

Exploratory Fishing Activities of the UNDP/FAO Caribbean Fishery Development Project, 1965-1971: A Summary

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ABSTRACT—The UNDP (United Nations Development Program)/FAO (Food and Agriculture Organization) Caribbean Fishery Development Project became operational in 1965. The Exploratory Fishing Section formed the largest component of the project; it was primarily staffed by FAO personnel, but was planned and directed by the U.S. National Marine Fisheries Service. Activities from 1965 to 1971 are summarized in this publication.

Beginning in 1966, nearly 2,500 sea days were spent by three vessels in resource experimentation and exploration. Operations extended from the Central American coastal shelf to the islands and banks off the Greater and Lesser Antilles and to the coastal shelves of eastern Venezuela, Guyana, Surinam, and French Guiana.

Experiments were conducted in attracting and catching pelagic fish by the use of longlines, live bait/pole-and-line, trolling, gill nets, lift nets, and handlines, and in catching demersal fish through the use of handlines, power reels, traps, longlines, trawls, and gill nets.

Exploratory efforts produced about 1 million pounds (453,597 kg) of usable food fish. Of this total, about 35 percent consisted of trawl-caught demersal fish, 38 percent of snapper, jacks, and fish of related species, 17 percent of sharks, and the remaining 10 percent mostly of pelagic fish.

Three major resources were delineated. The demersal trawl fishes are limited to the continental shelf off northeastern South America. The demersal snapper and related species exist throughout the project region, but are most concentrated on the edge of the Honduran/Nicaraguan continental shelf off Central America, on the banks of the northern Leeward Islands, and on the edge of the Guyanan/French Guianan continental shelf. A lesser resource, of sharks, occurs on the continental shelf of northeastern South America, and is concentrated off Surinam. A seasonal increase in availability of skipjack tuna to live bait/pole-and-line fishing was apparent during March through May in the Windward Islands. Pelagic species showed a seasonal increase in availability to trolling during the same period in the northern Leeward Islands and during September and October off Jamaica. Spiny lobsters were taken in good quantity in April on Pedro Bank south of Jamaica, but were not available on the other grounds in the project region. A small resource of tilefish was found in deep water off the edge of the Surinam continental shelf.

Accomplishments in the Exploratory Section of the UNDP/FAO Caribbean Fishery Development Project during the first year (1965) were limited to acquiring staff, ordering and receiving necessary equipment, and operational planning. Not until November of 1966, after delivery of the MV *Calamar* and MV *Alcyon* from

the builder, did actual operations begin. In June 1967, the MV *Fregata* was delivered and the three-vessel fleet was complete. Phase I of the project was completed on 31 August 1969, and Phase II on 31 August 1971.

The overall project can be described as a commercial feasibility or pre-investment survey of the fishery re-

EDITOR'S NOTE

This number of Marine Fisheries Review documents the results of a five-year international study of the fisheries potential of the Caribbean Sea.

The area surveyed under this study was immense, covering almost one million square miles. The countries involved in the study were Barbados; Guyana; Dominican Republic; France in respect to French Guiana, Guadeloupe, Martinique; Jamaica; Antigua; Montserrat; St. Christopher, Nevis, Anguilla; Netherlands Antilles; Surinam; Trinidad and Tobago; United States of America on behalf of Puerto Rico; Grenada; St. Lucia and St. Vincent.

Romantic names, these. Yet the West Indies are a good deal more than coconuts and steel bands and rum. Excluding the mainland countries of Guyana, French Guiana, and Surinam, the island countries in this study, although occupying wide arcs of the subtropical sea, have a total land area about the size of that of our small State of Maine. On these islands live more than 11 million people.

Only one aspect of this study has heretofore resulted in formal publication; yet the remainder of the material gathered provides a solid datum for future studies and development of fisheries in the Caribbean Sea.

This number of Marine Fisheries Review places in the permanent record a series of investigations that directly or indirectly affect the welfare of several million human beings and thus appear eminently worthy of preservation.

T.A.M.



Figure 1.—Caribbean Fishery Development Project Region.



