

of the narrowness of the optimum depth range, as well as an advantageous biological environment. The interior part of the shelf between the edges and 30 to 33 fathoms bottom was mostly devoid of snappers and it has flat and smooth bottom features. There were some outcrops on 30 to 33 fathoms bottom, but the size of the fish schools found there was relatively small.

In October 1969 the northwestern half of this area was fished for a total of 8 fishing days, mostly near the edges at 43 to 60 fathoms. The catch rate averaged 9.8 pounds/line/hour with a range from 0 to 39.4. The catches from the inward shelves were mostly nil. A most productive ground was on 43 fathoms bottom around lat. 6°51'N, long. 53°13'W. In the same month of 1970 a total edge distance of about 200 miles and the 30 to 45 fathoms bottom on the inward shelf, about 240 miles long total, were covered in 14 fishing days. On the northwestern half of the shelf, the catch rate was 6.3 pounds/line/hour for the deeper bottoms near the edges (from 10.8 actual fishing hours out of 27.1 total hours on the grounds) and zero for the shallower bottoms on the inward shelf (from 1.3 actual fishing hours out of 23.5 total hours on the grounds). In the southeastern half the catch rates were nearly three times better at 18.5 pounds/line/hour on or near the edges (53.8 fishing hours out of 144.4 total hours) and 5.3 pounds/line/hour on the inward shelf.

The catch comprised 66 to 92 percent snappers, 7 to 26 percent groupers, and 1 to 8 percent jacks. A few tilefish and triggerfish were also present. Only three varieties of snapper were caught in this area. Caribbean red snapper was most dominant throughout followed by vermilion snapper. Lane snapper was captured only from shallower bottoms of 29 to 35 fathoms. Yellowedge, Warsaw, snowy, and yellowmouth groupers were common on the shelf edges, but on the shallower bottoms on the inward shelf only snowy, yellowedge, and red groupers were common. Jacks were rare in daytime fishing, only a few amberjacks and green jacks being caught. From one night's fishing 27 horse-eye jacks (427 pounds) were captured from 2 hours

fishing on rugged 55 fathom bottom near the shelf edge, but from only one location (lat. 5°53'N, long. 51°34'W). Table A-17 gives further details of the catch rate by fishing ground.

The currents were generally strong to the northwest throughout this area.

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MFR PAPER 1084

Results of Live Bait and Pole and Line Fishing Explorations for Pelagic Fishes in the Caribbean

DONALD P. WAGNER

ABSTRACT—This paper presents results of exploratory fishing in the Caribbean for live bait and for tuna, using the pole and line method, 1967-1970. Seasonal fluctuations in abundance of both bait and tuna stocks were evident. Bait fishes were caught throughout the Caribbean but were most abundant off the Windward Islands, Trinidad, and Tobago. Catches of bait ranged up to 700 pounds per station and were primarily Atlantic thread herring, *Opisthonema oglinum*; dwarf herring, *Jenkinsia lamprotaenia*; pilchards, *Harengula sp.*; and sardines, *Sardinella sp.* Tuna catches were as high as 73 pounds per hour and were mostly skipjack, *Katsuwonus pelamis*. During 1970, an intensive survey near the Windward Islands produced catches averaging 24 pounds per hour.

INTRODUCTION

From March 1967 through June 1970, the United Nations Development Program/Food and Agriculture Organization Caribbean Fishery Development Project (CFDP) made live-bait surveys and pole and line fishing explorations as part of investigations of available fishery resources in the Caribbean Sea and surrounding waters. The following objectives were set:

1. Develop information on the availability of live bait suitable for pole and line fishing.
2. Define the geographical and seasonal distribution of surface schooling fishes, principally tunas.
3. Conduct experimental tuna fishing by the pole and line method.

