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EXPLORATORY FISHING OFF THE COAST OF NORTH CAROLINA, SEPTEMBER 1959-JULY 1960

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ABSTRACT

Exploratory fishing with the U. S. Bureau of Commercial Fisheries chartered trawler Silver Bay was conducted at 435 stations along the continental shelf and slope off North Carolina during 5 cruises in 1959-60. Fishing gear used consisted of clam and scallop dredges, roller-rigged fish trawls, industrial-fish trawls, and shrimp trawls. The region investigated was found to be generally suitable for bottom trawling, with sand, sand and shell, and sand and mud bottoms predominating. Commercial concentrations of hard clams (Mercenaria sp.) were found near Bogue Inlet, and calico scallops (Pecten gibbus) in commercial concentration were found off Core Banks. Despite widespread exploratory coverage of the region with trawls, no large concentrations of commercial shrimp were found outside existing fishing grounds, nor were large catches of bottom fish made with any consistency. The presence within the region of commercially-important concentrations of pelagic fish (anchovies and herring-like species) was indicated by the occurrence of these fish in some of the bottom-trawl catches.

INTRODUCTION

In 1959, the U. S. Bureau of Commercial Fisheries established the South Atlantic Exploratory Fishing and Gear Research Station in Brunswick, Ga., with the primary objective of determining the fishery potential of the continental shelf and slope from Cape Hatteras, N. C., to Cape Canaveral, Fla. The 96.4-foot North Atlantic trawler Silver Bay, which had previously served the Bureau in the Gulf of Mexico (Captiva and Rivers 1960) and off the east coast of Florida (Bullis and Rathjen 1959), was rechartered for use by the Brunswick station.

Investigations in the region prior to 1959 had taken place largely in winter or spring and had been conducted almost entirely with either New England fish trawls (Powell 1950) or shrimp trawls. Results had not been encouraging. A brief resume of the explorations that took place in the region between 1940 and 1958, and of their results, is given by Bullis and Rathjen (1959). More extensive exploratory work, utilizing a wider variety of gear and extending coverage throughout the year, was needed to obtain practical data on the distribution and availability of the resources in the region for use by commercial fishermen.

During the first year of operations, therefore, the Silver Bay was used in a general survey of the resources of the entire region with several types of trawling and dredging gear. Cruises were made off North and South Carolina, Georgia, and Florida between 5 and 100 fathoms. Five of these cruises, conducted off the coast of North Carolina, provide the basis for this report.

REGION COVERED

The region investigated (fig. 1) lies on the continental shelf adjacent to the North Carolina coast from Cape Hatteras south. The coastline forming the shoreward edge of the re-