Table 1.—Summary of project exploratory operations by fishing method or other classification. Catch (CA) in thousands of pounds and effort (EFF) in thousands of hours.

VESSEL & FISHING GEAR ¹	DEMERSAL TRAWLING		DEMERSAL HANDLINE & REEL		DEMERSAL POT OR TRAP		SHARK HANDLINE & SETLINE		PELAGIC TROLLING		PELAGIC LONGLINE		PELAGIC POLE & LINE		OTHER METHODS ²		
	CA	EFF	CA	EFF	CA	EFF	CA	EFF	CA	EFF	CA	EFF	CA	EFF	CA	EFF	
<i>Alcyon</i>																	
1966-67	0	0	8.4	17	0.4 ⁵	0	0	0	0	0	0	19.9	84	0.8	55	0	0
1967-68	0	0	91.6	113	2.0 ⁵	0	0	0	0	12	0	0	0	1.4	79	0	0
1968-69	0	0	79.2	145	0	0	0	0	0	0	0	0	0	0.5	40	0	0
1969-70	0	0	23.7	14	28.7	153	0	0	5.9	24	0	0	0	0	0	0	0
1970-71	0	4	37.4	16	9.2	50	0	0	1.3	26	0	0	0	0	0	0	0
<i>Alcyon</i> Subtotals	0	4	240.3	305	40.3	203	0	0	7.2	62	19.9	84	2.7	174	0	0	0
<i>Calamar</i>																	
1966-67	84.3	37	0	0	0	0	0	0	0	0	15.2	59	2.8	41	0	0	0
1967-68	155.9	198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968-69	86.8	42	0	0	0	0	62.9	75	9.7	20	0	0	0	47	0.3	0	0
1969-70	14.1 ⁵	0	0	0	0	0	102.9	130	0	0	0	0	6.6	48	6.8	3	0
1970-71	0	0	18.2	57	28.8	92	0	0	5.6	18	0	0	0	0	0	0	13
<i>Calamar</i> Subtotals	341.1	277	18.2	57	28.8	92	165.8	205	15.3	38	15.2	59	9.4	136	7.1	54	13
<i>Fregata</i>																	
1966-67	0	0	0	0	0	0	0	0	0	0	0	0	1.6	30	0	0	0
1967-68	0	0	0	0	0	18	0	0	0	6	0	0	5.9	96	2.4	40	0
1968-69	0	0	28.5	179	0	0	0	0	0	0	0	0	0	0	1.9	37	0
1969-70	0	0	12.8	53	0	0	0	0	0.2	11	0	0	11.5	86	0	0	0
1970-71	0	0	0	0	0	0	0	0	5.8	96	0	0	0	0	0	0	0
<i>Fregata</i> Subtotals	0	0	41.3	232	0	18	0	0	6.0	113	0	0	19.0	212	4.3	77	0
GRAND TOTALS	341.1	281	299.8	594	69.1	313	165.8	205	28.5	213	35.1	143	31.1	522	11.4	131	13
PERCENT OF TOTAL	28.5	11.3	25.0	23.8	5.8	12.6	13.8	8.2	2.4	8.5	2.9	5.7	2.6	20.9	1.0	5.2	0

¹ 1 September through August 31.

² Bottom and surface longline, bottom and surface gill net handline drift attraction, etc.

³ Live bait fishing was incidental to pelagic pole and line fishing.

sources of the region. It was divided into three sections with overlapping operational scopes:

1. Exploratory fishing.
2. Marketing study and demonstration.
3. Fishery officers' and fishermen's training.

The Exploratory Fishing Section included definition of resources, experimentation with fishing gear and methods, simulated commercial fishing, and demonstration fishing for fishermen from participating countries. On-the-job training was also

provided on the vessels for fishermen trainees.

Resource exploration was conducted in the waters of the Caribbean Sea, from the edge of the Central American continental shelf east to the arc of the Lesser Antilles (Fig. 1). Territorial and adjacent waters of the Central American countries, Colombia, and Venezuela were not under direct scrutiny of the Caribbean Fishery Development Project as they were within the study area of associated projects. In the Atlantic Ocean adjacent to the Caribbean Sea, some ex-

plorations were made in the waters near Hispaniola, Puerto Rico, and the Lesser Antilles. The continental shelf off northeastern South America between Margarita Island, Venezuela, and the border between French Guiana and Brazil was explored.