Exploratory fishing operations in 1967, 1968, and 1969 extended from the coast of British Honduras to Jamaica, Hispaniola, and Puerto Rico, thence south along the Antillean Arc

to Trinidad and west along the north coast of South America to about long. 75°W. The area surrounding the Windward Islands received the most extensive coverage in these 3 years due to encouraging reports from the U.S. Bureau of Commercial Fisheries research vessels *Geronimo* and *Undaunted*¹ and earlier results obtained by the CFDP that indicated a relatively greater abundance of tuna schools in this area. From January through June 1970, more concentrated surveys were made in the area west of the Windward Islands bounded by the St. Lucia Channel to the north and the southern tip of Grenada to the south.

The vessels used were the *Calamar*, *Alcyon*, and *Fregata*. They were designed as combination, multipurpose

¹ RV *Undaunted* Cruise Reports 66-2, 66-5, 67-1, and RV *Geronimo* Cruise Report 66-7 are available from the Southeast Fisheries Center, National Marine Fisheries Service, NOAA, 75 Virginia Beach Drive, Miami, FL 33149.

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exploratory fishing/training vessels but differed significantly in size, configuration, and adaptability to different types of fishing. None of the vessels were ideally suited to live-bait/pole and line fishing.

LIVE-BAIT SURVEYS

Between March 1967 and June 1970, 263 baiting stations were made at 92 locations. Approximately 6,118 buckets of bait² were caught by lift net, lampara, and beach seine (see Appendix Table I). Fifty percent of the stations were in the Windward Islands because they were closest to the best potential pole and line fishing areas. The yield of bait per station was highest in Trinidad, particularly Chaguaramas Bay (95.9 buckets) and Chupara Bay (61.9 buckets). High yields were also obtained in and around St. George's, Grenada, and Lime Cay, Jamaica.

In January 1970, a bait survey was made in the Windward Islands to further investigate bait resources between St. Lucia Channel and Grenada. This investigation was designed to find locations other than Grenada and Trinidad as possible points to replenish bait supplies during the scheduled concentrated pole and line fishing efforts of 1970. Of several locations explored during this period, Cumberland Bay, St. Vincent was the only new location that appeared to hold promise of a fairly continuous bait supply.

Three methods of live bait capture were used: beach seine, lampara or bag net, and the lift or blanket net (Radovich and Gibbs 1954). The lift net was the most effective method of catching bait fishes and was used on more than 90 percent of the live-bait stations occupied throughout the 4 years of investigations and exclusively in 1970.

The lift net was 16.5 m long and 12.8 m wide. The netting was made of

² One bucket of bait represents approximately 5 to 7 pounds of fish.

Table 1.—Bait species and catch by location.

	Species ¹						
	AN	DH	PL	RS	SA	SI	TH
Number of buckets							
Northern Caribbean							
Jamaica	108.0	238.0	16.5	0	0	53.0	98.0
Dominican Republic	30.0	132.0	28.0	0	0	0	6.0
Puerto Rico	75.0	0.5	0	0	0	0	296.0
Honduras	0	0	0	0	0	0	0
Total	213.0	370.5	44.5	0	0	53.0	400.0
Northeastern Caribbean							
St. Martin	0	0	0	0	0	2.0	0
St. Barthélemy	0	0	0	0	0	0	0
Barbuda	0	0	16.0	0	0	0	0
Guadeloupe	0	0	0	0	0	1.0	0
Dominica	14.0	0	9.0	0	0	0	0
Total	14.0	0	25.0	0	0	3.0	0
Southeastern Caribbean							
Martinique	33.5	0	0	9.0	18.0	9.0	0
St. Lucia	15.0	0	15.0	0	59.0	25.5	29.5
St. Vincent	0	5.5	8.0	16.5	5.5	1.5	239.5
Grenada	49.0	799.0	916.0	35.0	0	0	0
Barbados	0	0	0	0	0	27.5	6.0
Grenadines (north sector)	0	0	2.5	112.5	0	2.5	112.5
Carriacou (south sector)	17.0	0	0	17.0	17.0	0	17.0
Petit Nevis	0	0	0	0	0	6.0	0
Union Island	0	0	11.5	0	0	0	0
Total	114.5	804.5	953.0	190.0	99.5	72.0	404.5
Southern Caribbean							
Tobago	0	0	3.0	89.0	0	0	0
Trinidad	0	0	583.0	0	774.0	0	0
Venezuela	0	0	0	0	87.0	0	0
Total	0	0	586.0	89.0	861.0	0	0

