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PRELIMINARY STOCK
ASSESSMENT, NORTH CAROLINA:
FLOUNDER (*Paralichthys* sp.)

by
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and Community Development

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Completion Report for Project 2-294-R

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ABSTRACT

Catches of paralichthid flounders in North Carolina's inshore pound net, minor trawl, and recreational fisheries were sampled during August 1976 through June 1977. Data were compiled on species composition, length composition, size composition by sex, and fishing effort. Southern flounder (*Paralichthys lethostigma*) made up 95.8 percent by number of the pound net catch. Other flounders in the catch were summer flounder, *P. dentatus* (3.5 percent), and Gulf flounder, *P. albigutta* (0.8 percent). Southern flounder captured by pound net had a mean total length of 360 mm, 378 mm, and 406 mm during September, October, and November 1976, respectively. Mean length for female *P. lethostigma* was 456 mm, while males averaged 328 mm. The severe cold weather of the winter of 1976-1977 sharply curtailed the length of the pound net season and the amount of activity generated by the minor trawl and recreational fisheries.

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INTRODUCTION

North Carolina has extensive commercial and recreational fisheries for three species of flounders: summer flounder (*Paralichthys dentatus*), southern flounder (*P. lethostigma*), and Gulf flounder (*P. albigutta*). Commercial landings have exceeded 11 million pounds annually since 1974 (NMFS CFS No. 6954), making flounder North Carolina's leading foodfish. Data compiled by Chang and Pacheco (1975), combined with NMFS landing data, show that North Carolina has led the nation in landings of paralicthid flounders since 1965.

Powell (1974) supplied many significant contributions to the knowledge of North Carolina's flounders. He worked principally on *P. dentatus*, considering age, growth, length-weight relationships, food habits, environmental relationships, seasonal distribution, and spawning. Many of his conclusions were tentative and reinforced the need for further work, particularly on *P. lethostigma*, and *P. albigutta*.

Since 1973, the Division of Marine Fisheries has investigated the winter trawl fishery for flounder, utilizing the R/V DAN MOORE. Over the years this fishery has supplied from 75 percent to 92 percent of North Carolina's flounder landings (Table 1). Winter trawl fishery landings are almost exclusively *P. dentatus* (R/V DAN MOORE Cruise Reports 1974, 1975, 1976). Data have been acquired on seasonal and spatial distribution, size, catch and catch/effort, spawning, and migration. Migratory studies involved the release of several thousand tagged fish, virtually all of them *P. dentatus*. Despite considerable effort, very few *P. lethostigma* or *P. albigutta* were captured in the ocean; therefore, few were tagged. Data from that study are still being examined. That work agrees with previous studies that summer flounder is the dominant paralicthid in this area, followed by southern flounder and Gulf flounder respectively (Tagatz and Dudley, 1961; Struhsaker, 1969).

Within the last few years, an extensive pound net fishery for flounders has developed in North Carolina's estuaries, extending from Albemarle Sound, south through Pamlico and Core Sounds, to Cape Lookout (Figure 1). The

Table 1.--Flounder landings (lb) by trawls and pound nets in North Carolina 1960-1976.¹

<u>Year</u>	<u>Total landings all gears</u>	<u>Trawl landings</u>	<u>Percent</u>	<u>Pound net landings</u>	<u>Percent</u>
1960	1,236,000	908,600	73.5	43,800	3.5
1961	1,897,000	1,534,700	80.9	49,400	2.6
1962	1,876,000	1,550,000	82.6	48,600	2.6
1963	2,674,000	2,276,800	85.1	66,800	2.5
1964	2,450,000	1,861,000	76.0	57,100	2.3
1965	4,721,000	4,007,600	84.9	137,200	2.9
1966	4,017,000	3,709,900	92.4	170,100	4.2
1967	4,391,000	3,946,600	89.9	273,800	6.2
1968	2,602,000	2,137,700	82.2	277,700	10.7
1969	2,766,000	2,265,100	81.9	423,600	15.3
1970	3,163,000	2,677,100	84.6	367,300	11.6
1971	4,011,000	3,755,200	93.6	178,300	4.4
1972	4,655,000	3,978,200	85.5	471,000	10.1
1973	7,365,000	6,574,700	89.3	714,900	9.7
1974	11,812,900	10,445,700	88.4	1,166,600	9.9
1975	11,509,600	9,962,300	86.6	1,314,800	11.4
1976	11,452,200	10,028,600	87.6	1,281,000	11.2

¹Data from Chestnut and Davis (1975) and NMFS, Branch of Statistics, Beaufort, NC.