Under contract to FAO, the U.S. National Marine Fisheries Service (formerly Bureau of Commercial Fisheries) was responsible for planning, organizing, and supervising the exploratory fishing activities. The Chief of Exploratory Fishing and several specialist fishery consultants were employees of the National Marine Fisheries Service.

EXPLORATORY FISHING OPERATIONS

The MV *Calamar* (Fig. 2) and the MV *Alcyon* are sister ships built for FAO in Japan. They were registered

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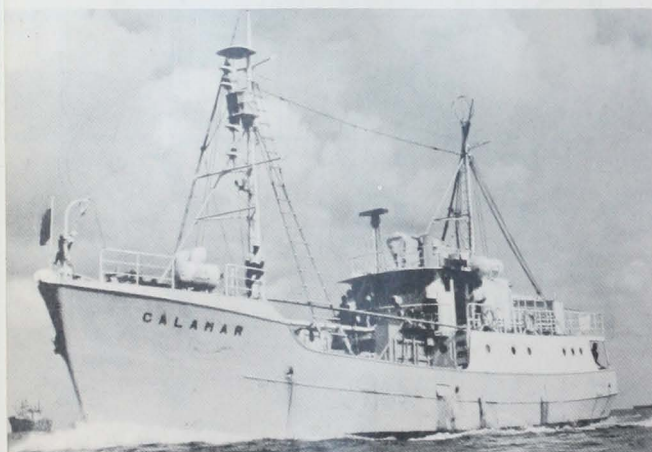


Figure 2.—The MV *Calamar*, one of two 82-ft FAO multi-purpose fishing vessels assigned to the UNDP/FAO Caribbean Fishery Development Project, 1966-71.

EFF) in days of directed fishing are presented for each project vessel and fishing gear.

TOTAL FOOD FISH		LIVE BAIT LIFT NET ³		LOBSTER & OTHER INVERTEBRATES		INDUSTRIAL FISH		OVERALL TOTALS	
CA	EFF	CA	EFF	CA	EFF	CA	EFF ⁴	CA	EFF
29.5	156	6.4	—	—	0	—	—	35.9	156
95.0	204	10.9	—	—	0	—	—	105.9	204
79.7	185	4.4	—	—	0	—	—	84.1	185
53.3	191	0	—	1.3	0	—	—	59.6	191
47.9	96	0	—	0.5	64	—	—	48.4	160
11.4	832	21.7	—	1.8	64	—	—	333.9	896
12.3	137	7.2	—	0.2	0	24.4	—	134.1	137
15.9	198	0	—	0.7	0	47.5	—	204.1	198
15.7	189	5.8	—	0.2	0	62.8	—	228.5	189
17.4	208	5.5	—	0.3	0	19.4	—	155.6	208
12.6	186	0	—	0	0	0	—	52.6	186
11.9	918	18.5	—	1.4	0	154.1	—	774.9	918
1.6	30	1.8	—	0	0	—	—	3.4	30
1.4	160	10.9	—	0	28	—	—	19.3	188
30.4	216	0	—	0	0	—	—	30.4	216
24.5	150	5.5	—	0	0	—	—	30.0	150
5.8	96	0	—	0	0	—	—	5.8	96
10.7	652	18.2	—	0	28	—	—	88.9	680
12.0	2,402	58.4	—	3.2	92	154.1	—	1,197.7	2,494
12.0	96.3	4.9	—	0.3	3.7	12.8	—	100.0	100

⁴ Industrial fish were caught incidentally during demersal trawl fishing.