¹ AN = anchovy (*Engraulidae*)
 DH = dwarf herring (*Jenkinsia*)
 PL = pilchards (*Harengula*)
 RS = round scad (*Decapterus*)

SA = sardine (*Sardinella*)
 SI = silversides (*Atherinidae*)
 TH = thread herring (*Opisthonema*)

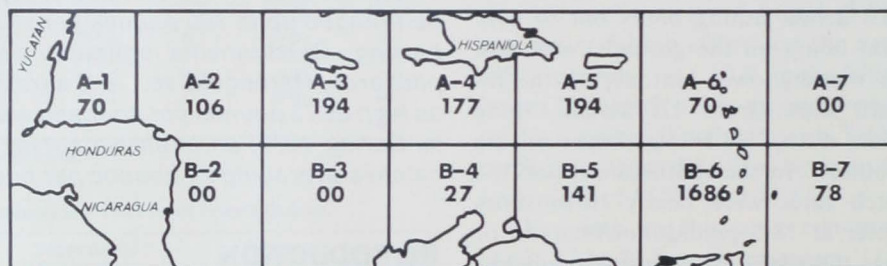


Figure 1.—Number of hours expended in exploratory fishing by 5° latitude and longitude from March 1967 through June 1970.

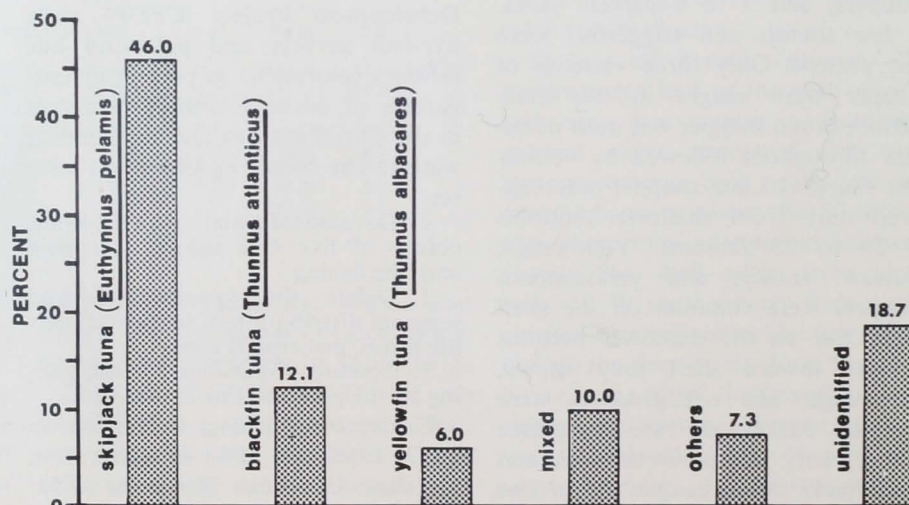


Figure 2.—Frequency of fish school sightings by species.

Table 2.—Summary of effort, pelagic fish schools sighted, and the rate of sightings expressed in sightings per hour for 1967, 1968, 1969, and 1970.

