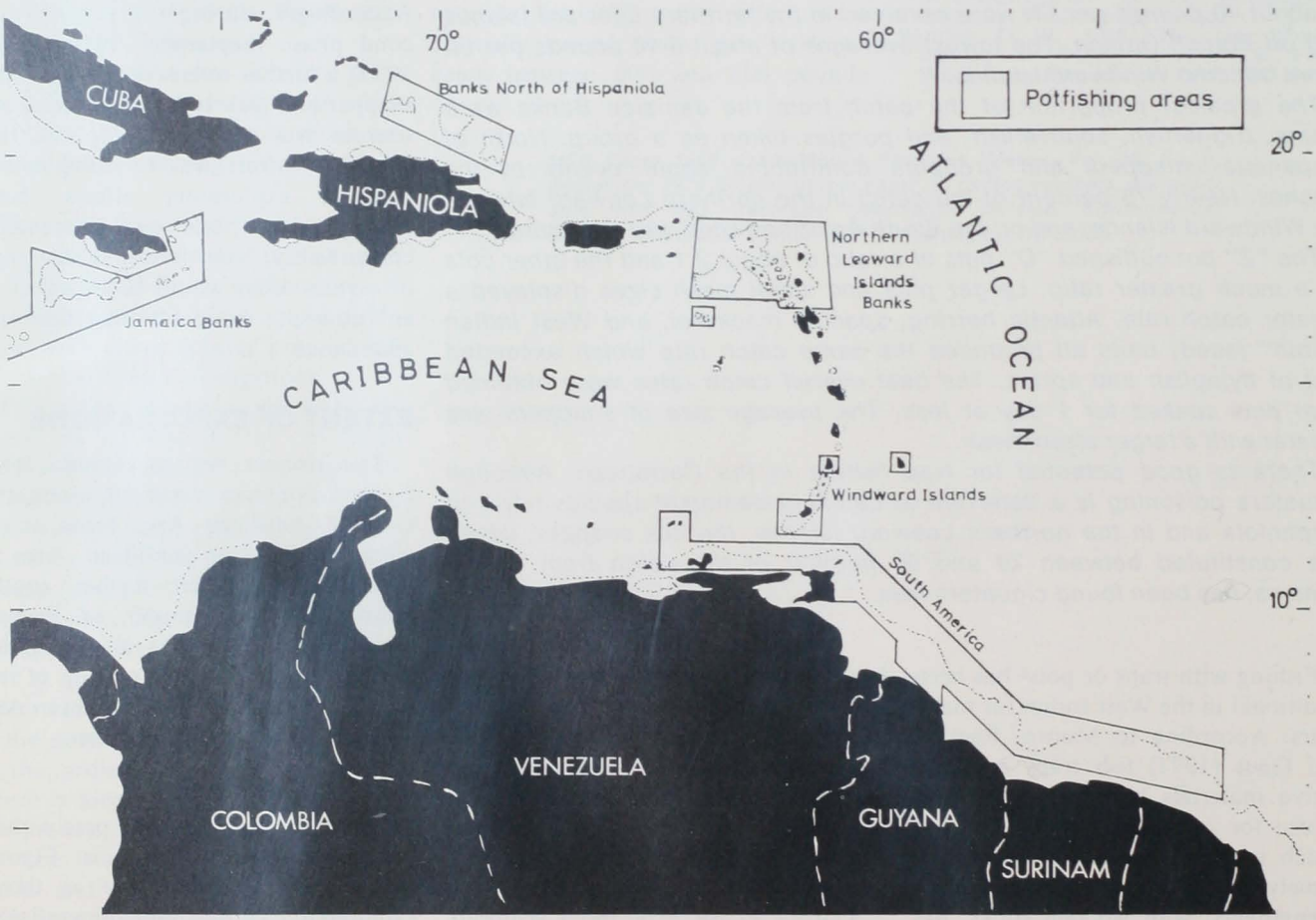
Banks north of Hispaniola

Navidad, Silver, and Mouchoir Banks lie 80 miles north of the island of Hispaniola. Though geologically a part of the Bahamas chain, these banks are the only sizeable offshore banks in the north central part of the project region. During Phase I of the project the Dominican Republic was a participant and handlining operations took place on the three banks. Even though this country was not a participant in Phase II, pot fishing explorations on those banks were conducted in January, May, and October 1970.

Northern Leeward Islands banks

There are three large bank areas in the northern Leeward Islands which are at the eastern end of the Greater Antilles and the northern end of the Lesser Antilles. Barbuda Bank, on which the islands of Barbuda and Antigua are located, is the farthest east. Anguilla Bank lying slightly to the northwest contains Anguilla, St. Martin, St. Barthélemy, and Dog Island. Moving to the southwest there is Saba Bank, which is completely submerged. Pot fishing explorations took place here in November 1969 and in March, June, September, and December of 1970. An experimental cruise to Saba Bank took place in April 1971.

Figure 1.—Project region showing areas of exploratory pot fishing.



South Leeward Islands, Gibbs Seamount, Windward Islands, Barbados

Because there are no extensive offshore banks below the northern Leeward Islands relatively little pot fishing effort was expended there. One exception was the Grenada shelf which received 3 days of direct exploratory coverage in January 1971. One set was made around St. Vincent in March 1971. A few pots were set around Barbados in April 1968 and one set in March 1971. Two exploratory sets were made on Gibbs Seamount (lat.16°32'N, long.63°56'W) in June 1971.

South America

The edge of the continental shelf off South America from Blanquilla Island, Venezuela east to Tobago then south and east to French Guiana was surveyed during three cruises in January, February, and March of 1971. Some pots were set on the shelf proper, but most effort was exactly at the shelf edge or on the slope adjacent to it.

EXPLORATORY FISHING EFFORT

Determination of Unit

Most of the exploratory fishing effort spent on pot fishing took place during the project's Phase II (1 September 1969-31 August 1971). Because the exploratory nature of the operations required the coverage of a rather large geographical area, the time spent at any one location during a cruise tended to be short. The basic unit of fishing effort therefore became the individual pot lift. Most data have been analyzed using this unit. There were, however, two principal and other lesser kinds of pot lifts based primarily on the elapsed time of pot soaking. The day lift was normally conducted from midmorning to midafternoon and averaged about 4.7 hours. The overnight lift was normally from late afternoon of one day to early morning of the next day and averaged about 15.4 hours. Occasionally, a pot would be left for a full day set, which averaged about 22 hours or longer.

A setting of pots consisted of from 6 to 16 pots in the same general location. Day sets usually contained fewer pots than overnight sets.

Amount

In all, 18 cruises were all or partially expended on pot fishing activities (Table 1). Most of the cruises consisted exclusively of pot fishing, but a few were combined with other work so that a total of over 300 sea days was expended for the purpose.

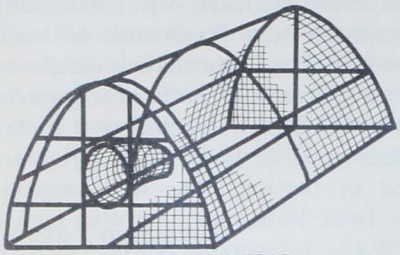
GEAR

The four styles of fish pot utilized during project pot fishing explorations are seen in Figure 2. While it was acknowledged that the "Z" pot was already the most familiar and universally employed trap in the West Indies, attempts were made to judge its effectiveness against other fish pots used in other parts of the world. Pot fishing for snappers has gained wide acceptance in Australia. Accordingly, a practicing snapper pot fisherman from Australia was made available to the project for a 5 month period. He introduced the "D" and "O" pots, which were fished comparatively with the "Z" pot, as was a nesting pot designed by the project to facilitate storing and handling aboard ship.