⁵ Catches are incidental to other directed fishing effort.

in and operated out of Barbados and Kingston, Jamaica, respectively. These are combination vessels, adaptable to longlining, trawling, live bait/pole-and-line fishing, trap fishing, reel fishing, and trolling. Sufficient space was provided for fishermen trainees. Specifications are given below:

Length (overall)	82 ft (24.8 m)
Beam	22 ft (6.65 m)
Draft	11.5 ft (3.5 m)
Power	380 hp
Speed	10 knots

The MV *Fregata* (Fig. 3) was built for FAO in England. Although registered in the Netherlands Antilles, she operated primarily out of Barbados. She also is a combination vessel, adaptable to trawling, gill netting, reel fishing, and trolling, and also has space for trainees. Her specifications are:

Length	56 ft (17 m)
Beam	16 ft (4.9 m)
Draft	8.7 ft (2.7 m)
Power	180 hp
Speed	8.0 knots

The masters of the vessels were internationally recruited FAO personnel. Other than captains, the crew consisted of West Indians recruited from countries participating in the project. Trainees spent periods up to 6 months aboard and performed in general as fishermen crew. In addition,

on each cruise, a scientist "cruise leader" was responsible for exploratory operations and record keeping. Sometimes additional technical personnel were aboard, provided from project staff, counterpart staff (from participating countries), or other interested agencies (University of the West Indies, Bellairs Marine Laboratory, National Marine Fisheries Service, etc.).

Individual cruises ranged from a few days to 2 months, but were normally planned at 17 days for the larger

vessels and 10-14 days for the MV *Fregata*. When possible a port stop was made for fish sales, fishing demonstrations, etc. Hydrographic observations, biological collections, drift bottle releases, and fish tagging for interested individuals and institutions were made as time allowed and priorities permitted.

As the project period was limited, it was necessary to emphasize exploratory activities that offered the greatest possibility for fishery development. Operational priorities were set on the basis of this general guide and were adjusted as results were received and analyzed.

RESULTS OF EXPLORATORY OPERATIONS

The overall results obtained from all project exploratory operations are presented in Table 1. Catch figures are shown by fishing method for food fish catches and by other general classification for additional catches. Ship effort is presented in days spent away from home port on fishing exploration and/or experimentation. In some cases, catches are shown without any corresponding effort. This was due to incidental fishing effort during cruises planned and devoted to another fishing method.

The total project effort of nearly 2,500 days resulted in a total catch of almost 1.2 million pounds of living marine resources. Nearly 1 million pounds of this was prime food fish. Of the food fish total, nearly three-fourths was composed of demersal



Figure 3.—The MV *Fregata*, a 56-ft FAO multi-purpose fishing vessel assigned to the UNDP/FAO Caribbean Fishery Development Project, 1967-71.

species taken by trawl, handline or reel, and pots. Effort for these species was almost one-half of the total. Over one-fifth of the total effort was devoted to live bait/pole-and-line fishing, but yielded only about 3 percent of the total catch.

Pelagic Fish Resource

The initial Caribbean Fishery Mission report (Kasahara and Idyll 1962) noted that the project area included an overwhelmingly large proportion of deep offshore waters. Even though these waters were generally low in productivity, some emphasis was programmed for assessment of pelagic stocks.

Longline Method

The results of fishing by the MV *Alyon* and the MV *Calamar* through the longline method did not offer encouragement for substantial landings of tuna (Kawaguchi 1974b) or related species (Kawaguchi 1974a). Eighty-one tuna longline sets resulted in catches ranging from zero to three fish per set of hundred hooks. The relatively low rate of capture, inexperience of the crew, and the turnover of available trainees did not permit operations much in excess of 100 baskets (of six hooks each) of gear set per day. This figure contrasts with 250-400 baskets of gear set each 24 hours in a normal commercial longline operation.

Considering the recent standstill in commercial tuna longline fishing in the world and the results of their explorations, project personnel concluded that the development of a longline fishery by participating countries would not be profitable. The availability of the resource varies with location and season throughout the year. The annual variation is uncertain, and anticipated yields are not considered adequate for small local operations.

Live Bait/Pole-and-Line Method

In part because of the lack of success in longlining, considerable emphasis was placed on the live bait/pole-and-line method in fishing for pelagic species, principally skipjack tuna (*Katsuwonus pelamis*). This phase involved assessment of the bait fish resource as well as the available tuna resource and

evaluation of the pole-and-line fishing method in the region (Wagner 1974).