Month	Gulf of Honduras (Area A1)		Eastern Honduras (Area A2)		Jamaica (Area A3)		Western Hispaniola (Area A4)		Puerto Rico (Area A5)		Leeward Islands (Area A6)		Venezuela-Columbia coast (Area B4)		Netherlands Antilles (Area B5)		Windward Islands (Area B6)		Barbados (Area B7)	
	HE ¹	SS ² S/H ³	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H	HE	SS S/H
Jan.																				
Feb.																				
Mar.																				
Apr.																				
May																				
June																				
July																				
Aug.																				
Sept.																				
Oct.																				
Nov.																				
Dec.																				
Total	70	00 0.00	62	11 .18	194	3 0.02	177	19 0.11	194	44 0.23	70	6 0.09	27	3 0.11	141	16 0.11	1,686	358	78	7 0.09

¹HE = Hours of effort. ²SS = Schools sighted. ³S/H = Sightings per hour.

Table 3.—Monthly results of pole and line fishing in 1970.

	Schools sighted	Schools fished	Total hours of effort	Total pounds caught	Catch rate
FEB.	4	0	180	0	0.0
MAR.	58	22	225	4,926	21.9
APR.	49	29	216	7,752	35.9
MAY	23	9	81	5,907	72.9
JUNE	10	0	63	0	0.0

synthetic fiber with 1.25 - cm stretched mesh in its center and outboard sections and 7.5 - cm mesh in the inboard section. The inboard section of the net was fastened to the boat rail and the outboard corners were suspended from two outrigger poles, 9.1 m long, that extended horizontally at right angles to the rail of the vessel. The net was operated as described by Radovich and Gibbs (1954).

The abundance of different bait species varied throughout the Caribbean. I divided the Caribbean into four regions:

1. Northern Caribbean — Jamaica, Dominican Republic, Puerto Rico, and Honduras.
2. Northeastern Caribbean — St. Martin, St. Barthélemy, Barbuda, Guadeloupe, and Dominica.
3. Southeastern Caribbean — Martinique, St. Lucia, St. Vincent, Grenada, Barbados, and the Grenadines.
4. Southern Caribbean — Trinidad, Tobago, and Venezuela.

In the northern Caribbean, thread herring and dwarf herring were the most abundant species. In the northeastern Caribbean, where relatively little live bait exploration took place, pilchards were most numerous, and in the southern Caribbean, sardines and pilchards were most abundant (Table 1).

FISHING SURVEYS

Twenty-eight exploratory pole and line fishing cruises, for 482 sea days, were conducted in the project region between March 1967 and June 1970. Figure 1 shows the distribution of fishing effort in the Caribbean. During daylight hours, each area was randomly searched and a watch maintained for bird flocks and fish schools. Upon sighting fish schools, attempts were made to conduct pole and line fishing. Records were maintained of time and date of sightings and whether fishing was attempted. Throughout the cruises, track charts were maintained, indicating the location of fish schools. Sightings were recorded as follows:

1. Tentative identification of species.
2. Approximate fish size.
3. Fish school association (birds, porpoises, whales, etc.).
4. Behavior of the school (jumping, breezing, etc.).
5. Estimated school size.

Fishing data were recorded similarly:

1. Time fishing started.
2. Number and species of fish caught.
3. Amount of bait used.
4. Time fishing stopped.

During 1967, 1968, and 1969, emphasis was placed on defining geographical and seasonal distribution of tunas and related surface schooling fishes. In 1970, priority was given to experimental and production fishing and was confined to the area that appeared to hold the most promise of producing the highest catches for the least amount of effort.

No set amount of effort was assigned to each school. As much as 2 hours were spent in chasing and baiting a particular school, while on other occasions very little bait was thrown and the school was abandoned early in the fishing attempt.

RESULTS

Seven species of surface schooling fishes were observed during the survey. The three most abundant species were: skipjack tuna, *Katsuwonus pelamis*; blackfin tuna, *Thunnus atlanticus*; and yellowfin tuna, *Thunnus albacares*. Dolphin, *Coryphaena hippurus*; rainbow runner, *Elagatis bipinnulata*; frigate mackerel, *Auxis* sp.; and little tunny, *Euthynnus alletteratus*, were also observed but in lesser quantities. Figure 2 is a breakdown of the frequency at which different species were observed; the three major species are classified separately and under "mixed," and the four remaining species are grouped under "others." Throughout the investigation, skipjack tuna have been the most frequently encountered species of tuna.

