Wash. 3/2/50

Re - No. Carolina Survey

UNITED STATES DEPARTMENT OF THE INTERIOR

Oscar L. Chapman, Secretary

FISH AND WILDLIFE SERVICE

Albert M. Day, Director

RESEARCH REPORT No. ____

~~AN EXPLORATORY~~ FISHERY SURVEY ~~IN~~ OF SOUTHERN COASTAL WATERS

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Manuscript Report Number
50 - 3

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PREFACE

This is the second of a series of reports concerning hydrographic conditions and exploratory fishing operations in southern coastal waters. The first report [1] was published by the Woods Hole Oceanographic Institution in January 1949. Reports on hydrographic conditions encountered during the present survey, the distribution of plankton, and future exploratory fishery surveys will appear at a later date.

[1] Bumpus, Dean F. and T. J. Wehe, 1949, Coastal Water Circulation off the East Coast of the United States between Cape Hatteras and Florida, Technical Report No. 16.

The objectives of this survey were (1) to examine the possibilities of expanding local fishery resources in southern coastal waters, principally those of North Carolina between Cape Hatteras and Cape Fear, by exploring with an otter trawl the area outside the 20-fathom line, and (2) to obtain detailed data on the hydrography and plankton of the area covered by the survey.

The survey was conducted under a cooperative agreement between the University of North Carolina, Institute of Fisheries Research and the Fish and Wildlife Service of the United States Department of the Interior. The Institute gave financial assistance to the amount of $4,000.00, supplied scientific personnel, and replaced Service-owned gear which was lost or became unserviceable. The Service furnished, operated, and maintained the research vessel Albatross III for the survey. The Woods Hole Oceanographic Institution lent hydrographic equipment and detailed two scientists to collect and interpret the hydrographic data.

INTRODUCTION

The continental shelf in the region of Cape Hatteras is a submerged plain 20 to 75 miles broad, gradually sloping from the shore until a depth of 50 to 100 fathoms is reached. Beyond the 50 to 100 fathoms zone there is a more abrupt drop in the ocean bed so that depths of 300 to 400 fathoms are recorded 5 to 10 miles beyond the edge of the shelf north of Cape Hatteras and 15 to 20 miles south of Cape Hatteras. Beyond this is a region of still deeper water extending down to the great depths of the ocean.

The continental shelf from Cape Hatteras southward probably harbors a supply of fish which is going to waste for the want of utilization, and the reason for this is that at least 60 percent of the shelf is unknown to the commercial fishermen of the area. Fishermen of North Carolina have been unwilling to risk their capital investment in boats and nets trying new bottom beyond the narrow strip of the shelf within the 20-fathom line which is familiar to them. Consequently, this stock of fish may be unwisely exploited--too much of it being taken near shore and none of it offshore.

The offshore grounds, however, are not completely unexplored. A winter trawl fishery for croakers in advance of the regular season led several New Jersey flounder draggers to Cape Hatteras in 1920 (Pearson, 1932)[2]. These small draggers, accompanied by several small, shallow-draft, oyster- or crab-dredge boats from Virginia, were prevented from extending the fishery far out to sea because of their small cargo capacity and construction. By the winter of 1928-1929 however, several larger vessels from New England fishing ports, equipped to trawl in the deep offshore waters, were concentrating their fishing efforts in the vicinity of Cape Hatteras. The number of vessels engaged in this winter trawl increased to about 50 in 1931 and to about 100 in 1934 (Nesbit and Neville, 1935).

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[2] Publications referred to parenthetically are listed in the Literature Cited, P

During the winter of 1930-1931 this trawl fishery was concentrated in two areas (Pearsen, op. cit). The first, north of Cape Hatteras, extended roughly from latitudes 35°50' to 37°N. and from longitudes 74°50' to 75°30' W. in depths ranging from 20 to 50 fathoms. The second area, south of Cape Hatteras, was enclosed on the north and south by latitudes 34°50' to 35°50' N. and on the east and west by longitudes 75°20' to 76°10' W. (Figure 1). These fishing grounds

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Figure 1--Location of winter trawl fishing grounds indicated roughly by dots which represent actual fish catches as reported by fishermen during 1930-1931 seasons.

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extended from 3 to 30 miles offshore in water from 10 to 30 fathoms in depth. The winter trawl fishery, as it now exists, is concentrated from Cape Hatteras north to the Virginia Capes while much of the area outside 20-fathoms south of Cape Hatteras remains unexplored.

In spite of the growth of this winter trawl fishery in the deeper waters off Cape Hatteras, the resident commercial fishermen of North Carolina have continued to exploit the fish populations indigenous to the shelf within the 20-fathom line. The Institute of Fisheries Research, cognizant of this limited fishery, sought ways to expand it, and as a result an exploratory fishery survey was cooperatively undertaken by the Fish and Wildlife Service of the United States Department of the Interior and the Institute of Fisheries Research of the University of North Carolina.