Bait fishes were attracted to the vessel with lights and caught primarily by use of the lift or "blanket" net. Catches of live bait averaged 96 buckets (600 pounds; 275 kg) per baiting station (usually one night). Best locations for baiting were Jamaica, Puerto Rico, and Trinidad. The resource has the potential for intensified harvesting for both human consumption and bait.

Pole-and-line fishing produced catches ranging from nil to over 5,000 pounds (approximately 2,250 kg) per boat day, but averaging only about 100 pounds (45 kg) per day. During concentrated efforts to test the effectiveness of the method in the Windward Islands area during 1970, the catch per day averaged only 228 pounds (100 kg) for a 10-hour fishing day.

Even though stocks of tuna and other surface school fishes exist in the Caribbean, the pole-and-line fishing method did not show itself to be sufficiently productive to support a large-scale commercial industry. The availability and species composition of bait fish, their biting and schooling behavior, the seasonal abundance of target species, and the water and weather conditions all combined to keep catch rates below those required for such a venture. The method is capable of providing reasonable catches for a very few boats during seasonal periods of high abundance.

Bait fish appear to hold minor prospects for greater exploitation in the region. The calculated weight of all bait caught exceeded the catch of fish caught by pole and line by two or three times—although less effort was expended.

Trolling

Another fishing method utilized for catching pelagic species was trolling (Wagner and Wolf 1974). This method was used in nearly 7 percent (13 cruises—all vessels) of all project vessel time and nearly all sea time of the MV *Fregata* during the final year. Catch rates were low except on the banks north of Hispaniola and in the northern Leeward Islands. Here during the early months of the year average

catches ranged from 18 to 30 pounds (8-11 kg) per fishing hour for an average of five lines. Deep trolling as practiced in the salmon fishery off the Pacific Coast of North America was also undertaken, but few fish were taken.

Other Fishing Methods

Other methods were experimentally applied to the pelagic resource. Their success was varied, but generally low in terms of production.

Gill netting was attempted under a variety of circumstances (Wolf 1974) with small- and large-mesh nets. Catches were generally poor, except for eight night sets off Trinidad when 38 shackles of 5-inch mesh nylon net caught over 2,000 pounds (900 kg) of Spanish mackerel (*Scomberomorus maculatus*), jacks, and sharks. Flying fish were extremely vulnerable to gill nets; however, this gear is already commonly used at Barbados.

Some experimental fishing effort was expended in attracting and concentrating pelagic species around floating objects (Wolf 1974). Methods of fishing included handlining, trolling, gill netting, and longlining. Catch rates were not high, but the use of artificial structures to concentrate pelagic fish such as flyingfish (Exocoetidae), jacks (Carangidae), wahoo (*Acanthocybium solanderi*), dolphin (*Coryphaena hippurus*), tunas (Scombridae), and sharks was successful.

Demersal Fish Resource

Trawling Method

Extensive trawling operations (Rathjen, Yesaki, and Hsu 1969), including exploration, demonstration fishing, and simulated commercial production fishing, were conducted during 19 cruises by the MV *Calamar* on the continental shelf off the Guianas, around Trinidad, and off eastern Venezuela. An extensive trawl resource consisting mostly of sciaenid fishes (sea trout, *Cynoscion virescens*; croaker, *Micropogon furnieri*; and whiting, *Macrodon ancylodon*) has been shown to exist between 5 and 20 fathoms on the continental shelf off the Guianas.

The overall catch rate was 676 pounds (306 kg) per trawling hour.

Of this catch, 68 percent was marketable fish, 28 percent was incidental or industrial fish, and 4 percent invertebrates. Production was highest off Surinam, averaging 735 pounds (334 kg) per hour. Of this catch, 44 percent was sea trout, 10 percent croaker, and 15 percent fish of other species. The best catch rate here was achieved during the period June through August, when nearly 1,000 pounds per hour were caught. Catch rate is positively correlated with fresh water outflow from the Surinam River. Daytime catch rates averaged 30 percent higher than nighttime with peak catches occurring between 6 a.m. and 9 a.m. The existing resource approximates 350,000 metric tons and a sustainable production of approximately 200,000 metric tons can be expected.