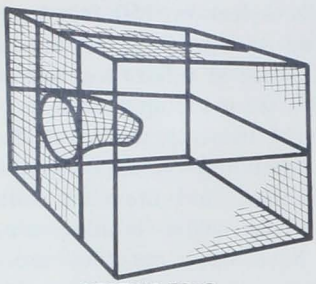
The "Z" pot is formed of hexagonal wire mesh (chicken wire) externally reinforced by a framework of hardwood sticks. Construction details of two styles of "Z" pots are given in Figure 3. Style A is preferred in the Lesser Antilles while both styles are used in Jamaica. The wire mesh is No. 14 or 16 Birmingham Wire Gauge (B.W.G.) galvanized, of 1½ inch or 2 inch opening. It is usually furnished in rolls 4 feet by 150 feet long. Depending on the length of trap desired (shown here at 9 feet) top and bottom sections are made up as in B or F. The height of the trap can be 2, 3, or 4 feet, depending on the preference of the builder, and the side walls cut accordingly. After bottom, top, and sides have been cut they are laced together with No. 20 B.W.G. binding wire. External strengthening is accomplished as shown in C or G by the use of hardwood sticks (mangroves preferred) wired to the outside of the mesh and wired together at junction points. The positions of vertical stick stiffeners are shown as black dots. When completed, the structure is completely rigid. Two entrance funnels (D and H) are fabricated of wire mesh and inserted at the apexes of the concave angles on each of the long sides of the trap (A and E). A door is cut

Table 1.—Exploratory cruises on which trapfishing was a major fishing effort.

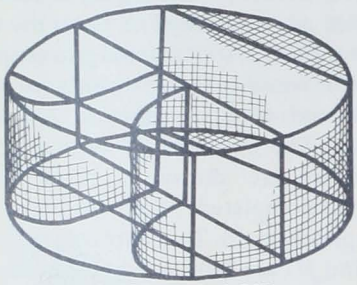
Vessel	Cruise	Month	Days pot fishing	Type of cruise	General area
Alcyon	67-6	June	6	Exploratory	Jamaica Banks
	67-8	Sept.	5	Exploratory	Banks N. of Hispaniola
	67-10	Nov.	6	Exploratory	Jamaica Banks
Fregata	68-3	Apr.	8	Exploratory	Barbados
Alcyon	69-11	Nov.	10	Exploratory	N. Leeward Is. Banks
	70-1	Jan.	19	Exploratory	Banks N. of Hispaniola
	70-2	Feb.	13	Exploratory	Jamaica Banks
	70-3	Mar.	26	Exploratory	N. Leeward Is. Banks
	70-4	Apr.	17	Exploratory	Jamaica Banks
	70-5	May	16	Exploratory	Banks N. of Hispaniola
	70-6	June	25	Exploratory	N. Leeward Is. Banks
	70-7	July	16	Exploratory	Jamaica Banks
Calamar	70-8	Sept.	17	Exploratory/ Experimental	N. Leeward Is. Banks
Alcyon	70-11	Oct.	7	Exploratory	Banks North of Hispaniola
	70-12	Nov.	9	Exploratory	Jamaica Banks
	70-13	Dec.	21	Exploratory	N. Leeward Is. Banks
Calamar	71-1	Jan.	24	Exploratory	N. Venezuelan Shelf-Grenada
	71-2	Feb.	18	Exploratory	Tobago-Trinidad-Guyana
	71-3	Mar.	4	Exploratory	St. Vincent-Barbados
	71-4	Mar.	17	Exploratory/ Experimental	French Guiana, Surinam, Guyana
	71-5	Apr.	10	Experimental	Saba Bank
	71-8	June	2	Exploratory	Gibbs Seamount



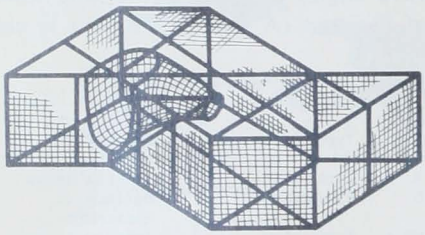
AUSTRALIAN D TRAP



NESTING TRAP



AUSTRALIAN O POT



WEST INDIAN Z TRAP

Figure 2.—Pot styles utilized during project exploratory operations.

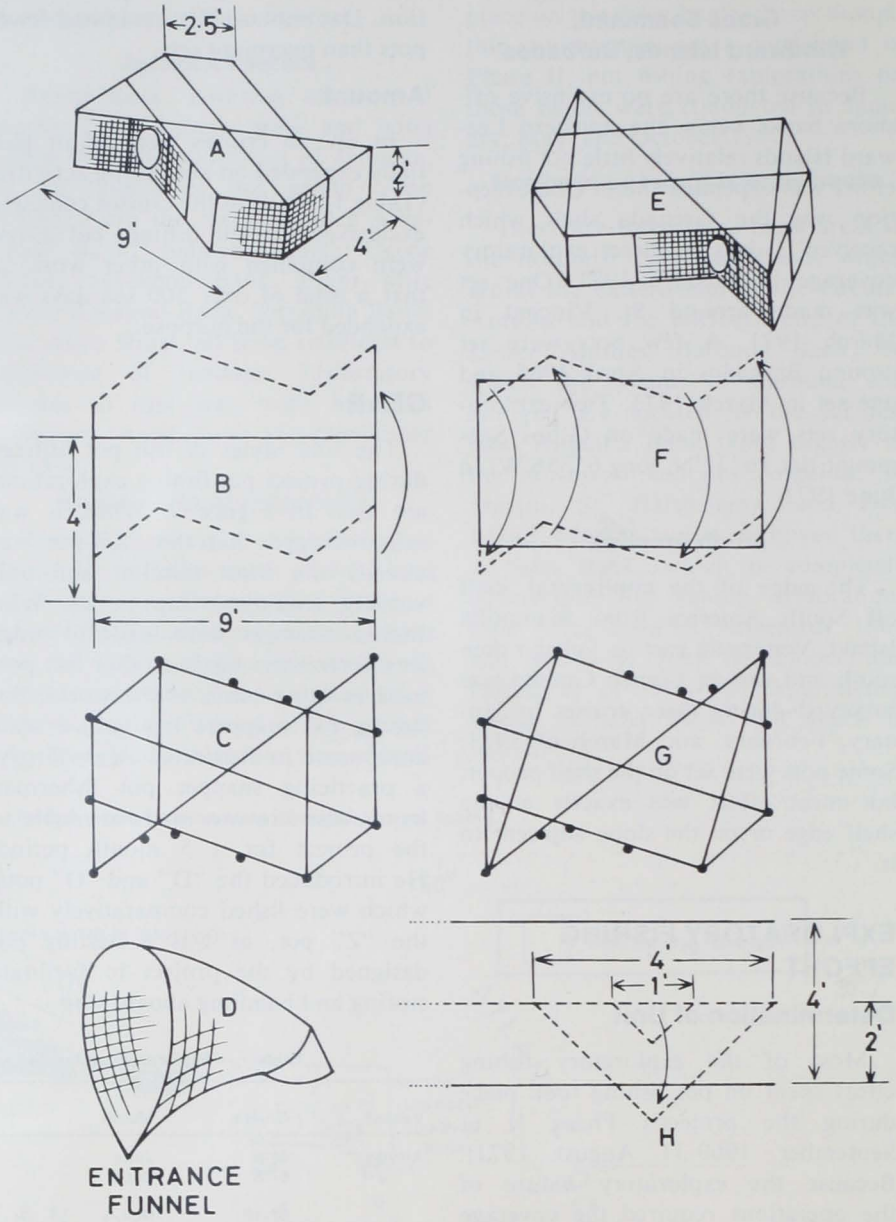


Figure 3.—Diagram showing the two methods most commonly used in constructing Z pots. Entrance funnel and side wall details also shown.

into the top to facilitate baiting and fish removal. A lifting bridle is fixed to the support sticks at one end.

The Australian "D" pot is shown in Figure 4. The frame base is constructed of 1 inch × 2 inch hardwood. Steel rods of 3/8 inch diameter, 10 feet long are hand bent into half circles and the ends passed through the frame and clinched on the underside. The entire structure is sheathed with wire mesh and stiffening sticks are wired along the upper portion. An oval funnel is made and inserted into one end of the trap and the lifting bridle fastened to the opposite end.

The "O" pot is shaped like a bass drum. The cylindrical steel rod frame is covered with mesh and one entrance funnel is fitted. The nesting type pot was devised by the project in order to increase the number of pots carried aboard a vessel, so as to increase the amount of fishing effort on a cruise. This pot was built in two sections for easy storage. Steel rod was used for framing. The first section was a truncated pyramid, 3 feet square on one end and 2 feet square on the other. The second section was a square frame, 3 feet on a side. Both sections were covered with wire mesh except for the 3-foot square end of the first section. The second section could be nested on top of others like it and stored until assembled for setting. To assemble, the entrance section was clipped to the open end of the pyramid section (funnel in). Both the "O" pots and the nesting pots were used experimentally during early cruises, but were abandoned as not worth the construction expense after their catching ability was found to be greatly inferior to "Z" and "D" pots.