THE SURVEY VESSEL

The United States Fish and Wildlife Service research vessel Albatross III (Figure 2) was used in the survey. The vessel is of steel construction

Figure 2.--The United States Fish and Wildlife Service research vessel Albatross III.

throughout; about 180 feet long, has a beam of about 24 feet and a draft of 12 feet; and is powered by an 805 horsepower diesel engine. It is equipped with full-size trawling gear of the type used by New England trawlers, and the latest electronic devices--Sonic Depth Recorders, Loran Receiver, Radio Direction Finder, etc.--which assured continuous depth and position recordings during fishing operations.

TRAWLING GEAR AND METHODS USED IN MAKING FISHERY SURVEY

Exploratory otter trawling was carried on from May 16 to June 9 with a slightly modified No. 1-1/2 Iceland trawl (Figure 3). The dimensions of the

Figure 3.--Diagram of the No. 1-1/2 Iceland otter trawl used in the North Carolina exploratory fishery survey.

trawl are as follows: 78-foot head-rope; 114-foot foot-rope; 6-inch mesh in the wings and square; 5-inch, tapering to 4-inch, mesh in the belly; and 4-inch mesh in the cod end. The cod end and upper belly were lined with 1-1/2-inch mesh twine. The entire net is approximately 100 feet long, and was attached to the doors by rope pennants 30 feet long. The doors were fastened directly to the towing warps. Part of the foot-rope was equipped with wooden rollers--the largest of which were about 18 inches in diameter and 4 to 6 inches thick--to permit trawling on the expected coral bottom without tearing or losing entire nets.

The trawl and oceanographic instruments were operated in a standard manner during the fishery survey. Upon arrival on station a bathythermograph was lowered to obtain the bottom temperature. A thermometer was also lowered to record the surface temperature. While the fishermen were "shooting" the trawl, the biologist in charge of the watch obtained a Loran fix to establish the starting position for the tow. After the trawl had been set and the towing warps had been hooked up, the Loran position and time of hook-up were recorded on the fathometer tape. At the end of the tow a second Loran fix was taken to obtain the end position for the tow.

During most of the trawling operations (excluding hang-ups) the trawl was towed for half-an-hour, from the time of hook-up to the start of haul-back, at a towing speed of 4.5 knots. A total of 42 half-hour tows were made at 30 randomly selected stations on the continental shelf between Charleston, South Carolina and Cape Henlopen, Delaware. Locations of these stations are illustrated in Figure 4. A complete log of these operations may be found in Appendix B.

Figure 4.--Locations of trawl stations, indicated by dots, completed during the exploratory fishery survey in southern coastal waters in May and June, 1949.

LIMITATIONS OF TRAWLING GEAR USED IN THE SURVEY

The trawling gear used to make this survey had certain limitations. The heavy rollers and total weight of the net caused it to hug the bottom to the extent that large numbers of those species normally taken with balloon trawls probably escaped capture. In a like manner, the large rollers raised the foot-rope off the botton and presumably permitted the escapement of some fish--flatfishes especially. Despite these limitations, it is believed that sufficient quantities of butterfish, scup, and flatfishes were caught to provide adequate information on the supply of these species.

DISCUSSION OF RESULTS

The catch figures presented in Appendix B are not impressive when compared with the trawl catches from fishing grounds in the Northwest Atlantic Ocean. They are representative, however, of the size of trawl catch which might be expected from randomly selected stations in southern coastal water, where it is known that many of the resident species migrate northward during the early summer months.

For the purposes of analyzing these catch figures, it was found convenient to divide the area surveyed with the otter trawl into three depth zones--20-50 fathoms, 51-100 fathoms, and over 100 fathoms. The productivity of the botton fisheries, as measured by the otter trawl catches, varied with these depth zones. The composition of the catch and relative abundance of each species also varied in a distinct pattern from station to station and with depth. Owing to these marked variations in each of the three depth zones, it became desirable to analyze the exploratory fishing results by depth zones.

20-50 FATHOMS:--Eighteen productive tows (tear-ups occurred on two tows) were made in these depth zones with the otter trawl previously described. Fish were caught at the over-all estimated average of 87 pounds per half-hour tow. The greatest catch, approximately 720 pounds in one tow, was made at latitude 33°40' N. and longitude 77°06.5' W. (Station 8, Figure 4). The major proportion of the catch of commercial species taken in this depth zone was comprised of scup, butterfish, pigfish, tomtate, pinfish, goatfish, and white-bone porgy. These fish, plus smaller numbers of sea bass, spot, red porgy, and vermillion snapper, accounted for about one-half of the exploratory trawl catch in this depth zone; the remainder as a miscellaneous mixture of non-commercial species. The major proportion of these non-commercial species were filefish, round scad, lizard fish, and snake fish.

The absence of large quantities of shrimp in the trawl catches was surprising, since the local fishermen are known to catch them with small shrimp trawls in less than 20 fathoms. The 1-1/2-inch mesh liner of the trawl net was small enough to retain shrimp, and at the outset of the survey it was thought that shrimp would be reasonably abundant offshore. Apparently they are confined to those more estuarine inshore waters fed directly by the rivers and creeks which drain into the ocean along the coasts of the southern states. Only six coral shrimp, Sicyonia brevirostris (Stimpson)[3], were taken in this depth zone.