Even though most of the Caribbean was surveyed, except areas B2 and B3 (Figure 1), most of the effort was centered in the Jamaica to Puerto Rico area (A3, A4, and A5) and the Windward Islands (B6). These two areas were closest to our bases of operations, Jamaica to the west and Barbados to the east. Operating range, therefore, dictated this bias to some extent. Table 2 summarizes the effort, sightings, and sighting rate for the 4 years.

An analysis of the monthly variation in catch was performed only for 1970, due to the greater number of fish caught in that year. Table 3 shows the variation in catch rate from February through June 1970. February was unproductive, but there was a large increase in school sightings in March then gradually declining through June. The number of hours of effort expended in March and April are comparable, yet the catch rate increased from 21.9 pounds/hour in March to 35.9 pounds/hour in April. In May the catch rate doubled to 72.9 pounds/hour. Response to live bait appeared to be better as the season progressed. School sightings decreased sharply in June, and no fish were caught.

Most of the tuna schools encountered were small (estimated from 1/2 to 5 tons). In many instances more than one school could be seen at the same time in a given area. Seldom did these schools have the same biting characteristics. One school might not respond to chumming at all or remain far back in the wake of the vessel, while another school a mile away would respond very well to chumming and start biting almost immediately. No significant differences were observed in the size or species composition of these schools. Response to chumming did, however, seem to be better with the larger schools.

In 1970, observations were made on the feeding response of tuna schools to various species of bait. Anchovy and dwarf herring were the most desirable bait for attracting and holding tuna schools within catching range of the vessel. Pilchards, although available in fairly large quantities, were not as desirable. Pilchards tended to disperse, whereas anchovies and dwarf herring remained with the vessel for a longer period. In addition, pilchards

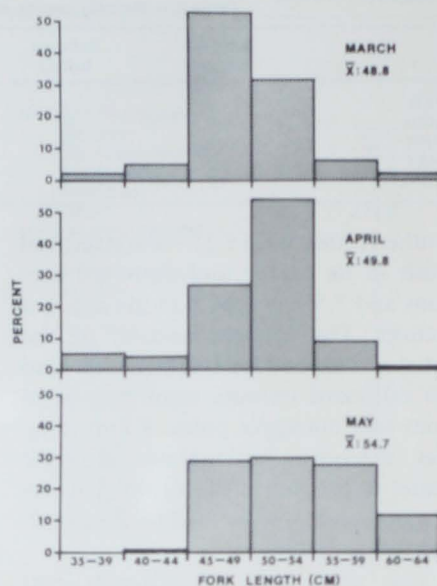


Figure 3.—Length frequencies of skipjack tuna captured during March, April, and May 1970.

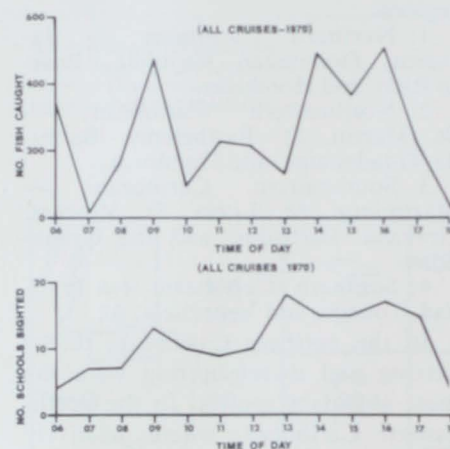


Figure 4.—Fishing success and school sightings by time of day, 1970.

were usually larger (8-10 cm) than anchovies or dwarf herring (4-6 cm), which would limit the amount of bait that could be carried.