BAIT

During the early phases of pot fishing, all pots were baited with cut, frozen Atlantic herring (*Clupea ha-*

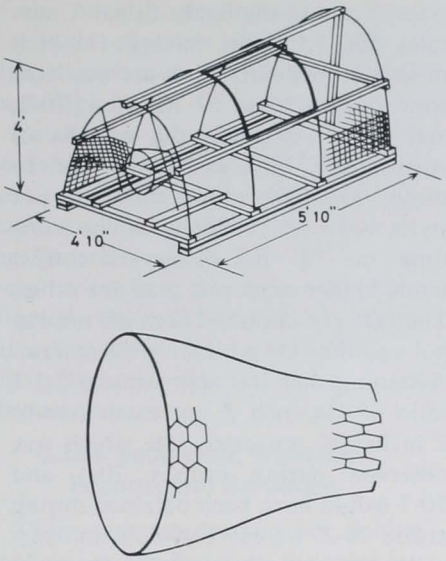


Figure 4.—Diagram illustrating "D" pot and funnel construction.

rengus harengus) imported from eastern Canada. Early in 1970, it was no longer possible to obtain herring, so frozen Spanish mackerel (*Scomberomorus maculatus*) were imported from Florida. In May of 1970, a glut of West Indian "robins" (round scad—*Decapterus punctatus*) caught in the Grenadines occurred in the markets in St. Vincent. This allowed the project to purchase a supply and for the first time locally caught pot bait was used. Robins were used together with Spanish mackerel until March of 1971, when further supplies of robins enabled us to discontinue the use of imported bait. At various times, Barbados-caught fourwing flyingfish (*Hirundicthys affinis*), sprats (*Harengula* sp.), sharks, and some of the food fish catch were tested for suitability as pot bait.

FISHING METHOD

Beginning in November 1969 (*Alcyon* cruise 69-11), a full-scale program was initiated to assess the demersal fish resources obtainable by pots in the relatively productive areas found during earlier handline and reel exploratory fishing. This was continued through June 1971. Gear experimentation using different types of pots was included as well. All pots were rigged with a 100-fathom polypropylene lift rope (1 inch circumference), one end of which was tied to the lifting bridle on the pot and the other end to a large inflatable highly visible float painted with a distinguishable identification number. Another small float was attached to a position on the rope such that the length between this float and the pot was approximately the same as the depth of water in which the pot was to be set. The remaining rope between the two floats was shortened to a length of 5 to 10 fathoms by coiling up the excess. Each pot was baited with 5 pounds of cut bait strung on a wire or wires and hung from the top of the pot, just inside the inner end of the entrance funnel. "D" pots having one funnel entrance were carefully set running against the current in order to maximize the chance that the funnel entrance would open down current when the pot came to rest.

Typically, the pots were set along the edge or slope of a shelf at intervals of about 100 to 150 yards. While the pots were being prepared for setting, close examination of the bottom topography was carried out by echo sounder to find a proper location for setting. On steep slopes the pots were set close to, but inside of, the drop-off edge, but if the slope was reasonably gradual they were set on the slope down to 100 fathoms. Shallow water settings of 25-35 fathoms on the shelf were chiefly made around ridges, bottom risings, or outcroppings as distinguished by the echo sounder.

The pots were left in the water for 3 to 5 hours for a daytime set, or overnight (before sunset to after sunrise) for a night set. They were retrieved one by one using a hydraulic pot hauler[2] suspended from the forward trawl gallows. Catches were recorded for each pot with details of time set and lifted, depth, number and weight of each species, mesh size, type of pot, etc.

RESULTS

Species Composition

The species composition of the catch from all pot fishing is given in Table 2. It shows generally that the proportions of the various species and family groups changed measurably between the different areas explored. On the Jamaica Banks, as shown in Figure 5, the largest portion of the catch by weight in all months when fishing took place was made up of the "lesser reef fishes." Groupers formed the next higher proportion except during June. Groupers and snappers alternately formed the highest proportion of the catch from the banks north of Hispaniola, as seen in Figure 6. Snappers form an overwhelming proportion of the weight of fish taken on the banks in the northern Leeward Islands (Fig. 7) and silk snappers (*Lutjanus vivanus*) are the most abundant species caught. North of central Venezuela, in the Windward Islands, from the banks north of Hispaniola, and the Jamaica Banks, the blackfin snapper (*L. bucanella*) predominates (Fig. 8). Indeed, this species was the only snapper represented in the catch of all areas explored. Caribbean red snapper (*L. purpureus*) dominates the catches off the continental shelf from Trinidad south and east to French Guiana. Groupers formed a significant but generally secondary proportion of the catches from all areas. Jacks (Carangidae) did not form a large proportion of the catch from any area.

Catch Rate

The catch rates observed for various fish pot types and areas are given as total pounds of fish per pot lift. Pot lifts may be from daytime sets, overnight sets, or, on a few occasions, a full 24 hour day or longer. Catch rate data are presented as a/b-c; a, the number of pot lifts; b, the average number of fish caught per lift; and c, the average weight of the catch per lift. Since all fish can be utilized in the West Indies, the significant figure becomes the average number of pounds per pot lift. This can be considered an indication of what a fisherman might expect to catch, on an average, every time he sets and lifts his pots under the same conditions of depth, bait, pot size and configuration, and general fishing area, as those used by the project.

Jamaica banks

The results of all project exploratory pot fishing on the banks near Jamaica are given in Table 3. Results are given for the various pot styles and mesh

[2] Marco J.0105 Crab Block. Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 2.—Catch composition of trap fishing by cruise. (Numbers of fish - weight in pounds.)

Cruise number	General location	Blackfin snapper (*L. buccanella*)	Silk snapper (*L. vivanus*)	Red snapper[1] (*L. purpureus*)	Yellowtail snapper (*O. chrysurus*)	Vermillion snapper & Wenchman[2]	All snapper[3] (Lutjanidae)	Hinds & Coneys	All grouper[3] (Serranidae)	All jacks (Carangidae)	Lesser reef fishes[4]	Other	Total
A67-6	Jamaica banks	7- 4	0- 0	0- 0	91- 130	0- 0	105- 138	0- 0	9- 93	0- 0	160- 197	3- 18	277- 446
A67-8	Banks N. of Hispaniola	- 129	- 0	- 0	- 8	- 0	- 137	- 0	- 239	- 33	- 44	- 44	- 497
A67-10	Jamaica banks	24- 26	0- 0	0- 0	54- 94	0- 0	98- 151	150- 156	182- 526	22- 33	659- 647	154- 138	1,115- 1,495
F68-3	Barbados	26- 25	117- 154	0- 0	0- 0	0- 0	143- 179	0- 0	0- 0	63- 229	0- 0	8- 4	214- 412
A69-11	N. Leeward Is. banks	126- 181	618- 695	1- 2	18- 32	202- 157	1,106- 1,086	56- 83	95- 469	10- 69	288- 147	12- 53	1,511- 1,824
A70-1	Banks N. of Hispaniola	136- 358	0- 0	0- 0	30- 67	0- 0	178- 455	195- 283	334- 1,592	1- 10	437- 464	14- 299	964- 2,820
A70-2	Jamaica banks	93- 119	0- 0	0- 0	13- 41	2- 1	135- 257	182- 186	244- 775	9- 36	1,022- 993	20- 48	1,430- 2,109
A70-3	N. Leeward Is. banks	958- 1,478	2,982- 3,010	7- 33	81- 121	531- 355	4,599- 5,037	20- 29	115- 1,190	11- 102	73- 117	12- 45	4,810- 6,491
A70-4	Jamaica banks	475- 703	70- 119	0- 0	72- 150	0- 0	624- 987	490- 641	525- 1,097	0- 0	1,553-1,475	228- 250	2,930- 3,809
A70-5	Banks N. of Hispaniola	725- 1,688	0- 0	0- 0	4- 6	0- 0	730- 1,700	75- 76	132- 603	0- 0	130- 115	7- 32	999- 2,450
A70-6	N. Leeward Is. banks	548- 1,007	2,204- 2,100	1- 3	15- 25	233- 123	3,013- 3,273	15- 21	105- 816	4- 33	64- 26	16- 46	3,202- 4,194
A70-7	Jamaica banks	378- 393	0- 0	0- 0	0- 0	0- 0	412- 504	714- 685	799- 1,459	72- 159	4,017-2,588	176- 182	5,476- 4,892
C70-8	N. Leeward Is. banks	1,271- 1,845	6,536- 6,999	0- 0	45- 67	957- 626	8,815- 9,624	28- 40	170- 1,783	250-1,062	86- 142	31- 23	9,352-12,634
A71-11	Banks N. of Hispaniola	407- 756	0- 0	0- 0	0- 0	0- 0	467- 868	156- 171	288- 721	0- 0	57- 69	18- 17	770- 1,675
A70-12	Jamaica banks	- 116	- 0	- 16	- 77	0- 0	- 210	- 180	- 261	- 53	- 662	- 55	- 1,241
A70-13	N. Leeward Is. banks	1,077- 1,235	2,888- 3,703	0- 0	127- 166	185- 146	4,279- 5,253	52- 55	103- 442	78- 366	133- 86	133- 126	4,726- 6,273
C71-1	Venezuelan Shelf	306- 645	7- 18	28- 139	8- 27	240- 244	598- 1,107	114- 182	245- 656	83- 104	1,193-1,179	190- 393	2,309- 2,377
C71-2	Trinidad-Guyana Shelf	6- 22	7- 21	353- 901	0- 0	854- 252	1,232- 1,239	0- 0	69- 568	4- 11	1,245- 484	57- 104	2,607- 2,406
C71-3	St. Vincent-Barbados	111- 151	42- 55	2- 15	0- 0	2- 3	158- 232	2- 4	2- 4	15- 26	20- 9	1- 3	196- 274
C71-4	French Guiana-Surinam-Guyana	20- 75	0- 0	2,453-4,804	0- 0	1,409- 592	3,883- 5,471	0- 0	93- 1,018	3- 28	158- 65	3- 13	4,139- 6,595
C71-6	Saba Bank	97- 164	2,856- 2,843	0- 0	0- 0	57- 37	3,010- 3,044	0- 0	11- 95	36- 220	2- 8	8- 36	3,067- 3,403
C71-8	Gibbs Seamount	3- 12	0- 0	0- 0	0- 0	0- 0	5- 19	3- 10	23- 174	20- 75	95- 196	3- 10	146- 474
	Totals (weight)	-11,132	-19,717	-5,913	-1,011	-2,536	-40,971	-2,802	-14,581	-2,649	-9,713	-1,939	-68,791