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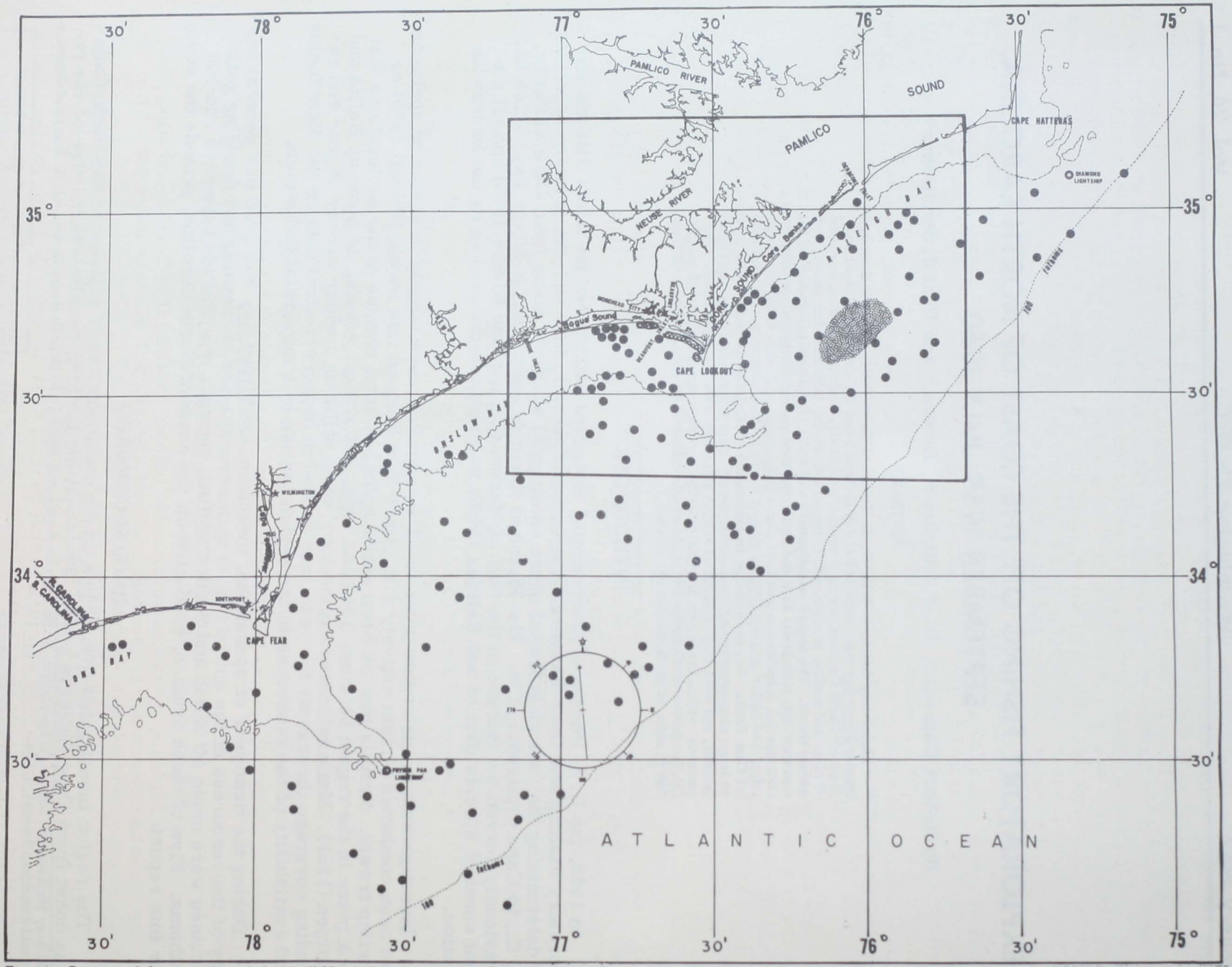

Fig. 1 - Portion of the continental shelf off North Carolina explored by the Silver Bay, 1959-60. Area within black lines enlarged in figure 2. Black dots signify trawl drags; stippled area, scallop bed; open circles, clam bed.

gion extends in a southwesterly direction from Cape Hatteras and is divided into two large bays, Raleigh and Onslow, by projections formed by Capes Hatteras, Lookout, and Fear. Each of the projections is accompanied by an extensive shoal--Hatteras by Diamond Shoals, Lookout by Lookout Shoals, and Fear by Frying Pan Shoals. Between the bays and the mainland proper lie the outer banks and an extensive series of sounds, the larger of which are Pamlico, Core, and Bogue. Oregon Inlet allows vessels to enter Pamlico Sound and its fishing ports; Beaufort Inlet provides a pass through the banks to the deep-water ports of Beaufort and Morehead City; and the Cape Fear River, emptying at Cape Fear, provides entrance to Southport and Wilmington. A small portion of a third large bay--Long Bay--is included in the region covered between Cape Fear and Little River Inlet.

The seaward edge of the region is formed by the 100-fathom curve which lies about 26 miles due east of the Cape Hatteras Light on the north end (at 35°15' N., 75°00' W.), and extends from there in a somewhat more southerly direction than the mainland so that, at the southern end of the region, it is nearly 80 miles offshore on a line projected from the North Carolina-South Carolina boundary (at 33°03' N., 77°35' W.). The region thus encloses more than 8,000 square miles of potential fishing grounds varying in bottom type, but predominantly sand, sand and shell, or sand and mud. Gravel and coral bottoms are encountered occasionally, but with care and proper choice of gear, gear damage can be held to a minimum.

The region constitutes a transition zone between the colder water regions to the north and the tropic-subtropic regions to the south and contains animal groups common to both. It should, therefore, be expected to contain more species, though not necessarily more individuals, than the adjoining regions to either side, a factor that influenced the choice of a wide range of gear for the investigations.