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[3] Identifications of the shrimp caught during the North Carolina exploratory fishery survey were made by Dr. Fenner Chace of the United States National Museum, Washington, D. C.

In regard to the mechanics of operation, only two tear-ups were encountered in this depth zone. The first was attributed to coral, and the cause of the second tear-up (a minor tear along the foot-rope) is unknown.

51-100 FATHOMS:--Ten tows were made in this relatively narrow depth zone. More than three-fourths of the trawl catches in this zone were composed of non-commercial species. Snake-fish, boar-fish, and spotted hake comprised the bulk of these species. The major portion of the small catch of commercial species consisted of butterfish, red grouper, and hogfish.

About one-half pint of shrimp, Hymenopenaeus tropicalis (Bouvier), were taken in this depth zone. These shrimp, a non-commercial species, were formerly unknown north of the West Indies.

Large limestone rocks, in the vicinity of Diamond Shoals Lightship were responsible for the only tear-up in this depth zone.

OVER 100 FATHOMS:--Twelve tows were made in this depth zone with an over all estimated average catch of 58 pounds of fish per half-hour tow. Commercial species, principally red groupers and butterfish, accounted for 60 percent of the catch in this area. Twelve red groupers, weighing a total of 346 pounds, were caught at latitude 33°11.5' N. and longitude 77°07' W. in 152 fathoms (Station 7, Figure 4). Small numbers of 30 non-commercial species--chiefly boar-fish, spotted hake, lantern fish, Stearn's sea robin, cardinal fish, and snake-fish--were caught in this depth zone. Three non-commercial species of shrimp--Hymenopenaeus tropicalis (Bouvier), Parapenaeus longirostris (Lucas), and Panaeopsis megalops (Smith)--were also taken in the trawl catches.

The possibilities of expanding the otter trawl fishery in depths over 100 fathoms off the coast of North Carolina are encouraging. The relative abundance of commercial species as compared with non-commercial species (as indicated by the trawl catches) is much greater in this depth zone than the others. It is believed that vessels operating on a commercial scale--staying on good fishing, making tows of one-hour or longer, and concentrating their efforts--could operate profitably in 100-200 fathoms. The fact that no tear-ups were encountered in these depths, which is important in profitable commercial fishing, is very encouraging.

TOPOGRAPHY OF THE SHELF

It is apparent, from the small number of tear-ups--3 in 42 tows--that commercial fishing operations may be carried on outside the 20-fathom contour in southern coastal waters with the type of gear used in the exploratory fishery survey without an undue loss of gear. The recording depthfinder was in constant use during the four-week period the Albatross III operated in southern coastal waters, except for a 24-hour period when electrical difficulties were experienced. An analysis of the traces made on courses which were parallel with the outer edge of the shelf (100-200 fathoms) shows no gullies which would endanger commercial fishing operations, and which are common north of Cape Hatteras. Likewise, fathometer traces made on courses which were perpendicular to the shelf show the slope of the shelf to be gradual out to, and often beyond, the 200-fathom line. Near Cape Hatteras, however, the slope of the shelf beyond 100 fathoms is very abrupt and precipitous.

The topography of the shelf underlying southern coastal waters off North Carolina and South Carolina, as indicated by the fathometer traces, is much less irregular than was suspected. The United States Coast and Geodetic Survey Charts for this region omit many soundings, and a special series of charts--which depict bottom types--show large, broad expanses of coral covering the shelf south of Cape Hatteras. This coral is either a low growing form, or occurs infrequently, for only small amounts were encountered during the trawl survey. Furthermore, the frequency of tear-ups was inconsequential when compared with those occurring during fishing operations on some of the major Northwest Atlantic fishing banks. If the coral were as profuse as the charts indicated, and if the lack of soundings were indicative of rough bottom, then many more tear-ups most certainly would have occurred.

CONCLUSIONS

The results of this exploratory fishery survey in the deeper waters of the continental shelf south of Cape Hatteras indicate that otter trawling can be pursued without undue loss of gear. Success of the venture, of course, will depend upon the fishermen using gear that will enable them to fish the deeper areas. This gear should include larger winches, which have a greater towing-wire capacity, and probably rollers on the foot-ropes of their nets to permit trawling on the slightly irregular bottom. Also, success will depend on finding concentrations of fish and staying on them. The results of the exploratory work in 1949 made this a promising possibility.

The possibilities of increasing North Carolina's catch of fishery resources, and affording resident fishermen the opportunity to carry on fishing operations throughout the year would probably warrant the moderate additional expense involved in changing over to gear needed to fish the offshore fish populations.

Marketing this increased catch would, doubtless, be a problem with some species. This, however, might be overcome by increasing consumer demand through the Market Development Section of the Service's Branch of Commercial Fisheries.

The trawling intensity that these fish populations can support is unknown since the exploratory work performed dealt chiefly with determining if the area were trawlable, and too few tows were made to explore the fishing potential of the area. Limited observations can be presented on several valuable commercial species, however.