[1]Identification according to Rivas (1966).
[2]Vermillion snapper (*Rhomboplites aurorubens*); Wenchman (*Pristipomoides aquilonaris*).
[3]Includes fish of other snapper species in addition to those specifically identified.
[4]Grunts (Pomadosyridae); Triggerfish (Balistidae); Squirrelfish (Holocentridae); Porgies (Sparidae).

sizes used and the banks fished. Catch rates for "Z" pots having 1¼-inch mesh set on Pedro Bank are available from cruises 67-6, 67-10, 70-4, 70-7, and 70-12, covering the months of April, June, July, and November. In those instances where different pot styles were set randomly at the same time, the "Z" pot displays a consistently higher catch rate than any other. The "D" pot outfished both the nesting pot and the "O" pot by a wide margin. Assuming that the approximate 2.3:1 ratio of 1¼-inch Z pot catch rate to 2 inch "D" pot catch rate which was observed during cruises 70-4 and 70-7 would have been obtained during cruise 70-2, we can calculate an overnight "Z" pot catch rate of about 56 pounds per set for "Z" pots on Pedro Bank in February.

Banks north of Hispaniola

The results of exploratory trap fishing effort on the banks located north of Hispaniola are given in Table 4. Here again, where comparable data are available, the "Z" pot outfishes the "D" pot, this time at the ratio of about 1.5:1. During cruise 70-1 in January 1970, catch rates appeared to be highest on Silver Bank, but in May the catch rates were highest on Navidad Bank. Mouchoir Bank showed lower catch rates. Where comparable data were gathered, daytime sets appeared more productive than overnight ones.

Northern Leeward Islands banks

This area received the most concentrated exploratory pot fishing effort of any in the project region. This came about because initial efforts indicated higher catch rates here than in the previous two areas. The results of this effort are given in Table 5. Again, where comparable data exist, the "Z" pot was seen to outfish the "D" pot. Here, it was by about 2 to 1 and other pots by an even higher ratio. Due to the topography, it was possible to fish deeper off the edges of these banks than on the banks off Jamaica or north of Hispaniola. Where good comparable data are available, as with "D" pots on Barbuda Bank during cruise 70-3, with "D" pots on Saba Bank and both "D" and "Z" pots on Barbuda Bank during cruise 70-6, it can be seen that fishing on the slope

of the bank in deeper water, where the angle of slope allows, invites a higher catch rate than fishing on the bank edge.

Catch rates were highest most often on Saba Bank. Barbuda Bank was the next most productive, while Anguilla Bank was the least productive. Speaking generally, overnight catch rates were higher than daytime catch rates, although there are exceptions. Catch rates on these banks are generally higher than off Jamaica and north of Hispaniola.

Gibbs Seamount, Windward Islands, and Barbados

There was no specific pot fishing exploration conducted in the southern Leewards. It is assumed, however, that pot fishing observed in the Windward Islands would be comparable to that of the southern Leewards. A limited amount of pot fishing exploration was conducted in the Windward Islands and Barbados during three cruises. Results are given in Table 6. Catch rates observed were significantly less than from the three areas in the northern half of the project region. Again, where comparable data exist, overnight catches exceed daytime ones. The daytime catch rate at Gibbs Seamount is encouraging.

South American continental shelf

The results of pot fishing explorations conducted on the continental

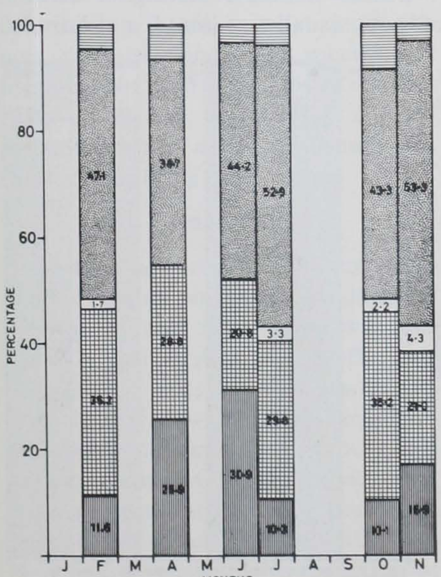


Figure 5.—Proportional catch composition by weight—Jamaica banks.

Table 3.—Observed trap fishing catch rates on the Jamaican banks.
(No. of traps lifted/aver. no. of fish per lift - aver. weight of fish catch per lift)

Vessel and Cruise	*Alcyon* 67-6	*Alcyon* 67-10	*Alcyon* 70-2		*Alcyon* 70-4			*Alcyon* 70-7		*Alcyon* 70-12	
Month	June	November	February		April			July		November	
Trap type-(mesh size)	"Z" - (1¼")	"Z" - (1¼")	"D" - (2")	Nesting - (2")	"Z" - (1¼")	"D" - (2")	"O" - (2")	"Z" - (1¼")	"D" - (2")	"Z" - (1¼")	"D" - (2")
Location											
Pedro Bank											
Day	6/--64.7	—	4/12.3-29.0	—							
Overnight	7/--54.3	[1]58/19.4-25.7	25/28.4-24.4		14/47.2-40.0	132/11.3-16.5	47/3.3-5.9	150/26.2-16.2	12/5.7-7.0	42/--20.4	11/ -2.1
Salmon Bank											
Day											
Overnight			12/16.2-28.3	1/0 - 0							
Albatross Bank											
Day			8/8.1 -29.5	1/24.0-54.5							
Overnight			16/15.2-32.6	2/17.0-60.0							
Decca Ridge											
Day											
Overnight			8/7.8 - 8.3	1/7.0 -15.0							
Mackerel Bank											
Day											
Overnight			7/6.7 - 2.4	1/8.0 - 2.0							
Eight Mile Bank											
Day								76/16.4-22.4	22/5.0-11.2		
Overnight											
Rosalind Bank											
Day											
Overnight										1/88-68.5	
Seranilla Bank											
Day											
Overnight										6/31.2-41.9	
Alice Shoal											
Day											
Overnight										6/4.2-5.2	5/1.2-3.7
Totals	13/--59.1	58/19.4-25.7	80/17.1-23.8	6/12.2-32.0	14/47.2-40.0	132/11.3-16.5	47/3.3-5.4	226/22.9-18.3	34/5.3-9.7	55/ -22.0	16/ -2.6

[1]Includes sets of 1-5 days duration.

shelf of South America (and Trinidad) are given in Table 7. These grounds were not surveyed on a seasonal basis as were those in the northern half of the project region. Catch rates ranged from relatively poor off the northern Venezuela and Trinidad coasts, to progressively better working south and east from Trinidad to Guyana, Surinam, and French Guiana. Catch rates from French Guiana and Surinam are as high as those observed in the northern Leeward Islands. Here again, where good comparable data are available, "Z" pots catch at twice as high a rate as "D" pots and overnight catch rates exceed daytime rates.