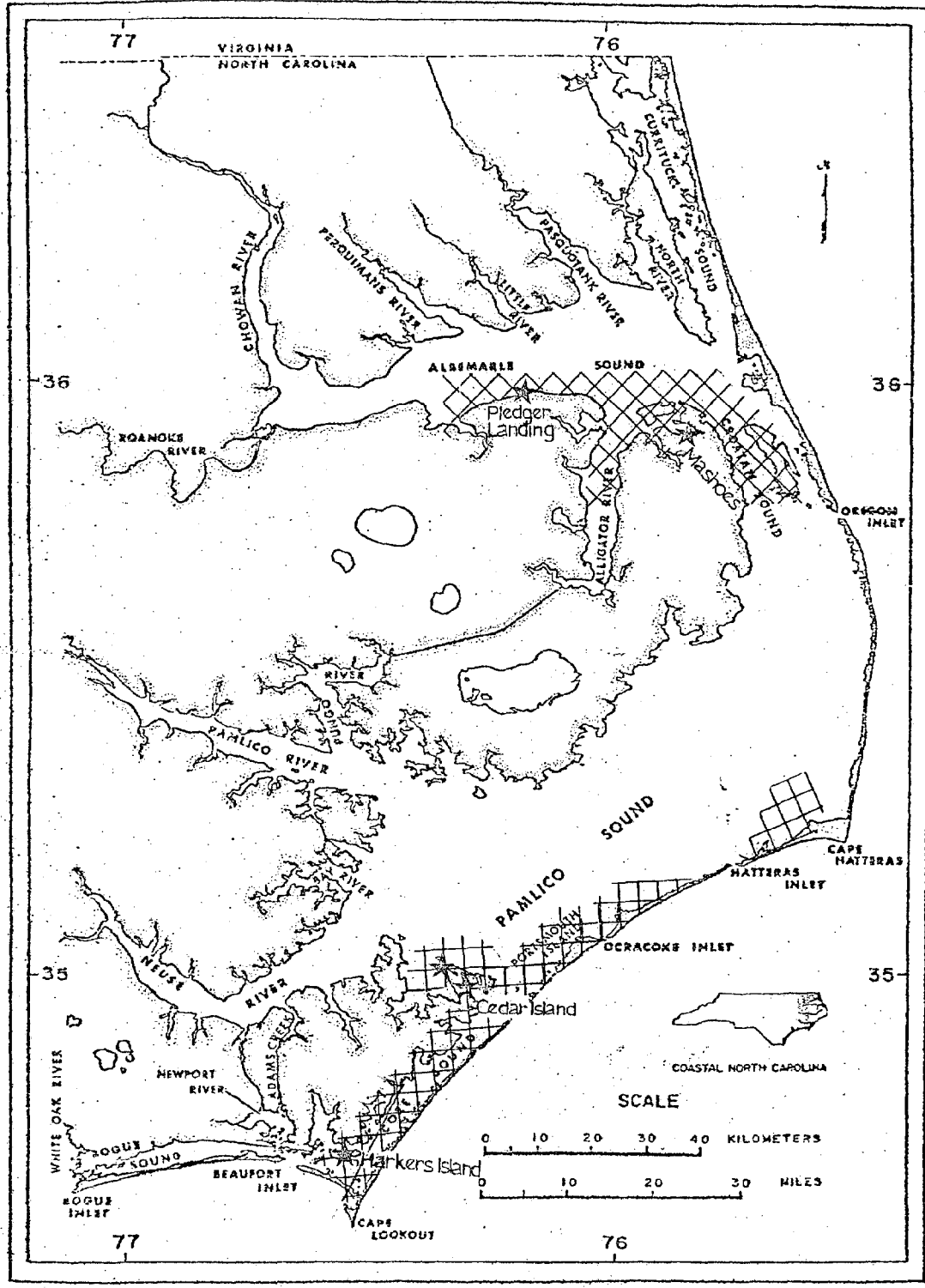


Figure 1.--Areas of major activity (◇◇◇◇) and sampling sites (★) of North Carolina's pound net fishery for flounder, 1976.

magnitude of this fishery is unknown even though pound nets supply over 10 percent of North Carolina's flounder landings, more than 1.2 million pounds in 1976 (Table 1). Prior to this study, it was believed to depend on *P. lethostigma*, unlike the winter trawl fishery which depends on *P. dentatus*. This pound net fishery generally runs from September through February, depending on temperature and fish movements.