Sufficient quantities of butterfish, scup, tom-tate, grunts, hog-fish, pinfish, and pig-fish were caught to indicate that these species might support a commercial fishery. In deeper water a moderate number of red groupers were caught, indicating that these valuable food fish may be abundant enough to support a small fishery.

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APPENDIX A

Common and Scientific Names of Fish and Shellfish Caught during the Exploratory Fishery Survey in Southern Coastal Waters

Many of the identifications were made by Dr. Issac Ginsburg, Curator of Fishes, United States National Museum, who was assigned to the Albatross III for the first half of the trawl survey. The nomenclature for fishes caught during the remainder of the trawl survey, at which time identifications were made by Fish and Wildlife Service and Institute of Fisheries Research personnel alike, are after Jordan and Evermann (1896-1900), Goode and Bean (1895), Breder (1929), Hildebrand and Schroeder (1928), and Bigelow, Parfante and Schroeder (1948).

- A -

Amberjack	Seriola dumerili

- B -

Bat-fish	Ogcocephalus vespertilio
Bat-fish, Short-nosed	Ogcocephalus radiatus
Bat-fish, Spiny	Halieutichthys aculeatus
Bluefish	Pomatomus saltatrix
Boar-fish	Antigonia capros
Brotula	Brotula barbata
Burr-fish	Chilomycterus schoepfii
Butterfish	Peronotus tricanthus
Butterfly fishes	Chaetodontidae
Common butterfly fish	Chaetodon ocellatus
Banded butterfly fish	Chaetodon striatus
Common Angelfish	Angelichthys isabelita

- C -

Cardinal Fish, Spotted	Apogon maculatus
Croakers	Sciaenidae
Cubbyu	Eques acuminatus
Northern Kingfish	Menticirrhus saxatilis
Ribbonfish	Eques lanceolatus
Spot	Leiostomus xanthurus
Cornet fish	Fistularia tabacaria
Common Mojarra	Eucinostomus gula
Conger eel	Leptocephalus conger
Cow fish	Lactophrys tricornis
Cusk eel	Lepophidium cervinum

- D -

Deep Big-eye	Pseudopriacanthus altus

- F -

File fishes	Monacanthidae
Common file fish	Monocanthus hispidus
Orange file fish	Ceratacanthus schoepfii
Unicorn file fish	Ceratacanthus monoceros
Flounders	Pleuronectidae
Eyed flounder	Platophrys ocellatus
Flounder (no common name)	Cyclopsetta chittendeni
Flounder (no common name)	Notoscena dilectum
Flounder (no common name)	Syacium papillosum
Fluke	Paralichthys dentatus
Four-spotted flounder	Paralichthys oblongus
Peacock flounder	Platophrys lunatus
Southern Fluke	Paralichthys lethostigmus
Whiff	Citharichthys sp.

- G -

Goatfish	Mullus auratus
Goosefish	Lophius piscatorius
Grouper, Red	Epinephelus morio
Grouper, Snowy	Epinephelus niveatus
Grunts	Haemulidae
Caesar (Tom Tate)	Bathystoma rimator
White Grunt	Haemulon plumieri
Gray Grunt	Haemulon macrostomum
Pigfish	Orthopristis chrysopterus

- H -

Hake, Spotted	Urophycis regius
Hake, White	Urophycis tenuis

- J -

John Dory	Zenopsis ocellatus

- L -

Lantern Fishes	Inioni
Lantern Fishes	Myctophidae
Lizard Fishes	Synodontidae
Lizard fish	Synodus foetens
Sand-diver	Synodus intermedius
Snake-fish	Trachinocephalus myops
Lobster	Homarus americanus

- M -

Mackerel	Scomber scombrus
Moray, Spotted	Lycondontis ocellatus

- O -

Ocean Surgeon	Acanthurus bahianus

- P -

Parrot fish	Sparisoma flavescens
Phoebe	Prionodes phoebe
Porgies	Sparidae
Jolt-head porgy	Calamus bajanado
Pinfish	Lagodon rhomboides
Red porgy	Pagrus pagrus
Soup	Stenotomus chrysops
White-bone porgy	Calamus leucosteus

- S -

Sand Fish	Diplectrum formosum
Scad, Round	Decapterus punctatus
Sea Bass	Centropristes striatus
Sea Bass, Gulf	Centropristes ocyurus
Sea Robbins	Triglidae
Carolina Sea Robin	Prionotus carolinus
Slender Sea Robin	Prionotus scitulus
Stearn's Sea Robin	Prionotus stearnsii
Winged Sea Robin	Prionotus alatus
------- Sea Robin	Bellator militaris
Scorpion Fish	Scorpaena braziliensis
Scorpion Fish	Pontinus rathbuni
Skates	Rajidae
Big Skate	Raja diaphanes
Clear-nosed skate	Raja eglanteria
Skipper	Scomberesox saurus
Snake Mackerel	Gempylus serpens