Factors Affecting Catch Rate and Species Composition

Comparison of bait effectiveness

During *Calamar* cruise 70-8 a test comparing the attractiveness of frozen West Indian robin bait to that of frozen imported Spanish mackerel was carried out. Twenty comparative multipot settings were made using "Z" pots of equal size and evenly divided mesh sizes. Efforts were made to keep each pot at the same depth level during each setting. The results are presented as the number of pots lifted and the average catch per pot in pounds. (The uneven number of pots set is due to pot loss.)

	Robin	Mackerel
1¼ inch mesh	73/46.0	73/44.6
2 inch mesh	69/41.7	78/40.1

Although the slight reduction in catch per pot lift between robin-baited pots and mackerel pots was consistent with both mesh sizes, it was not of sufficient magnitude to be significant and the two baits were concluded to be equally attractive.

On *Calamar* cruise 70-4 the effectiveness of flyingfish and sprat herring pot bait was tested against robin bait. A total of 29 "Z" and "D" pots baited with robins is compared with 14 "Z" pots baited with flyingfish and 11 "Z" and "D" pots baited with sprat herring. The number of pots hauled and the average catch per pot are shown below:

Pot	Robin	Flyingfish	Sprat herring
"Z"	25/39.4	8/21.1	6/13.3
"D"	4/11.0	6/9.8	5/3.8

Table 4.—Observed trap fishing catch rates on the banks north of Hispaniola. (No. of traps lifted/aver. no. of fish per lift - aver. weight of fish catch per lift)

Vessel and Cruise Month	*Alcyon* 67-8 September	*Alcyon* 70-1 January		*Alcyon* 70-5 May		*Alcyon* 70-11 October
Trap type - (mesh size)	"Z" - (1¼")[1]	"Z" - (1¼")	"D" - (2")	"Z" - (1¼")	"D" - (2")	"Z" - (1¼")
Location						
Navidad Bank						
Day			6/1.8-5.3			
Overnight	10/ - 18.4	2/8.5-30.5	20/4.0-22.6	42/9.5-22.1	85/6.2-15.7	79/8.6-18.3
Silver Bank						
Day		3/13.3-46.7	10/7.3-29.3			
Overnight	11/ - 30.8	12/17.9-36.8	31/7.9-17.2	6/6.3-13.3	20/1.2-3.8	6/15.0-34.9
Mouchoir Bank						
Day		3/2.7-12.7	20/3.6-14.8			
Overnight		5/7.0-16.6	20/8.0-21.9			
Totals	21/ - 24.9	25/12.6-30.6	107/6.0-19.1	48/9.1-21.0	105/6.2-13.4	85/9.1-19.7

[1]Sets of 1-5 days duration.

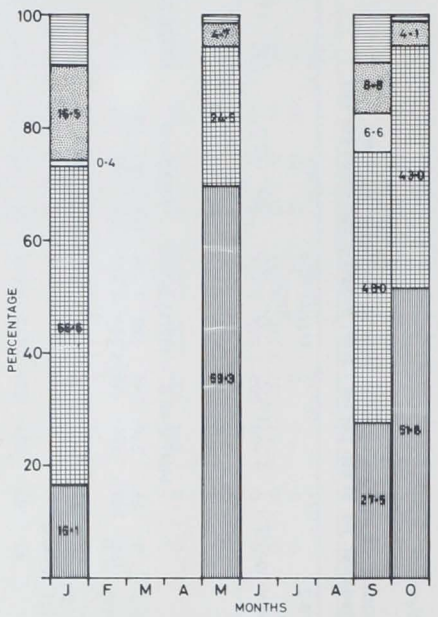


Figure 6.—Proportional catch composition by weight—banks north of Hispaniola.

Robins proved to be the most effective of three local West Indian species tested. Shark and pot-caught food fish were tested and were found to be poor pot bait.

The amount of bait placed in each pot was determined generally by experience. When pot fishing explorations began in earnest during Phase II, the Australian consultant fisherman advocated the use of much bait—up to 25 pounds per trap set. Since bait is expensive, the practice could not be followed for a long time. From March 1970 on, only 5 pounds per pot or two wires was the standard baiting, with no visible effect on catch rate.

W. High of the National Marine Fisheries Service, Northwest Fisheries Center (personal communication—K. Kawaguchi), reported on underwater observation of shallow-set pots during the Tektite II diving operations near St. John, U.S. Virgin Islands. There unbaited pots appeared to catch fish as well as baited pots. Likewise, Munro et al. (1971) actually found unbaited traps to be 15 percent more effective in catching fishes, but a heavier weight of fish was taken from baited traps. They also report the use of fruit and vegetable baits and other fish attractants like broken crockery. This latter may also aid fishermen in relocating traps in shallow water. On several occasions this project has compared the catch of baited and unbaited pots in deeper waters. On all occasions the unbaited pots caught little or nothing, while the baited pots continued to produce at their usual levels. It would appear that bait is a much greater and more necessary attraction in deep water than in shallow.

Fishing depth

Unlike handline fishing, a setting of pots usually required a relatively

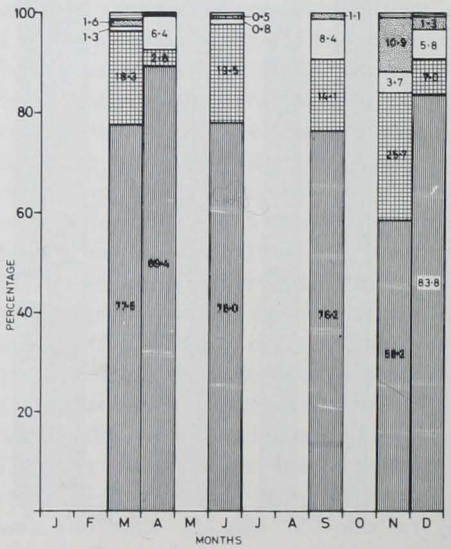


Figure 7.—Proportional catch composition by weight—northern Leeward Islands banks.

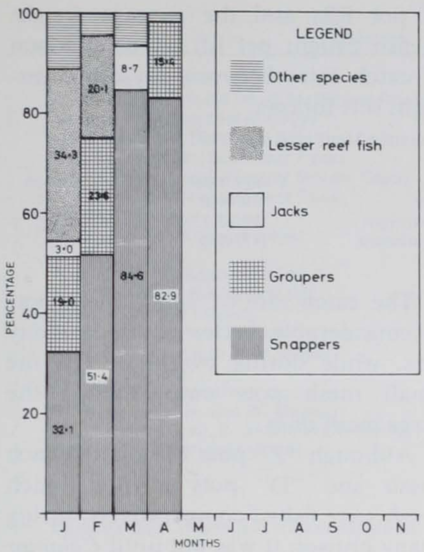


Figure 8.—Proportional catch composition by weight—South American shelf—Windward Islands.

gentle slope at the desired 50-100 fathom depth to be most successful. This was discovered by experience when pots set on too steep a slope were tumbled down it by current action and, depending on ballast weighting, either pulled their marker buoys under or floated away. It was possible to anchor the pots, but this led to increased strain on the pots and warps during hauling, which caused pot breakage and losses. Where the required gentle slope did not exist, it became standard practice to set the pots as close to the drop off of the bank or continental shelf edge as possible. This was often at 20-30 fathoms. Slope angle then became the determining factor in what depth the pots were set and how successfully they caught fish. Pot losses during explorations ran between 10 and 20 percent per trip and were usually the result of tumbling down slope.

Pot size

On *Calamar* cruise 71-4 a combination of many pot types of different dimensions and mesh sizes was utilized. A comparison of the effectiveness of "Z" pots by size was made. Forty lifts of 1¼-inch mesh Jamaican-built pots, measuring 9 × 4 × 2 feet were compared with 40 lifts of 2-inch mesh project-designed "Z" pots built in Barbados which measured 10 × 4 × 3 feet. Even with the reduction of overall catch rate expected from 2-inch mesh over 1¼-inch mesh, the

Table 5.—Observed trap fishing catch rates on the northern Leeward Islands banks.
(No. of traps lifted/aver. no. of fish per lift - aver. weight of fish catch per lift.)