Handline Method

Nearly one-fourth of all project exploratory fishing effort was devoted to line fishing (powered reels) for snappers (Lutjanidae), jacks (Carangidae), and groupers (Serranidae), and fish of other related species throughout the project region. Average catch rates per line per 10-hour day by fishing area were: 350 pounds (160 kg) off the Honduran-Nicaraguan coasts; 150 pounds (70 kg) in the northern Caribbean; 100 pounds (45 kg) around the banks in the northern Leeward Islands; 15 pounds (7 kg) throughout the remainder of the Lesser Antilles and southeastern Caribbean; and 115 pounds (54 kg) on the edge of the continental shelf off the Guianas.

Considered by the results obtained during 5 years of exploratory fishing, the resource of demersal snappers and related species in the Caribbean and adjacent waters can support an increased annual production of 75,000 tons, if fully exploited. Present annual production by local fishermen on local grounds is estimated at 20,000-25,000 tons. Ciguatera fish poisoning will remain a deterrent to expansion of the fishery for snappers, groupers, and jacks in the northern Leeward Islands; an early solution to this problem does not seem likely (Kawaguchi 1974a).

Pot Fishing

Comparative pot (trap) fishing was undertaken for snapper and jack (Wolf

and Chislett 1974) during 17 cruises by the three vessels.

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 fabricated to project design. Various sizes of pots, sizes of mesh, baits, soaking periods, and fishing depths were compared. Overall catch rates for the "Z" pot averaged about 15 pounds (7 kg) per pot lift on the Jamaican Banks, north of Hispaniola, and off Venezuela, Guyana, and Surinam. Catch rates of about 40 pounds (18 kg) per lift were obtained in the northern Leeward Islands and off French Guiana. Catch rates were lowest, about 5-10 pounds (2-4 kg) per lift, in the Windward Islands. The "Z" pots out-fished the "D" at a ratio of about 2:1 and the other pots by a much greater ratio. Larger pots and small mesh sizes yielded a greater catch rate. Atlantic herring (*Clupea harengus harengus*), Spanish mackerel, and West Indian "robin" (scad) baits all produced about the same catch rate. The best overall catch rates were obtained from pots soaked for one day or less. The average size of snappers was greater with a larger sized mesh. A declining catch rate was observed during May, June, and July.

The greatest proportion of the catch from the Jamaica Banks consisted of grunts (Pomadasyidae), trigger fish (Balistidae), squirrel fish (Holocentridae), and porgies (Sparidae), 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.

In all areas with offshore banks or having continental shelves of any magnitude, the catch rates were high enough to evoke commercial interest. The smaller banks off Jamaica would probably not support unlimited effort because of size, but they have potential. On the other hand, Pedro Bank is large enough to provide a good ground for Jamaican fishermen. The eastern end of the Bank receives some effort presently, but it is by small canoes carrying only a few traps, while the southern and western sides of the Bank

are comparatively untouched. Silver and Navidad Banks both offer good trap fishing potential. In the northern Leeward Islands, banks near Saba and Barbuda have excellent potential, and Anguilla Bank has good potential. Gibbs Seamount has limited potential, due to small size. In the Windward Islands, the Grenada shelf has shown some moderate trap fishing potential. The waters off eastern Venezuela, Guyana, and Surinam have good potential, while French Guiana has excellent potential.

As mentioned, ciguatera poisoning is a deterrent to marketing demersal species from the northern Leeward Islands; but the apparently ciguatera-free silk snapper (*Lutjanus vivanus*) has contributed between 70 and 90 percent of the pot catch from 60 to 100 fathoms.

Other Fishing Methods

Bottom longline fishing for snappers and fish of related species produced unsatisfactory results (Kawaguchi 1974a). Sets in deep water (100-200 fathoms) off the end of the Guianan continental shelf produced catches of tilefish (*Lopholatilus chamaeleonticeps*) and grouper (*Epinephelus* sp.) up to 1.0 pound (0.4 kg) per hook off Surinam, but averaging only 0.5 pound (0.2 kg) per hook along the entire shelf edge.