Snappers	Lutianidae
Caribbean Red Snapper	Lutianus campechanus
Pensacola Red Snapper	Lutianus blackfordii
Vermillion Snapper	Rhomboplites aurorubens
Snipe Fish	Macrorhamphosus scolopax
Squirrel Fish	Holocentrus ascensionis
Star-gazer	Astroscopus y-graecum
Star-gazer	Kathetostoma albigutta
Swell Fishes	Tetraodontidae
Marbled Swell fish	Spheroides marmoratus
Southern Swell fish	Spheroides spengleri
Sharks	
Brown Shark	Carcharhinus milberti
Cat Shark	Scyliorhinus retifer
Dogfish	Squalus fernandinus
Shrimp	
Coral shrimp	Stenonis brevirostis
------ Shrimp	Hymenopenaeus tropicalis
------ Shrimp	Parapenaeus longirostris
------ Shrimp	Parapenaeus megalops

Trigger Fishes	Balistidae
Common Triggerfish	Balistes carolinensis
------ Triggerfish	Hollardia hollardi

- W -

Whiting (silver hake)	Merluccius bilinearis
Wrasses	Labridae
Hogfish	Lachnolaimus maximus
Pearly Razor-fish	Xyrichthys psittacus

- Y -

Yellow-tailed Reef Fish	Chromis enchrysurus

APPENDIX B.

TABLE 1.--Log of exploratory fishing operations in southern coastal waters during 1949

Station number	Tow number	Date 1949	Starting position North latitude	Starting position West longitude	Direction of tow	Depth Fathoms Start	Depth Fathoms End	Bottom temperatures °F.	Catch: Total number of fish	Catch: Number of non-commercial fish	Catch: Number of commercial fish	Catch: Number of commercial fish over 6 inches [2]	Principal commercial [1] species in order of decreasing numbers	Estimated total weight of catch (pounds
1	1	May 26	32°30'	79°00'	060° T	21	21	72.6	1	1	-----	-----	-----	---
1	2	May 26	32°32'	78°57.5'	060° T	21	21	----	9	9	-----	-----	-----	---
2	1	May 26	32°34'	78°39'	055° T	25	25	67.1	6	6	-----	-----	-----	5
2	2	May 27	32°37'	78°34'	045° T	26	27	67.7	None--tear up		-----	-----	-----	---
3	1	May 27	32°52'	77°57'	070° T	93	93	60.0	131	55	76	69	hogfish, groupers	350
3	2	May 27	32°52'	77°55'	060° T	102	102	----	228	191	37	19	hogfish, groupers, southern flounder	100
4	1	May 27	32°50.5'	77°39'	045° T	133	134	51.0	19	17	2	-----	hogfish	15
4	2	May 27	32°52'	77°36.5'	048° T	134	134	50.8	16	16	-----	-----	-----	5
5	1	May 27	33°03.5'	77°38'	090° T	97	97	60.0	18	18	-----	-----	-----	5
5	2	May 27	33°03'	77°36'	045° T	105	105	----	132	132	-----	-----	-----	40
6	1	May 28	32°59'	77°10'	060° T	200	200	49.0(123 fm)	90	86	2	3	white hake, silver hake	20
6	2	May 28	33°00.5'	77°07.5'	045° T	206	216	----	8	8	-----	-----	-----	5
7	1	May 28	33°11.5'	77°07'	045° T	152	152	49.0(138 fm)	28	16	12	12	groupers	350
8	1	May 29	33°40'	77°06.5'	050° T	19	19	73.5	2,019	176	1,843	1,449	tomtate, scup, pinfish, pigfish, white grunt	720
9	1	May 29	33°43'	76°45'	030° T	28	28	74.0	70	18	52	36	scup, pinfish, red porgy, tomtate	30
10	1	May 29	33°52'	76°49.5'	045° T	20	22	75.4	1,484	80	1,404	1,204	scup, tomtate	540
11	1	May 29	34°02.5'	76°37'	045° T	20	20	76.4	55	28	27	22	scup, tomtate	15
11	2	May 29	34°05.5'	76°33'	090° T	21	21	----	16	14	2	2	scup	5
12	1	June 2	35°02'	75°06.5'	040° T	20	20	55.3	97	95	2	2	silver hake	15
13	1	June 3	35°17.5'	76°08'	160° T	18	18	76.5	87	-----	87	-----	scup	20
13	2	June 3	35°16.5'	76°02'	045° T	48	40	----	14	2	12	1	scup, sea bass	5
14	1	June 3	34°55'	75°31'	270° T	27	27	72.9	28	26	2	2	red porgy, red snapper	90
15	1	June 3	34°48'	75°33'	250° T	48	42	70.3	35	32	3	2	butterfish	5
16	1	June 7	34°29.5'	76°44'	190° T	11	11	71.7	1,471	1,203	268	1	scup, mackerel, spot	90
17	1	June 8	33°54'	76°26.5'	045° T	84	84	61.3(81 fm)	85	57	28	4	butterfish	20
18	1	June 8	34°08'	76°10'	040° T	156	156	57.3(93 fm)	15	11	4	-----	butterfish, scup	---
19	1	June 8	34°18'	76°07'	090° T	28	32	74.3	28	28	-----	-----	-----	5
19	2	June 8	34°16'	76°03'	100° T	32	44	-----	None--tear up		-----	-----	-----	---
20	1	June 8	34°15'	75°58'	035° T	125	125	50.5	784	3	781	24	butterfish	90
21	1	June 8	34°32'	76°58'	045° T	23	25	76.5	35	18	17	-----	butterfish	10
21	2	June 8	34°34'	75°58'	045° T	26	26	----	17	17	-----	-----	-----	5
22	1	June 8	34°35'	75°46'	045° T	68	68	57.1	2	2	-----	-----	-----	---
23	1	June 8	34°34'	75°40	050° T	114	120	51.3	4	4	1	1	silver hake	---
23	2	June 8	34°36'	75°37.5'	020° T	124	125	----	25	22	3	3	groupers	60
24	1	June 8	35°05'	76°18'	048° T	80	86	65.6	147	146	1	1	fluke	45
25	1	June 9	35°09'	75°08'	000° T	60	60	76.5(60 fm)	3	2	1	1	sea bass	---
25	2	June 9	35°07'	75°09'	055° T	80	80	63.7(75 fm)	22	14	8	4	butterfish, grouper, amberjack	40
26	1	June 9	35°35'	74°52'	000° T	35	38	60.3	57	25	32	3	butterfish	15
27	1	June 15	37°06'	74°35'	048° T	76	100	54.8	70	14	56	51 [3]	butterfish, lobster	60
28	1	June 15	37°26.5'	74°26.5'	090° T	60	104	53.0(93 fm)	7	1	6	4 [4]	lobster	5
29	1	June 15	37°53'	74°01'	045° T	108	98	----	10	4	6	4 [4]	lobster	10
30	1	June 16	38°34'	73°16'	045° T	56	57	----	16	8	8	6	butterfish	15