Vessel and Cruise	*Alcyon* 69-11			*Alcyon* 70-3			*Alcyon* 70-6		*Calamar* 70-8		*Alcyon* 70-13	*Calamar* 71-6	
Month	November			March			June		September		December	April	
Trap type - (mesh size)	"Z" - (1¼")	"D" - (2")	"O" - (2")	"Z" - (1¼")	"D" - (2")	Nesting - (2")	"Z" - (1¼")	"D" - (2")	"D" - (1¼")	"Z" - (2")	"Z" - (1¼")	"Z" - (1¼")	"D" - (1¼")
Location													
Saba Bank													
Bank edge													
Day							3/16.0-14.4						
Overnight	5/48.1-34.1	7/17.4-17.7	9/10.0-19.9				7/3.6-2.9	23/2.3-4.4					
Bank slope													
Day				14/59.0-52.1	26/10.7-16.1	8/9.5-9.6	29/16.6-13.5	25/2.7-4.4	41/31.5-32.6	40/16.3-33.6	43/24.9-33.8		
Overnight	4/51.0-49.0	6/51.7-69.0	6/3.8-3.6	25/56.4-55.6	38/20.3-34.0	12/11.3-15.1	44/18.3-14.5	41/5.2-6.8	48/56.1-54.7	50/29.9-37.9	38/28.6-37.2	[2]53/49.3-55.6	[2]14/33.4-33.9
Anguilla Bank													
Bank edge													
Day													
Overnight	2/3.0-10.3	10/6.6-14.8	8/5.5-12.0								37/26.8-31.2		
Bank slope													
Day							7/3.3-13.0	7/0.3-2.0					
Overnight				12/13.1-35.1	24/3.8-18.0	6/2.3-10.3	21/8.8-20.6	17/3.6-9.5	7/15.6-33.6	8/13.3-35.0			
Barbuda Bank													
Bank edge													
Day													
Overnight				5/28.0-37.9	24/8.8-18.8	6/4.3-9.6	11/7.1-7.6	11/0.8-2.2					
Bank slope													
Day				5/65.4-47.0	14/1.1-4.6	2/0.0-0.0	34/4.3-9.4	36/2.2-6.9	19/14.2-29.1	19/26.3-63.7	12/30.2-45.9		
Overnight	4/27.3-15.1	12/9.9-12.9	11/17.4-21.7	11/15.8-18.7	17/11.6-30.6	4/1.0-2.8	31/16.4-15.7	30/6.7-15.5	31/49.1-61.3	32/23.2-38.8	35/24.2-33.1		
Totals	15/37.3-29.9	35/17.6-24.1	34/10.3-15.8	72/41.0-42.0	143/10.9-22.2	38/6.8-10.3	187/12.3-13.4	190/3.6-7.4	146/40.3-45.5	149/23.4-40.1	165/26.4-34.7	53/49.3-55.6	14/33.4-33.9

[1]Nesting pot.
[2]Includes sets of 1-5 days duration.

Table 6.—Observed trap fishing catch rates on Gibbs Seamount and the Windward Islands. (No. of traps lifted/aver. no. of fish per lift - aver. weight of fish catch per lift.)

Vessel and Cruise Month	*Fregata* 68-3 April	*Calamar* 71-1 January	*Calamar* 71-3 March	*Calamar* 71-8 June
Trap type - (mesh size)	"Z" - (1¼")[1]	"Z" - (1¼")	"Z" - (1¼")	"Z" - (1¼")
Location				
Gibbs Seamount				
Day				6/20.3-65.3
Overnight				6/4.0 -13.6
St. Vincent				
Day				
Overnight			11/11.1-15.0	
Barbados				
Day				
Overnight	16/13.4-25.7		11/6.1 - 8.1	
Grenada				
Day		48/6.5-9.5		
Overnight		48/8.5-15.4		
Totals	16/13.4-25.7	96/7.5-17.5	22/8.6 -11.5	12/12.2-39.5

[1]Includes sets of 1-4 days duration.

Table 7.—Observed trap fishing catch rates around Trinidad and on the South American continental shelf. (No. of traps lifted/aver. no of fish per lift - aver. weight of fish catch per lift.)

Vessel and Cruise Month	*Calamar* 71-1 January	*Calamar* 71-2 February		*Calamar* 71-4 April	
Trap type - (mesh size)	"Z" - (1¼")	"Z" - (1¼")	"D" - (2")	"Z" - (1¼")	"D" - (1¼")
Location					
Venezuela					
North coast					
Day					
Overnight	80/3.0- 6.5				
Isla Blanquilla					
Day	7/0.0- 0.0				
Overnight	48/20.9-17.3				
Islas Testigos					
Day					
Overnight	32/1.0- 2.1				
Trinidad					
North edge					
Day					
Overnight	48/5.6-11.1				
East Edge					
Day		72/2.0-1.9	22/0.5-2.6		
Overnight		56/27.8-11.6	18/0.3-0.2		
Venezuela					
East Edge					
Day				19/7.1-24.5	4/2.2-16.2
Overnight		19/7.4-8.4	5/1.2-3.2	29/12.1-20.3	18/22.7-18.6
Guyana shelf					
Day		28/10.9-5.4	3/0.0-0.0		
Overnight		11/11.9-41.6	4/9.1-14.0		
Guyana edge					
Day		14/4.1-10.1	2/0.5-3.5	10/3.3-9.3	3/21.6-9.3
Overnight		38/11.7-13.0	3/1.3-9.3	8/41.0-21.9	
Surinam edge					
Day				10/1.5-14.6	3/6.0-2.0
Overnight				10/9.3-49.5	3/5.3-8.0
French Guiana edge					
Day				38/21.6-33.0	11/17.7-15.9
Overnight				38/16.9-64.3	9/30.4-32.3
Totals	215/7.2-9.0	235/10.8-9.2	57/1.2-2.9	162/19.3-34.9	51/20.8-18.1

large pots, average catch of 30.1 pounds per lift significantly exceeded the 18.7 pounds per lift figure of the small pots having only 1¼-inch mesh. It thus appears that pot size is of greater significance than mesh size in determining its effectiveness.

The mechanism behind such a relationship is not clear except that during *Calamar* cruise 71-6, when only "Z" pots of 1¼-inch mesh were fished, there was a positive correlation (not significant) between pot height and catch rate. When the pot catch rate was compared with pot length, pot width, and pot volume the correlation was not evident.

Mesh size

Catch rate variation.—During *Calamar* cruise 70-8 comparative tests on the effects of mesh size were conducted. All pots used were of equal dimensions, baited with either Spanish mackerel or West Indian robins. Each test consisted of about the same number of 2-inch mesh and 1¼-inch mesh pots, usually eight large and eight small, placed at about the same depth. Results are given as the total number of pot lifts and the average weight of fish caught per lift. A comparison of catch rates between day and overnight sets follows:

	2 inch mesh	1¼ inch mesh
Day	59/44.2	60/31.6
Overnight	88/33.7	86/54.9
Combined	147/40.9	146/45.3

The catch rate of 2-inch mesh pots is considerably better during the day sets, while during overnight sets the small mesh pots outperformed the large mesh ones.

Although "Z" pots having 1¼-inch mesh and "D" pots having 2-inch mesh were fished comparatively during many cruises, it was not until *Calamar* cruise 71-4 that a direct comparison between "D" and "Z" pots of the same 1¼-inch mesh was made. During 14 multipot settings which included from 2 to 6 pots of each type, a total of 47 "D"-pot lifts produced an average catch of 19.6 pounds per lift, while 58 "Z"-pot lifts produced 41.4 pounds per lift.

Fish size and species variations.—Because of the general size differences of the various species and families included in the fish pot catches of the region, the species composition of the catch is affected by mesh size. During *Calamar* cruise 70-8, a comparison was made of the proportions by weight of snappers, groupers, jacks, and others by mesh size in the "Z" pot catches on Saba Bank. This location was selected because the general evenness of slope allowed all pots to be set at approximately the same depth. Proportions of family groups by mesh size are given below. The number of lifts was about evenly divided between day and night sets and bait species.