Bottom gill net sets were generally nonproductive except for catches of bait fish in Kingston, Jamaica harbor and a catch of 417 pounds of mixed mackerels (*Scomberomorus* spp.), jacks, and sharks.

Explorations of the spiny lobster resource (Chislett and Yesaki 1974) did not indicate commercial potential on the northern Leeward Islands Banks, on the banks north of Hispaniola, nor on small banks south and southeast of Jamaica. Better results were obtained from the western end of Pedro Bank, located southwest of Jamaica, where catches up to 0.45 lobster per trap lift were observed. Incidental efforts in the Windward Islands and Trinidad were not generally productive.

Shark Resource

Experimental and exploratory fishing for sharks was conducted on the

continental shelf off the Guianas during eight cruises of the MV *Calamar* (Kleijn 1974). Fishing during daylight was done by handlining, a small trawl for catching bait, and at night with one or two sets of steel-cable bottom setline.

Over 4,600 sharks of 25 species, weighing over 165,000 pounds (74,820 kg) were caught. Nearly half were caught during 245 hours of handlining with 1-8 lines and about the same number were caught with 105 sets or 1,212 hours of steel-cable setlines with 100-175 hooks. Sharks were most abundant between 15 and 20 fathoms during November and December and off the mouths of the Iracoube and Coppename Rivers. The more common species were blacktip shark (*Carcharhinus limbatus*), smalltail shark (*C. porosus*), bull shark (*C. leucas*), and tiger shark (*Galeocerdo cuvieri*).

The whole area off the coast of the Guianas will yield an average of 3,000 pounds (1,360 kg) of dressed shark meat (about 60 percent of round weight) per 24 hours of fishing, i.e., 1,000 pounds (458 kg) with two steel-cable sets during the night and 2,000 pounds (907 kg) with handlining during the day alternated with required trawl hauls.

Because the catch rate of shark is initially high, and the stock rather small, overfishing could easily result from any intensive fishing efforts.

CONCLUSIONS

The results of explorations by project vessels, as well as others, coupled with analyses of ongoing fisheries indicate that fishery resources available to participating countries in the project are not vast, but several offer potential for expansion. Foremost is the trawl resource on the continental shelf off northeastern South America. The second most promising latent resource awaiting greater use is that of snappers, jacks, and groupers. The keys to development of these resources by project countries are training of fishermen in trawling, handlining, and reel and pot fishing for snappers, and the operation of fishing vessels of the size and endurance necessary for these offshore operations. Resources of shark and bait fishes, as well as various pelagic

fishes available to live bait fishing and to trolling, are of insufficient magnitude to offer large-scale commercial development, but when and where they are abundant they could be important in increasing the supply of animal protein for local residents. Based on project experience, there appears to be little hope of development of a tuna fishery by the longline or live bait methods by participating countries in the project.

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

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ABSTRACT—*Explorations for snapper and related demersal species have been conducted in the Caribbean and adjacent waters by vessels of the Caribbean Fisheries Development Project. This report presents the results of those explorations which used the handline and bottom set longline methods on the under- or unexploited shelves and banks within the project region.*

Three project vessels spent a total of 382 days conducting exploratory and simulated commercial type production fishing for snappers, groupers, and jacks. They produced about 291,000 pounds of fish which averaged about 760 pounds per fishing day or about 14.6 pounds/line/hour of fishing. The species composition of the overall catch was 51 percent snapper (Lutjanidae), 34 percent jacks (Carangidae), 6 percent groupers (Serranidae), and 9 percent other mixed species. The daily catch rates ranged from 0 to 137 pounds/line/hour. Fishing efficiency and catch rates are discussed.

Catch results as related to fishing ground, water depth, bottom type, fishing season, and species composition are examined. Results of experimental use of the bottom set longline method are given.

From exploratory fishing results it is estimated that annual production of snapper could be increased from two to four times by utilizing under- or unfished grounds.