[1] Commercial species are defined as species which are listed as marketable in Fishery Statistics of the United States, and the tomtate which is sold occasionally in North Carolina as the "red mouth".

[2] Southern markets commonly accept fish larger than this size.

[3] Includes 8 legal-size lobsters.

[4] Includes 4 legal-size lobsters.

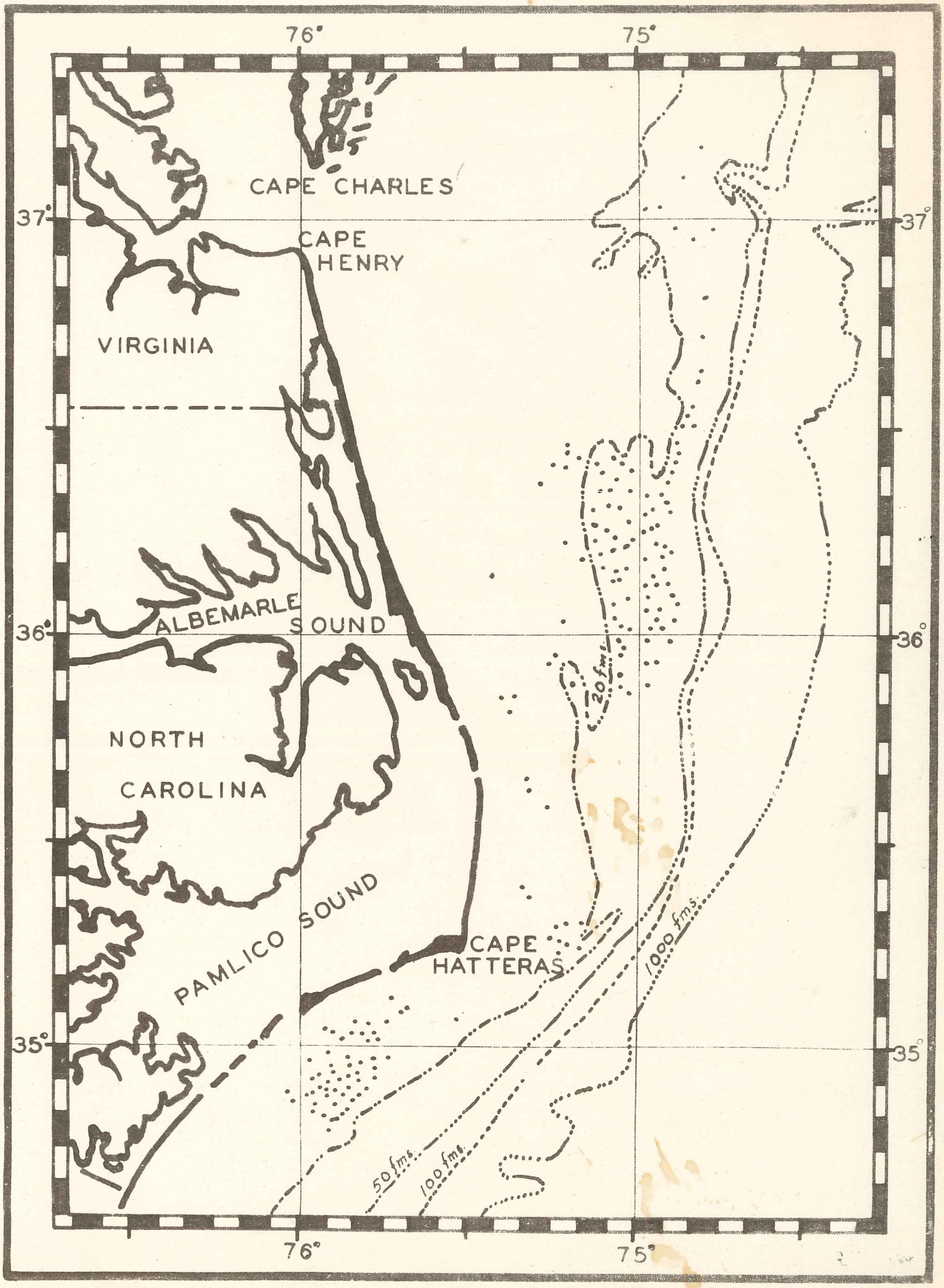
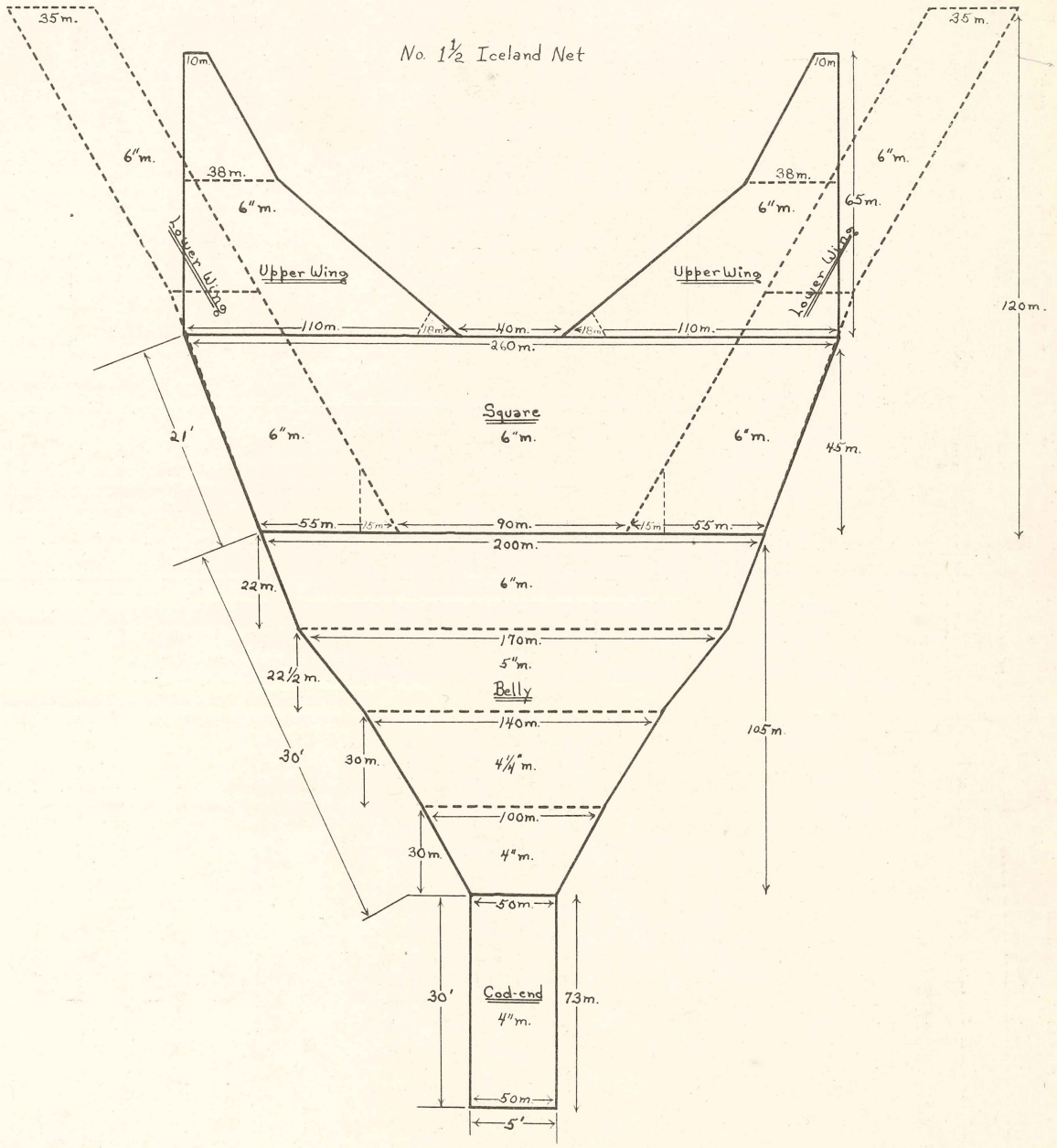

76°
75°
CAPE CHARLES
37°
CAPE
HENRY
VIRGINIA
ALBEMARLE
SOUND
36°
NORTH
CAROLINA
PAMLICO SOUND
CAPE
HATTERAS
35°
20 fms.
1000 fms.
50 fms.
100 fms.