Mesh size (inches)	No. lifts	Percentage by weight(average wt. per fish) Snappers	Groupers	Jacks	Other
1½	89	83.3	8.9	7.0	0.8
		(0.85)	(13.6)	(6.1)	(1.2)
2	90	75.4	15.8	7.6	1.2
		(1.18)	(12.8)	(6.3)	(2.8)

It is obvious that small mesh pots caught a higher proportion of snappers and a resultant lower proportion of the other groups. Snappers and jacks caught in small mesh pots averaged smaller, but groupers averaged slightly larger. No reason for this is evident.

Table 8.—Circumstances of good consistent trap fishing catch rates (where 10 or more lifts average 20 or more pounds per lift).

Location	Month-Year	Day (D) or Night (N) set	Pot type and mesh size	Depth range (fms)	No. of lifts	Lbs. per lift
Jamaica Banks						
S.W. Pedro Bank (30 mi. S.W. Blower Rocks)	Feb. 70	N	"D" 2"	20 - 22	25	24.4
Salmon Bank (on center ridge)	Feb. 70	N	"D" 2"	20 - 54	12	28.3
Albatross Bank (East and Southeast edges)	Feb. 70	N	"D" 2"	18 - 22	16	32.6
S.E. Pedro Bank (Southeast Peak)	Apr. 70	N	"Z" 1¼"	18 - 30	14	40.0
8-mile Bank (13 mi. West of Morant Cays)	July 70	N	"Z" 1¼"	22 - 27	76	22.4
S.E. Pedro Bank (Southeast Peak)	Nov. 70	N	"Z" 1¼"	18 - 27	42	20.4
North of Hispaniola						
Silver Bank (Southeast edge)	Jan. 70	N	"Z" 1¼"	10 - 20	12	36.8
	Jan. 70	D	"D" 2"	10 - 20	10	29.3
Navidad Bank (Southeast tip)	Jan. 70	N	"D" 2"	21 - 30	20	22.6
Mouchoir Bank (Southeast tip)	Jan. 70	N	"D" 2"	10 - 15	20	21.9
Northern Leeward Islands						
Barbuda Bank (N.W. slope)	Nov. 69	N	"O" 2"	43 - 52	11	21.7
Saba Bank (N. tip to N.W. slope)	Mar. 70	N	"Z" 1¼"	50 - 75	25	55.6
	Mar. 70	N	"D" 2"	50 - 75	38	34.0
Anguilla Bank (Northern slope)	Mar. 70	N	"Z" 1¼"	44 - 60	12	35.1
Barbuda Bank (N. and W. slopes)	Mar. 70	N	"D" 2"	50 - 65	17	30.6
Small Bank (11 mi. E. of Sombrero Bank)	Jun. 70	N	"Z" 1¼"	52 - 86	21	20.6
Saba Bank (Northwest slope)	Sept. 70	D	"Z" 1¼"	60 - 82	41	32.6
	Sept. 70	N	"Z" 1¼"	60 - 82	48	54.7
	Sept. 70	D	"Z" 2"	60 - 82	40	33.6
	Sept. 70	N	"Z" 2"	60 - 82	50	37.9
Barbuda Bank (North and Northwest slope)	Sept. 70	D	"Z" 1¼"	60 - 80	19	29.1
	Sept. 70	N	"Z" 1¼"	60 - 80	31	61.3
	Sept. 70	D	"Z" 2"	60 - 80	19	63.7
	Sept. 70	N	"Z" 2"	60 - 80	32	38.8
Saba Bank (Northwest slope)	Dec. 70	D	"Z" 1¼"	60 - 115	43	33.8
	Dec. 70	N	"Z" 1¼"	60 - 115	38	37.2
Anguilla Bank (East edge)	Dec. 70	N	"Z" 1¼"	30 - 55	37	31.2
Barbuda Bank (N. and N.W. slope)	Dec. 70	D	"Z" 1¼"	60 - 100	12	45.9
	Dec. 70	N	"Z" 1¼"	60 - 100	35	33.1
Saba Bank (Northwest slope)	Apr. 71	N[1]	"Z" 1¼"	65 - 80	27	54.5
South American continental shelf						
Guyana Shelf (43 mi. E. Waini Point)	Feb. 71	N	"Z" 1¼"	41	11	41.6
Venezuela (50 mi. N.E. × E. Orinoco Delta)	Apr. 71	D	"Z" 1¼"	55 - 63	19	24.5
	Apr. 71	N	"Z" 1¼"	55 - 63	29	20.3
Surinam (70 mi. N.E. Georgetown, Guyana)	Apr. 71	N	"Z" 1¼"	49 - 56	10	49.5
French Guiana (60 mi. N. Cayenne)	Apr. 71	D	"Z" 1¼"	45 - 65	38	33.0
	Apr. 71	N	"Z" 1¼"	45 - 65	38	64.3

[1]All traps in water 22 hours.

Soaking period

Calamar cruise 71-6 was planned as a specific experiment to observe the change in pot catch rate during soak periods varying from 1 to 5 days. Twenty "Z" pots and five "D" pots were set on a 1½ mile line in random order in 70 to 80 fathoms on the west side of the north peak of Saba Bank. All pots were of 1¼-inch mesh and were baited identically with about 5 pounds of robins. All pots were set in 1 day. Five pots (4 "Z", 1 "D") were hauled and reset the next day. The following day those same five pots were again hauled and reset the next day. The following day those same five pots were again hauled and a new group of five pots were also hauled. This latter sequence was continued for an additional 3 days. On the sixth day all pots were hauled and the experiment completed. Results were as follows:

Days in water	No. pots lifted	Total no. fish	Total lbs. fish	Average no. fish/ pot	Average lbs. fish/ pot
1	34	1509	1686	44.4	49.6
2	10	506	540	50.6	54.0
3	10	569	595	56.9	59.5
4	8	279	369	34.9	46.1
5	5	216	231	43.2	46.2

There is an increase of about 5 pounds per lift between 1 and 2 and between 2 and 3 days soaking, after which the catch rate declined back to about 46 pounds/lift. From the appearance of bait strings observed during the experiment, the rise and fall of catch rates was closely coupled to the time during which bait stayed available to the fish before falling off the wires and out of the trap.

DISCUSSION

The species composition of trap catches varied considerably throughout the region. A number of factors, including geographic area, fishing depth, mesh size, and to some extent, bait, affect the variation of species. The most important of these is felt to be the depth. Generally speaking, the species composition available to the pots will become less complex and the proportion of snapper will increase as the depth increases. Where it is not yet physically possible to fish pots on the precipitous bank peripheral slopes, fishing will be limited to the usually shallower edges and the species composition of the catch will be so affected and be more complex. It was found during our explorations that only the slopes of the banks in the northern Leeward Islands, and then only on the slopes facing away from the prevailing current (usually north and northwest), are gradual enough to permit pot fishing down to 100 fathoms and below. Consequently, in this area, catches were overwhelmingly dominated by silk snapper. This was most fortunate as this particular area appears to hold a high level of ciguatera type fish poisoning (Halstead 1970) which was not reported from any of the nearly 20,000 pounds of silk snapper caught from this area and sold by the project.

Because species composition is related to the sizes of fish retained by the pot, it will also vary with a change in mesh size. This is because a larger mesh size will allow small fish to escape from the trap, but will retain the larger (and usually more desirable) ones.

Mesh size can be applied as a fishery management tool also. During *Calamar* cruise 70-8 on Saba Bank, at one station 545 silk snappers were caught and measured. Twelve 2-inch mesh "Z" pots caught 223 of these, while

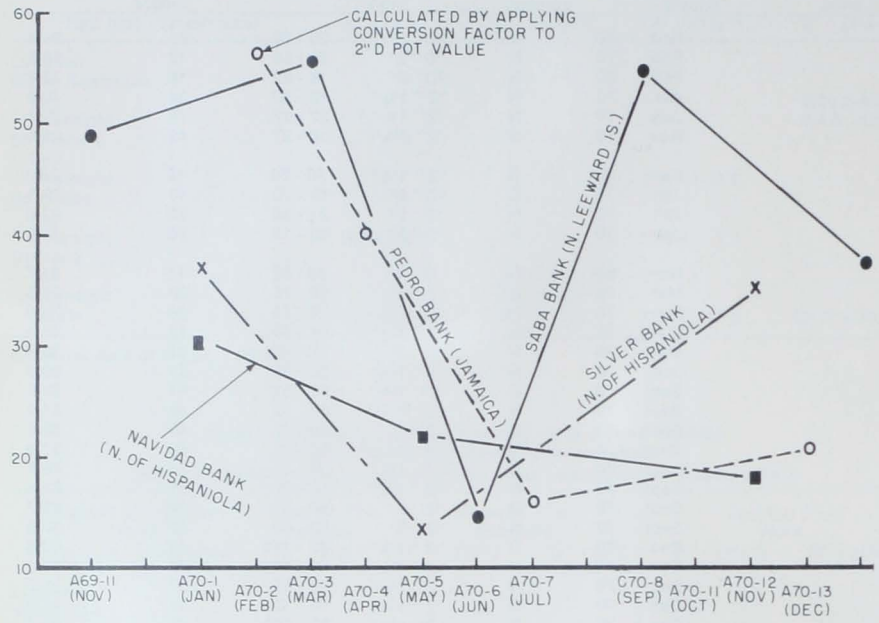


Figure 9.—Pot fishing catch rate (all catch rates obtained from overnight sets of 1¼-inch mesh "Z" pots) variations by month and location.