EXPLORATORY GEAR AND PROCEDURES

Because primary emphasis was on obtaining maximum year-round coverage of the entire region, fishing operations were carried out from the Silver Bay round the clock, in all weather conditions encountered, and on all bottom types.

Gear used consisted of (a) 14-tooth Fall River clam dredges, described by Tiller, Glude, and Stringer (1952); (b) 8-foot modified Georges Bank scallop dredges similar to those described by Posgay (1957); (c) roller-rigged fish trawls described by Knake (1956) and Captiva and Rivers (1960) and constructed of nylon; (d) 2-seam industrial-fish trawls described by Bullis, Captiva, and Knake (1960) and constructed of both nylon and cotton; and (e) shrimp trawls similar to those described by Bullis (1951). The bags of the clam and scallop dredges were constructed with 2-inch rings. Nylon liners of $1\frac{1}{2}$-inch-mesh webbing were generally used in the scallop dredges.

Some modification of the 14-tooth clam dredges was necessary (Captiva 1960) because the Silver Bay could not be slowed to the dragging speed found to be optimal for operation of that gear in its original condition.

Where preliminary explorations indicated commercial concentration of a resource, additional drags were made for confirmation and, where warranted, simulated commercial dragging operations were carried out as time was available.

RESULTS OF EXPLORATORY FISHING

Most of the region surveyed is suitable for bottom trawling if rollers and chafing gear are used judiciously and depth-recorder tracings are watched. Gear damage during the explorations was minor. In all, 435 stations were fished.[1/]

HARD CLAMS: Hard clams (Mercenaria sp.) were found in greatest abundance between Cape Lookout and a point about 4 miles west of Beaufort Inlet in depths of $3\frac{1}{2}$ to $7\frac{1}{2}$ fathoms (fig. 2). Following initial explorations in that general area, a series of 12 drags was made

1/Including 10 night-light dip-net stations not considered further.