Length frequencies of skipjack tuna caught during March, April, and May 1970 indicated that size gradually increased as the fishing season progressed (Figure 3). The average size increased from 48.8 cm fork length in March to 54.7 cm in May. The larger fish also seemed to respond to chumming much better than the smaller fish.

School sightings and fishing success by time of day showed similar trends (Figure 4). A morning peak around 0900 hours was followed by a low period of productivity from 1000 to

1200 hours. In the afternoon, school sightings and fishing success increased markedly until 1600 hours when a decline began.

LITERATURE CITED

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Appendix I.—Bait stations.

	Station	Buckets	Dominant species ¹
Honduras	<i>Lift Net</i>		
	Bonacca Island	1	0 —
	Puerto Cortés	1	11.0 ?
Jamaica	Bull Bay	1	23.5 TH
	Discovery Bay	1	41.0 DH
	Gun Cay	1	16.5 PL
	E. Kingston Harbor	1	3.0 TH
	Lime Cay	13	441.5 RS, SI, TH
	Long Bay	1	0 —
	Morant Cays	1	0 —
	Negril Bay	1	0 —
	Pigeon Island	1	72.0 TH
	Port Morant	2	4.0 AN
	Port Antonio	3	27.5 AN, DH
	Port Royal	4	68.5 AN
	Port Royal Cays	1	0 —
	Southwest Pedro Cays	1	0 —
Dominican Republic	Bahía de las Calderas	1	22.0 PL
	Samana Bay	6	132.5 DH
Puerto Rico	Aguadilla Bay	1	1.0 TH
	Bahía de Añasco	1	5.0 TH
	Bahía de Boquerón	1	100.0 TH
	Cabo Rojo	1	1.5 DA, TH
	Matei Island	1	28.5 TH
	Mayaquez Harbor	6	149.0 AN, TH
	Puerto Quijano	1	33.0 TH
	Quaniulla	1	23.5 TH
St. Vincent	Kingstown Harbor	3	22.0 DH, RS, SA, PL
	Chateaubelair Bay	1	11.0 RS
	Cumberland Bay	16	239.5 TH
	Bucament Bay	1	1.5 SI
	Layou Bay	2	5.0 PL, DH
Grenadines	Bequia Island	13	225.5 RS, TH
	Canouan Island	2	10.0 PL, SI
	Union Island	2	11.5 PL
	Petit Nevis Island	1	6.0 SI
Carriacou	Hillsborough	2	34.0 RS
	Tyrell Bay	4	50.5 AN, SA, TH
Grenada	Grand Anse Bay	1	10.0 RS
	Black Bay	3	28.0 PL, DH
	Grand Mal Bay	1	11.0 Mixed
	Halifax Bay	2	16.0 Mixed
	Beau Sejour Bay	10	234.0 PL
	St. George's Harbor	46	1,472.5 DH, PL
	Outside St. George's	2	146.0 PL, DH, AN
	St. Eloi Point	2	25.0 RS
Barbados	Carlisle Bay	2	4.0 SI
	Deepwater Harbor	1	6.0 TH
	Freshwater Bay	1	2.5 SI
	Sandy Lane	2	19.0 SI
St. Martin	Baie Grand Case	1	2.0 SI
	Marigot Baie	1	0 —
St. Barthélemy	Grand Saline Baie	1	0 —
Barbuda	Palmetto Point	1	16.0 PL
Guadeloupe	La Grande Baie	1	1.0 SI
Dominica	Prince Rupert Bay	2	18.0 AN, PL
	Layou River	1	5.5 AN