six 1¼-inch mesh "Z" pots caught 322. All pots were baited alike and set at the same depth. It was found that 96 percent of the silk snappers from the 2-inch mesh pots were above 24 centimeters in length, while only 50 percent of the silk snappers from 1¼-inch mesh pots exceeded 25 centimeters. As 24 centimeters represents the average length at maturity for this species (as determined by gonadal examination) 2-inch mesh pots would be excellent conservation gear for the species.

The catch rates given in Tables 3 through 7 are comprehensive in that they provide the full range of values as observed during all pot fishing explorations. In order to determine what constitutes a good or bad catch rate, certain parameters had to be applied. It was arbitrarily determined that catch rates in excess of 20 or more pounds per lift obtained from 10 or more individual lifts would be considered not only good, but also consistent catch rates. In Table 8, the circumstances including location, month, and year obtained, whether a day or night set, the pot type and mesh size, and the fishing depth range of all consistently good catches are given. This table becomes a reflection of the relative importance of the general areas of the region in that the number of entries from the northern Leeward Islands banks are highest, while the Windward Islands are not represented at all. It can also be seen that the majority of good catches were made by 1¼-inch mesh "Z" pots fished at night in generally deeper water.

Seasonal availability (to fish traps) can be determined by examining the variations in the catch rates by the month they were observed. Seasonal abundance can be inferred from these data providing other seasonal factors that might inhibit fish from being trapped did not prevail. In Figure 9, the variations in catch rates by cruise (month) from four banks representing three areas are shown. All data were obtained from overnight sets of 1¼-inch mesh "Z" pots. Although all changes are not the same there appears to be an overall reduction in catch rates (availability) occurring during May-June-July, with relatively higher rates during the remainder of the year. The period of reduced catch rates corresponds with the period of seasonal warming in waters of these areas.

Although pounds of fish per lift is an acceptable measure of fishing effort for determining potential, the amount of fish available to a vessel using fish pots will be limited by the number of pots that it can effectively work in a day or any other time period. Pot setting and hauling is generally limited to daylight hours although it is possible (though not desirable) to set pots in darkness. By examining Table 5, it will be seen that when a pot is set and hauled twice a day, its total catch will greatly exceed the catch if hauled only once a day (as in *Calamar* cruise 71-6). This was determined early during pot fishing explorations and two sets in 24 hours became standard procedure when the boat stayed in one location. It was also determined that during normal operations a pot could be lifted, emptied, rebaited, and reset in 10-15 minutes. Therefore, if pots were handled twice a day and took an average of 10-15 minutes each to handle, the maximum number of pots to be worked daily would be between 15 and 20. This would require 8-10 hours, which is about maximum, particularly if fish are being dressed and stored between morning and evening hauls. This number of pots was also convenient for *Calamar* and *Alcyon* as they could carry about 24 assembled "Z" pots on deck at a time, which provided an ample number of spare pots to replace those lost or damaged.

SUMMARY AND CONCLUSIONS

In summary, project pot fishing for snappers and related demersal species in the Caribbean and adjacent waters has displayed generally good potential. In all areas possessing offshore banks or shelves of any magnitude, the catch rates have been high enough to evoke commercial interest. While the smaller banks off Jamaica would probably not support unlimited effort because of size, Pedro Bank is large enough to provide a continuously good ground for Jamaican fishermen. The eastern end of the bank receives some small effort presently, but it is by small canoes carrying a few traps. The southern and western sides of the bank are almost untouched. Silver and Navidad Banks both display good trap fishing potential. In the northern Leeward Islands, Saba and Barbuda display excellent potential, while Anguilla Bank is also good. Gibbs Seamount

has demonstrated potential that must be limited because of size. In the Windward Islands, the Grenada Shelf has shown some moderate potential. Good potential was observed off eastern Venezuela, Guyana, and Surinam. Excellent potential was found off French Guiana.

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MFR PAPER 1088

Exploratory Tuna Longline Fishing in the Caribbean and Adjacent Waters

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ABSTRACT—This report gives the results of tuna longline exploration conducted by the Caribbean Fisheries Development Project. All such fishing was conducted in the Caribbean Sea and adjacent Atlantic Ocean waters in 1966 and 1967. Background information, including the fishing history, topography, oceanography, fishing grounds, and seasons, is given. Vessels and gear are described, after which fishing results are presented by geographic region. Overall results were generally poor and below commercial catch rates observed in the same regions for a variety of reasons. In summary, the resource was considered insufficient for the establishment of a continuous tuna longline fishery in the Project region.

INTRODUCTION

This report is one of a series on exploratory fishing activities of the Caribbean Fisheries Development Project which became operational in August 1965. Although the tuna resources in the Caribbean waters had already been explored by the United States (since 1954) and by Japanese research vessels and commercial vessels (since 1955), the fishery is utilized only seasonally by foreign vessels. This type of fishing was adopted by the Project to evaluate its potential for fishermen of the Caribbean Region.

BACKGROUND OF TUNA LONGLINE FISHING IN THE CARIBBEAN

History

The U.S. Fish and Wildlife Service's exploratory fishing vessel *Oregon* carried out tuna longline fishing in April and May 1955, January 1956, and August, September, and October 1957, to determine the extent of subsurface tunas in the northern, western, and eastern Caribbean, and to gain information on the possible continuity of yellowfin tuna stocks between the Gulf of Mexico and the Caribbean.

Several Japanese longliners conducted commercial feasibility operations in the Caribbean between 1955 and 1958. The results were encouraging in catch rate and there was less distance to vessel bases when compared with the Pacific or Indian Ocean operations. In 1958, 51 vessels caught 30,984 tons during 131 cruises. In 1961, total vessels operating in the Atlantic were 86 with 82,251 tons caught during 258 cruises.

This increase continued until about 1964 with a final total of over 100 vessels involved. Some of these vessels, however, started to move to the Indian and Pacific oceans due to uneconomical operating conditions. Factors included a change of market, labor problems, and decrease in catch rate. In 1968, the vessels operating in the Atlantic decreased to about 25. Dominant size of those Japanese tuna longliners in the Atlantic is about 300 to 400 gross tons (GT). The larger sized vessels—more than 500 GT—usually carried one or more catcher boat(s) which could independently operate 200 to 250 baskets of longline gear each. Longline gear used by those vessels was mostly the same type as that used by the Project vessels mentioned in this report—400 to 450 baskets set per day by the commercial vessels.

Some of those vessels worked in the Caribbean during seasons when higher catch rates of tuna were possible. In the earlier stages of fishing, landing bases existed at Trinidad, Panama, Haiti, Cuba, Colombia, and Brazil. Recently there has been only one land-and operating base—St. Maarten.

In Venezuela, some of the local fishing vessels started tuna longline fishing in the eastern Caribbean about 1954. As a result of the *Bosu Maru* exploratory tuna longline fishing based at Venezuela, a Venezuelan-Japanese company was established in 1957 to initiate the fishing with two Japanese-built longliners which were manned by mixed crews. Successful operations of this company and favorable demands for tuna in Venezuela stimulated local vessel owners to increase modifications to longliners. In 1966, there were about 43 vessels, mostly 3 to 45 tons in capacity, fishing with an average of 100 to 120 baskets of Japanese-type longline. Annual landings in Venezuela from 1960 to 1966 ranged from 1,940 to 3,540 tons. The seasonal and annual change of yellowfin and albacore in the Caribbean and western Atlantic was studied, based on data collected from three longliners from 1960 to 1963.

In Cuba, a Japanese commercial longliner (462 GT) started demonstra-

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