Figure 1--Location of winter trawl fishing grounds indicated roughly by dots which represent actual fish catches as reported by fishermen during 1930-1931 seasons.



5 meshes used for lacing Cod-end
7 meshes used for lacing all other places

Headrope is 78 feet long
Footrope is 114 feet long with rollers &
116 feet long without rollers.

Figure 3.--Diagram of the No. 1-1/2 Iceland otter trawl used in the North Carolina exploratory fishery survey.

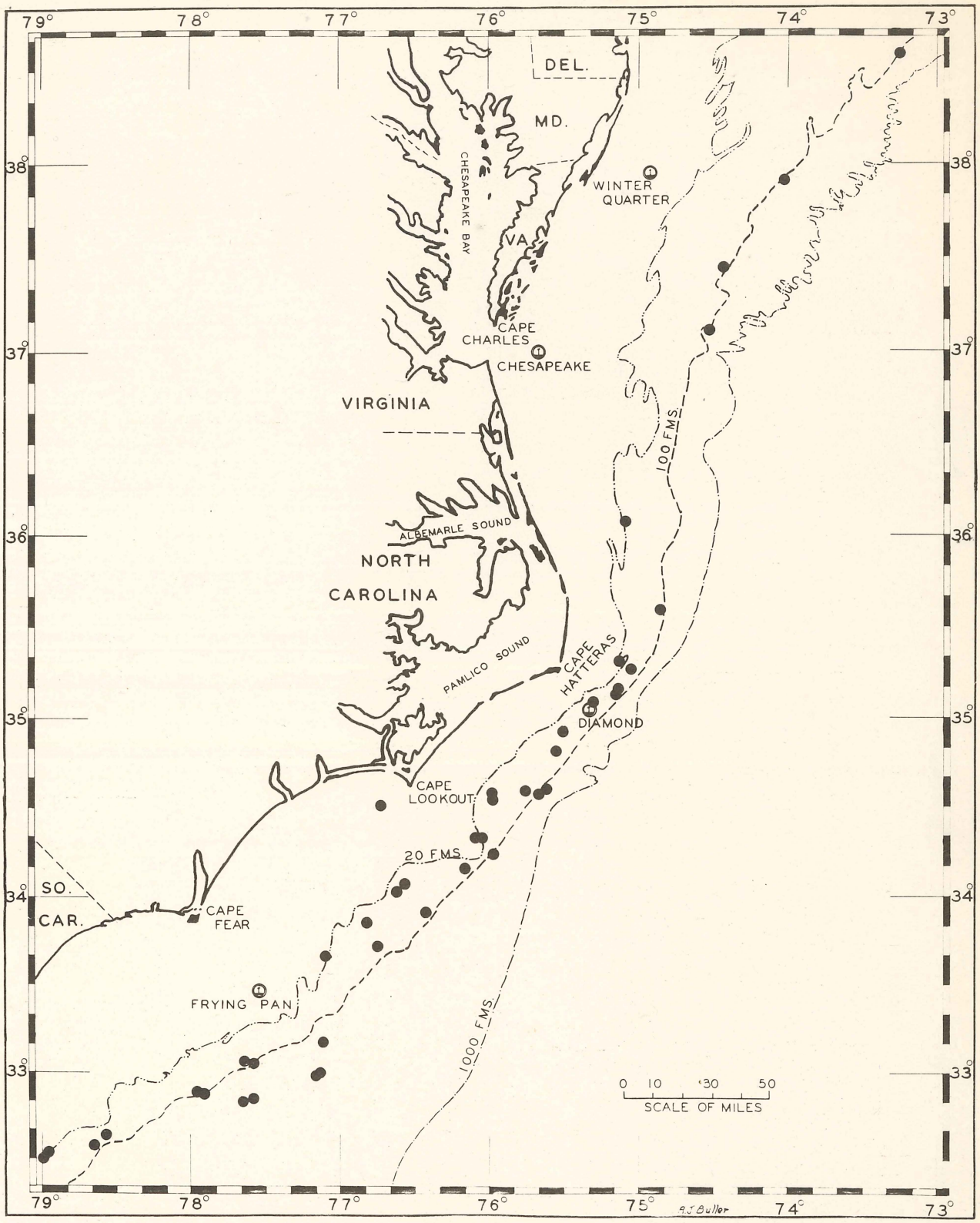

79°
78°
77°
76°
75°
74°
73°
38°
37°
36°
35°
34°
33°
DEL.
MD.
CHESAPEAKE BAY
WINTER QUARTER
VA.
CAPE CHARLES
CHESAPEAKE
VIRGINIA
100 FMS.
ALBEMARLE SOUND
NORTH CAROLINA
PAMLICO SOUND
CAPE HATTERAS
DIAMOND
CAPE LOOKOUT
20 F.M.S.
SO. CAR.
CAPE FEAR
FRYING PAN
1000 FMS.
0 10 30 50
SCALE OF MILES
G.S. Buller

Figure 4.--Locations of trawl stations, indicated by dots, completed during the exploratory fishery survey in southern coastal waters in May and June, 1949.