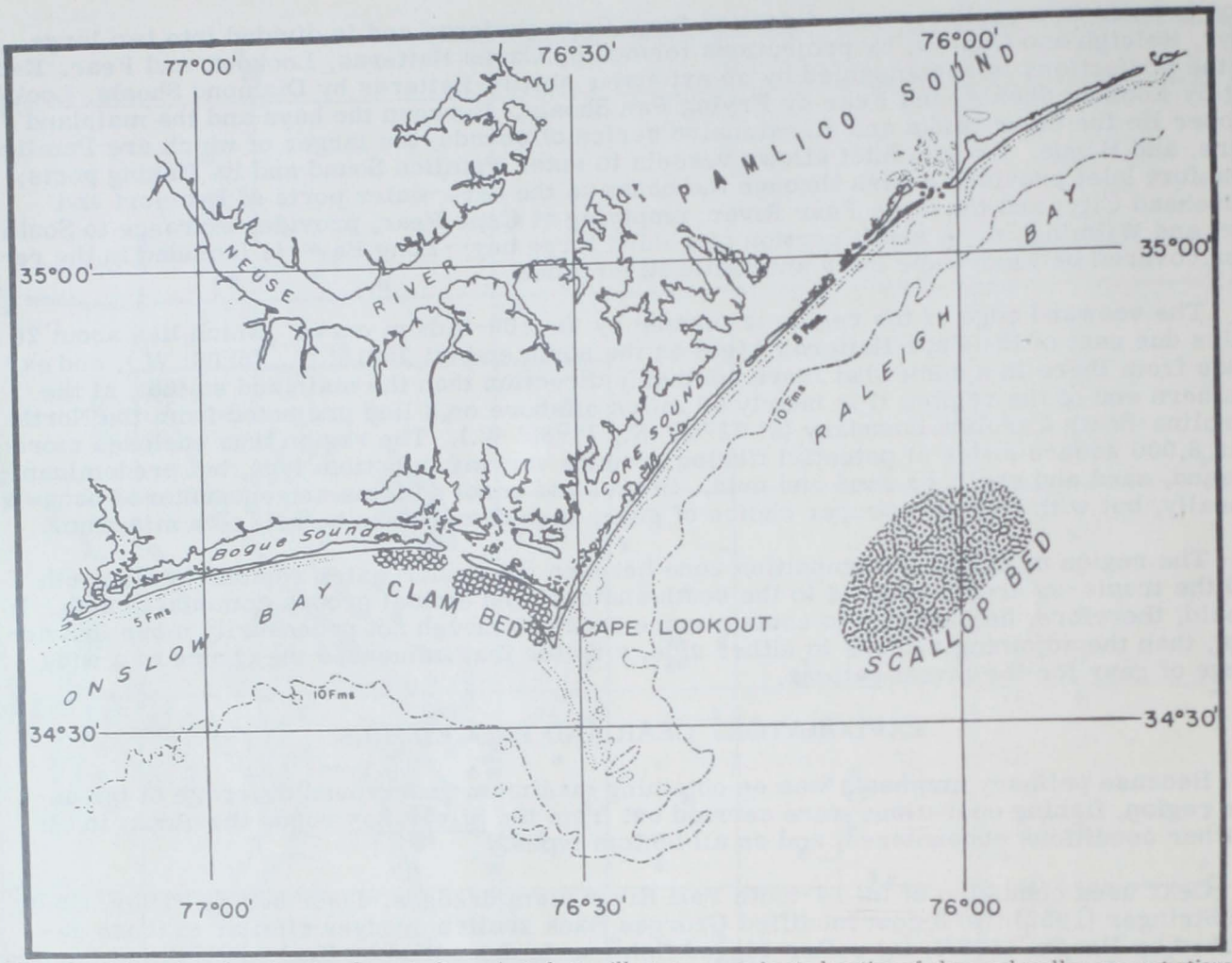

Fig. 2 - Enlarged section of region shown in figure 1, to better illustrate approximate location of clam and scallop concentrations outlined by work of the Silver Bay.

off Beaufort Inlet (at or near 34°39.7' N., 76°38.3' W.) in November 1959, to stimulate commercial operations. Results are shown in table 1. An over-all catch rate of 7½ bushels of live clams per hour fished was obtained, with a maximum catch rate of 13 bushels per hour. The catches consisted primarily of chowder-size clams, 3 to 5 inches in length, averaging 1 gallon of meats per 90-pound bushel of stock. This yield is lower than those cited for ocean quahogs (Arcisz and Sandholzer 1947) and for hard clams in other areas--probably because of the extremely thick shells possessed by the North Carolina clams. A catch ratio of 1 live clam to 1 dead clam (2 half-shells) was obtained in the area. Some evidence of seasonal fluctuation in quantity of clams available is indicated by results of follow-up work done in the same area in February and March 1960, when the maximum catch rate was only 5 bushels of live clams per hour, but more extensive dragging must be done before the apparent trend can be proved or disproved. The Cape Lookout-Beaufort Inlet

Table 1 - Results of Simulated Commercial Fishing for Hard Clams with a Single Dredge Near Beaufort Inlet, N. C., November 29, 1960

Station Number	Minutes Fished	Depth (Fathoms)	Catch	
				Whole Clams
			Lbs. 1/	Bushels (90 Lbs.)
1434	35	6	700	2½
1435	35	5-4½	700	2½
1436	34	6	900	4
1437	33	6-5½	850	3½
1438	34	5½-5	875	3
1439	30	5-3½	40	(18 individuals)
1440	27	3½-5	725	3
1441	30	5-6	1,000	4
1442	30	6-4½	1,200	5½
1443	30	5	1,100	6
1444	30	5	1,200	6
1445	40	5	1,200	6½
Totals	388	-	10,490	46½

1/Estimated weight. Includes dead shell.

Fig. 3 - A 14-tooth Fall River clam dredge coming aboard the Silver Bay with approximately 4 bushels of hard clams.

clam grounds are near shore and adjacent to a fishing port containing vessels that could be easily converted to clam dredging. In addition, an established clam-processing plant is available near the grounds.

Fig. 4 - A 14-tooth Fall River clam dredge coming aboard the Silver Bay with approximately 6 bushels of hard clams.

Small numbers of clams (up to 24 individuals per drag) were taken near Bogue Inlet and near the mouth of the Cape Fear River, and numerous dead shell but no live clams were taken in the vicinity of Drum Inlet. In all 125 stations were fished with Fall River dredges in 49 hours of actual fishing time[2/]. Mud was by far the most productive bottom type dredged for clams. Accounts of established fisheries for hard clams include those by Arcisz and Sandholzer (1947) and Tiller, Glude, and Stringer (1952).