Station	Buckets	Dominant species	Station	Buckets	Dominant Species	Station	Buckets	Dominant Species
Martinique			Trinidad					
Fort-de-France	6	33.5 AN	Chaguaramas Bay	11	1,055.0 SA, TH	Port Antonio	1	4.0 SI
Grande Anses d'Arlet	4	35.0 SA, SI, RS	Chupara Bay	4	247.0 SA	Port Royal	1	10.0 AN
St.-Pierre	2	13.0 RS	Port of Spain Harbor	3	50.0 PL	Port Royal Cays	3	102.0 DH, SI
St. Lucia			Las Cuevas Bay	1	6.0 PL	Port Royal Mangrove	1	45.0 AN
Anse Choiseul	2	30.0 PL, TH				Dominican Republic		
Caraiibe Point	1	5.0 SA	Jamaica			Bahia de Semana	2	30.5 AN
Castries Harbor	2	0.5 AN	East Kingston	2	52.0 AN	Venezuela		
Gros Islet Bay	1	0.5 Mixed	Lime Cay	1	15.0 SI	Islas Los Roques	1	87.0 SI
Marigot Bay	3	14.5 AN	Port Royal	1	0	Curaçao		
Petit Trou	1	0	Dominican Republic			Plaza Abao	2	5.0 RS
Roseau Bay	3	88.5 SA, TH	Bahía de Ocoa	2	125.0 PL, TH	Portanare Bay	1	3.5 SI
Soufriere Bay	1	25.5 SI	Boca del Yuma	1	0			
Vieux Fort	5	13.5 TH	Saona Island	1	0			
Tobago			Jamaica					
Great Courland Bay	1	1.0	Lime Cay	1	12.0 DH			
Man-of-War Bay	4	89.0 RS	Long Bay	1	8.0 AN			
Rockly Bay	1	3.0 PL	Negril Harbor	2	2.0 AN			
			Pigeon Island	1	70.0 DH			

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MFR PAPER 1085

Results of Troll Fishing Explorations in the Caribbean

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ABSTRACT—Exploratory and experimental troll fishing or "towing" was accomplished by all three project vessels, Alcyon, Calamar, and Fregata, during the project period. During most of Phase I (1966-1969) this effort was incidental. In May of 1969 and subsequently, specific cruises were either wholly or partially devoted to trolling.

Trolling explorations took place in the waters around Jamaica, around the banks north of Hispaniola, throughout the Lesser Antilles, and along the South American continental shelf down to lat. 8° 30' N. Experimental work included studies of lure preference; fishing depth; and line material, length, number, arrangement, and position. Vessel trolling speeds and the catch by time of day were investigated. Incidental trolling accomplished during Project Phase II is noted.

Summaries of catch rate data show a seasonal availability of troll-caught pelagic fish in the eastern Caribbean which begins very early in the year, rises to a peak during May, then falls off abruptly until the end of the year. This tendency is most pronounced on the banks in the northern Leeward Islands. The total weight of fish caught during cruises where trolling was a major portion of the effort was just over 28,000 pounds. Blackfin tuna (*Thunnus atlanticus*) made up 37 percent of the total, great barracuda (*Sphyraena barracuda*) 16 percent, and little tunny (*Euthynnus alleteratus*) 13 percent. All tunas as a group (blackfin, little, yellowfin, and skipjack) made up over 60 percent of the catch by weight. Trolling has displayed only slight success in harvesting the pelagic resources in the Caribbean.

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Trolling or "towing" as it is generally called in the West Indies involves a moving vessel dragging one or more lines behind it; some form of hook and lure combination is attached to these lines. The motion of the lure causes the fish to strike it and become hooked. The line is then retrieved, the fish removed, and the line trailed out again. The method has been in use for a long period and is today practiced in the project region mostly by fishermen on islands possessing narrow shelf edges. These trolling efforts are conducted almost entirely by very small boats towing only two to four lines.

Prior to the project's efforts, only a small amount of offshore trolling using larger vessels had been conducted. Whiteleather and Brown (1945) trolled six lines from a 77 foot LOA (length overall) modified U.S. west coast purse seiner in the vicinity of Trinidad and Tobago and obtained good results—up to nearly 200 pounds/hour off Tobago. Off Jamaica, Oswald (1963) reported catches of up to 200 pounds