Fig. 5 - Unloading a catch of 45 bushels of hard clams after 6 hours fishing with a single dredge in the Beaufort Inlet area. Bed was discovered by the Silver Bay in November 1959.

CALICO SCALLOPS: The largest concentration of commercial-size calico scallops (Pecten gibbus) fished in the course of the explorations was found southeast of Core

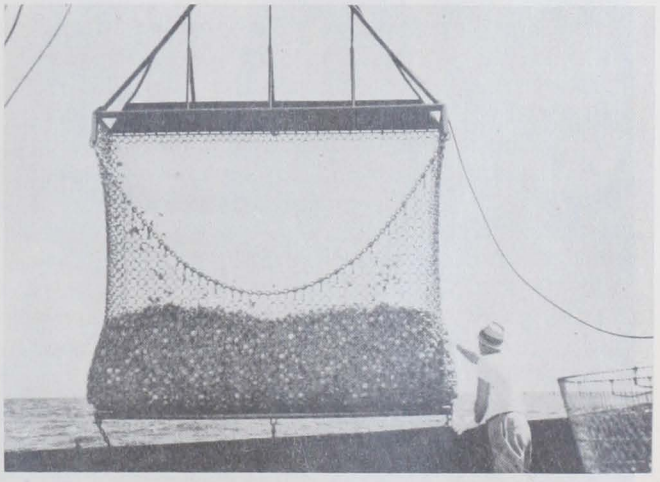

Fig. 6 - A 10-foot Georges Bank-type scallop dredge coming aboard the Silver Bay with approximately 40 bushels of calico scallops.

2/"Actual fishing time" is defined as the time the gear is actually on the bottom and in fishing position--"from dog-off to haul back."

Banks (fig. 2). This concentration, centered at 34°32' N., 76°00' W., about 10 miles in length, and lying in the 17- to 20-fathom interval, was first noticed in September 1959, during exploratory shrimp trawling operations. Follow-up work with dredges in December resulted in maximum catches of only 3 bushels per 30-minute drag, but in February catch rates rose to a maximum of 16 bushels per 30-minute drag and in July to 19 bushels (table 2). The scallops taken were mostly large--from $2\frac{1}{2}$ to 3 inches in shell diameter--but in contrast with large scallops on the Cape Canaveral bed (Bullis and Cummins 1961), the meats of the large Core Banks scallops were of uniformly high quality, firm, white, and palatable. Yields varied from an average of 5 pints per 75-pound bushel in September (trawl-caught scallops) to $3\frac{1}{2}$ pints per bushel in December, $3\frac{1}{2}$-4 pints per bushel in February, and $2\frac{1}{2}$-3 pints per bushel in July. Whether or not the variations in availability and yield represent seasonal fluctuations cannot be determined on the basis of work accomplished to date. Despite the variations, however, scattered areas containing commercial significant amounts of scallops (yielding 5 or more bushels of scallops per

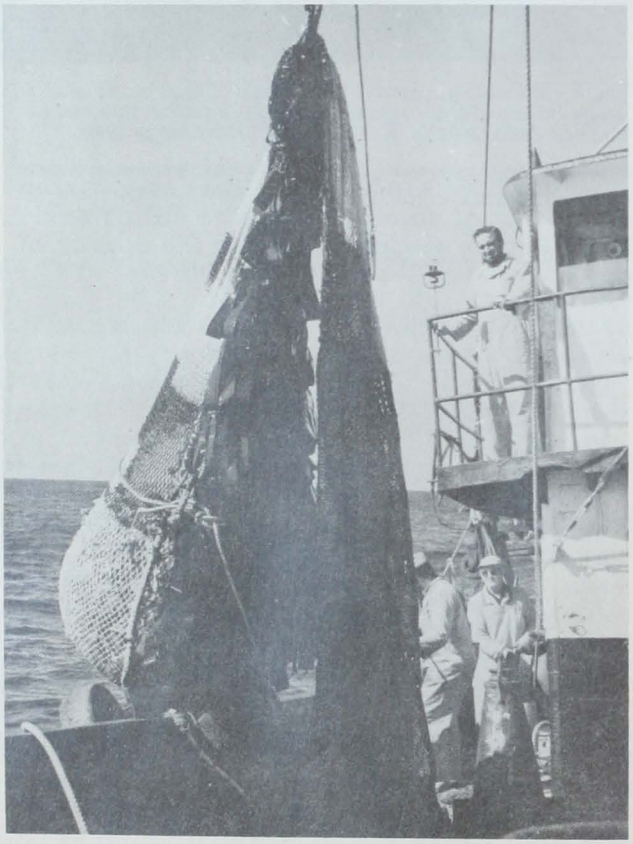

Fig. 7 - A roller-rigged nylon fish trawl coming aboard the Silver Bay with approximately 2,000 pounds of industrial fish.

Table 2 - Summary of Fishing Results from Scallop Explorations by the Silver Bay at 37 Stations East of Core Banks, N. C.

Cruise Number	Station Number	Date	Depth in Fathoms	Minutes Fished	Scallop Catch 1/
18	12702/	9-12-59	20	60	$\frac{1}{2}$ bushel
	12732/	9-12-59	17	120	$3\frac{1}{2}$ bushels
20	1496	12-8-59	16	34	15 individuals
	1497	12-8-59	20	30	$\frac{1}{2}$ bushel
22	16292/	2-22-60	18/17	60	75 individuals
	1644	2-24-60	20/19	30	35 individuals
	1645	2-24-60	19	30	15 bushels
	1646	2-24-60	19	30	10 bushels
	1647	2-24-60	19	35	5 bushels
	1648	2-24-60	19	30	12 individuals
	1649	2-24-60	16	30	1 individual
	1650	2-24-60	16	30	6 individuals
	1651	2-24-60	16	30	3 individuals
	1652	2-24-60	21/20	30	-
	1653	2-24-60	18	30	6 bushels
	16542/	2-24-60	21/20	60	60 individuals
25	21702/	7-18-60	52/42	40	10 individuals
	21822/	7-20-60	52/42	45	37 individuals
	21832/	7-20-60	19/18	60	5 bushels
	2194	7-23-60	19	30	$1\frac{1}{2}$ bushels
	2195	7-23-60	19	30	$1\frac{1}{2}$ bushels
	2196	7-23-60	19	30	5 bushels
	2197	7-23-60	19	30	$2\frac{1}{2}$ bushels
	2198	7-23-60	25	15	35 individuals
	2199	7-23-60	30	15	15 individuals
	2200	7-23-60	51/55	30	45 individuals
	2202	7-24-60	20	30	-
	2203	7-24-60	20	30	2 bushels
	2204	7-24-60	20	30	15 bushels
	2205	7-24-60	20	30	$5\frac{1}{2}$ bushels
	2206	7-24-60	20	30	-
	2207	7-24-60	18	30	50 individuals
	2208	7-24-60	18	30	10 individuals
	2209	7-24-60	20	45	19 bushels
	2210	7-24-60	18/17	30	4 individuals
	2211	7-24-60	15	30	-
	2212	7-24-60	12/14	30	-
Totals	37			1,339	95 bu. (approx.)

1/One bushel equals approximately 75 pounds.
2/Drags made with shrimp trawls. All others made with modified Georges Bank scallop dredges.

1-hour drag with an 8-foot dredge) can be found on the bed over much of the year. The Core Banks scallop bed resembles the Cape Lookout-Beaufort Inlet clam bed in being near shore, near a fishing port with available vessels, and near a processing plant.

Dredging in other portions of Onslow Bay failed to produce scallops, although occasional individuals were taken in shrimp trawls in November 1959 in the Bay. In all, 53 stations were fished with scallop dredges in 26 hours of actual fishing time. Scallops were found in greatest abundance on bottoms consisting of a mixture of sand and shell.

SHRIMP AND FISH: Despite widespread coverage of the assigned region with shrimp trawls, large-mesh New England fish trawls, 2-seam industrial fish trawls, and scallop dredges (fig. 1), no large concentrations of commercial shrimp were found outside already-known grounds, and the occasional

large catches of fish that were made were interspersed with many smaller catches. A summary of the results of the 270 actual hours of fishing time spent at 247 trawl stations shows that total catches (the sum of fish, shrimp, and trash) were the highest in the portion of the 0- to 10-fathom depth interval investigated (table 3).

Table 3 - Summary of Trawl Explorations and Results, M/V Silver Bay, North Carolina, 1959-60

Depth Interval, Effort, & Catch[1]	Cruise No. and Time of Year					
	No. 18 Sept.	No. 19 Oct.	No. 20 Nov./Dec.	No. 22 Feb./Mar.	No. 25 July	Totals All Cruises
0-10 Fathoms						
No. of Stations	43	7	8	14	24	96
Actual Fishing Time (hours)	50.28	7.63	9.17	14.00	24.46	105.54
Catch Rate[2]	397.07	141.67	836.96	14.0	274.52	354.33
11-20 Fathoms						
No. of Stations	41	3	15	22	9	90
Actual Fishing Time (hours)	44.98	3.33	17.66	22.0	8.86	96.83
Catch Rate[2]	185.07	18.18	714.43	119.18	942.43	251.98
21-30 Fathoms						
No. of Stations	12	1	6	4	8	31
Actual Fishing Time (hours)	12.78	2.00	7.0	4.0	8.41	34.19
Catch Rate[2]	212.51	50.0	294.57	24.82	118.07	198.12
31-40 Fathoms						
No. of Stations	2	-	-	3	1	6
Actual Fishing Time (hours)	2.28	-	-	3.0	1.0	6.28
Catch Rate[2]	24.12	-	-	154.00	29.00	86.94
41-50 Fathoms						
No. of Stations	2	-	1	-	1	4
Actual Fishing Time (hours)	1.38	-	1.0	-	0.66	3.04
Catch Rate[2]	-	-	35.00	-	41.66	19.73
Over 50 Fathoms						
No. of Stations	10	-	1	6	3	20
Actual Fishing Time (hours)	9.16	-	1.5	9.50	4.58	24.74
Catch Rate[2]	324.78	-	20.0	54.73	44.97	151.66
Totals						
No. of Stations	110	11	31	49	46	247
Actual Fishing Time (hours)	120.86	12.96	36.33	52.50	47.97	270.62
Catch Rate[2]	281.49	129.08	617.01	124.89	183.51	271.55

1/Includes all but scallops, clams, sponge, algae, and inert material.
2/Pounds per hour (average).

SHRIMP: Exploratory catches along the North Carolina coast suggest that sizable concentrations of brown, pink, and white shrimp are infrequent or absent outside the limits of already-known commercial shrimp grounds, at least during the months in which explorations were conducted with the Silver Bay. In September 1959, occasional catches were obtained between Beaufort and Bogue Inlets in 5 to 8 fathoms that contained from 5 to 35 pounds of brown shrimp (Penaeus aztecus) measuring 21-25 count (heads off); and in July 1960, 1 additional catch in the same area was made that contained 40 pounds of mixed pink (Penaeus duorarum) and brown shrimp measuring 26-30 count (heads off). These catches, however, were interspersed with many others that were less productive or totally non-productive for shrimp. In other areas and other months only scattered individual brown, pink, and white shrimp were taken. Small numbers of rock shrimp (Sicyonia sp.) were found in many of the catches from portions of the region shallower than 25 fathoms.

FISH: Exploratory results indicate that only small-to-medium catches of fish can be expected with any degree of consistency in the region investigated over any prolonged

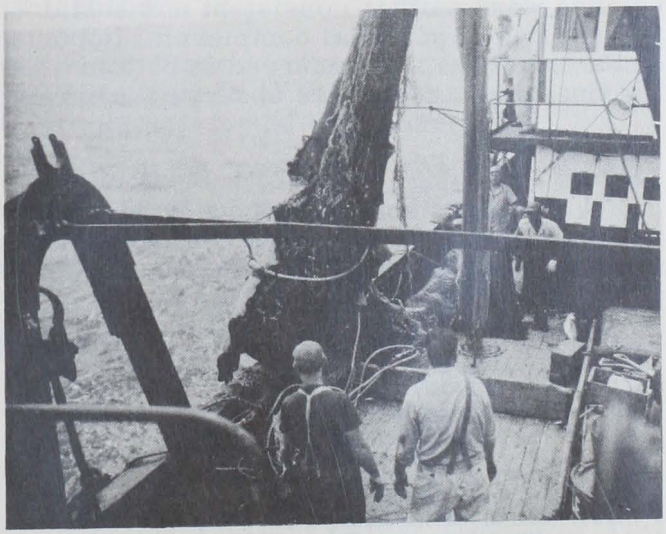

Fig. 8 - A roller-rigged nylon fish trawl coming aboard the Silver Bay with approximately 3,000 pounds of industrial fish.

period. Interspersed among the smaller catches resulting from drags made by the Silver Bay, however, were a few that ranged as high as 3,000 pounds per hour. These larger catches consisted primarily of small Atlantic croaker (Micropogon undulatus), spot (Leiostomus xanthurus), and butterfish (Poronotus triacanthus), usable only for industrial purposes. Outside of established fishing grounds, the largest catches were made in 5-12 fathoms in September, 12 to 14 fathoms in December, 17 to 100 fathoms in February and March, and 16 to 22 fathoms in July.

A few marketable food fish were taken--mostly flounders--but the proportion of these fish to those utilizable for industrial processing was low[3/]. Sport fish were also noted on occasions, either as they appeared on the surface and were viewed from the vessel or as they were taken on trolling lines for biological study.

The occurrence of large anchovies (Anchoa sp.) and herring-like fish in some of the trawl catches indicates the possibility of an as-yet-unexplored midwater school fish resource that might prove to be of commercial value in the future.

SUMMARY

The continental shelf bordering the North Carolina coast south of Cape Hatteras contains over 8,000 square miles of potential fishing grounds. Preliminary fishery explorations on that portion of the shelf have revealed the following:

BOTTOM CHARACTERISTICS: Most of the shelf region explored is suitable for some type of trawling. Sand, sand and shell, and sand and mud bottoms are the most common.

CLAMS: Commercial concentrations of hard clams were found near Beaufort Inlet in depths of $3\frac{1}{2}$ to $7\frac{1}{2}$ fathoms. Catch rates ranged up to 13 bushels of clams per 1-hour drag and yields ranged to approximately 1 gallon per 90-pound bushel.

SCALLOPS: Commercial concentrations of calico scallops were found off Core Banks in depths of 17 to 20 fathoms. Catches ranged up to 19 bushels per 30-minute drag and yields reached a maximum of 5 pints per 75-pound bushel.

SHRIMP: No large concentrations of brown, pink, or white shrimp were found beyond the range of the present commercial fishery.

FISH: Individual catches of mixed fishes in commercial quantities were made. Such catches were neither consistent nor sustained over long periods of trawling. Quantities of pelagic fish of potential commercial importance were observed on depth-recorder traces, and a few of the fish occurred in bottom-trawl catches. Some sport fish were taken on trolling lines and others were observed in surface waters.

APPENDIX

A detailed fishing log showing geographic position, depth, date, catch components, and related data for each drag is available as an appendix to the reprint of this article. Write for Separate No. 636, which includes "Table 4--Fishing Log:--North Carolina Fisheries Explorations, 1959-60; M/V Silver Bay."

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3/Regulations in North Carolina place a limit on the amount of non-food fish that can be brought in and landed by commercial trawlers when the principal objective of the cruise is shrimp or food fish.

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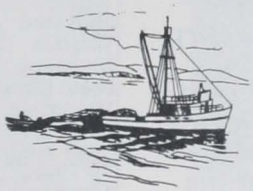

PIRANHAS A PROBLEM IN BRAZIL'S INLAND WATERS

The experience an inland fresh-water biologist in Brazil is having with piranhas certainly belongs in the "If You Think You Got Troubles Department."

The biologist reports that for two years Argentina has had a serious problem with piranhas attacking cows at the Parana River Basin. Particularly in the marginal lagoons which abound with piranhas and where the oxen and cows must drink. Argentina is experimenting with timbo powder (with rotenone concentration about 5 percent) to eradicate piranha. The results appear doubtful because of the very high price of the powder and the large number of lagoons.

Within Brazil, particularly the northeastern part, in the dry region named "Nordeste-Poligono das Secas," the fight against piranhas in the dams, rivers and lagoon is a serious problem and the results are uncertain and expensive.

During 1959 15.9 tons of timbo was used to treat 4,073 small pools and 140 dams. Piranhas were found in 1,063 pools and in 21 of the dams.

It was during this operation against piranhas that 6 of the workers were wounded by Serrassalmus (that is the scientific name of several species of piranhas) and 12 other persons were mutilated when taking the piranhas after the water was treated with timbo. One worker almost died from the results of his mutilations. (Outdoor California, May 1961.)