Additional fisheries were believed to be developing in the Neuse and Pamlico Rivers and along North Carolina's southern coast in the Cape Fear and New Rivers. These fisheries depend exclusively on trawls with flounders and blue crabs dominating the catch.

Flounders also support one of the most important recreational fisheries in North Carolina, particularly near the inlets and in the surf zone, utilizing both hook-and-line and gigs. The magnitude of this recreational fishery is unknown, as are virtually all marine recreational fisheries in the state. The species composition of this recreational harvest is also unknown.

The Division of Marine Fisheries proposed a study to conduct a preliminary assessment of the estuarine and nearshore flounder fisheries, concentrating on the commercial pound net fishery. The objectives of this project were:

1. To determine species and size composition and catch/effort for flounders in the pound net fishery,
2. To determine species and size composition of flounder taken in the minor trawl fishery,
3. To determine species and size composition of flounders taken in the recreational hook-and-line and gig fisheries, and
4. To prepare a report on those determinations.

SURVEY OF POUND NET FISHERY

Description of the Fishery

Pound nets have been fished in North Carolina for about a century, following their introduction in the Albemarle Sound anadromous fishery during the early 1870s.

A typical pound net has three sections: the lead, the heart, and the pound. The lead extends straight out from shore, or along a shoal, and ends at the mouth of the pound, or trap area. Fish swimming along the shore are turned by the lead toward the pound. There may be one or more intermediate entrapping areas between the lead and the pound called a heart. Fish entering the heart are funneled into the pound, which is enclosed webbing, cutting off avenues of escape.

Several pound nets usually are set in a continuous row so that the entire set may be more than a mile in length, particularly in Core Sound. The longest set observed in Core Sound during this study had 17 leads and pounds in it. Albemarle Sound and Manns Harbor sets numbered three or four leads and pounds per set.

To remove their catch, fishermen maneuver their skiffs inside the pound, raise and close off the funnel, then gradually pull the side and bottom netting up until the fish are trapped or "pounded" in the small portion of the net left in the water. The fish are then transferred into the skiff by dip net.

Species commonly caught in pound nets are river herring, shad, catfish, striped bass, croaker, sturgeon, and flounder.

The pound net season for flounder usually runs from late August through February, starting in Albemarle Sound and ending in the Core Sound-Harkers Island area.

Sampling Methods

Sampling was conducted at four landing sites near pound net activities: Pledger Landing in Albemarle Sound, Mashoes Creek between Albemarle and Croatan Sounds, Cedar Island on Pamlico Sound, and Harkers Island on Core and Back Sounds (Figure 1). Sampling consisted of going directly to the net sites with the fishermen or waiting until they landed their catch. Data collected were species composition, length frequency (total length), sex ratio, and associated species.

Early in the study, I went out to the net sites and determined that there was no culling at the nets. Thereafter all samples were collected at the landing sites. Flounders were randomly dipped from the run boat, identified as to species, total length taken, and sex determined by visual inspection of the gonad after a 40 to 50 mm slit was made in the white side. At least 10 percent of the sample was sexed. Associated species were noted and an approximate count made as the remaining catch was offloaded.

Sampling visits were made at least monthly as travel permitted. Severe cold weather in November caused all pound netting to stop as the nets were removed to protect them from ice. This in turn abruptly halted all sampling efforts.

Results

A total of eight pound net samples was taken at five different landing sites. A pound netter, who was to be sampled at Hatteras, did not fish flounder nets during this short season due to trash (grasses) in the water, a continued high catch of croaker, and the advent of severe cold weather before the flounder normally reach Hatteras, which caused him to remove his nets.

A total of 793 flounders was sampled in the eight visits to fishermen (Table 2). These flounder were selected from total landings in excess of 10,500 lb. for the sampling dates. One species, *P. lethostigma*, comprised 95.8 percent of the total sample by number. The summer flounder, *P. dentatus*,

Table 2.--Species composition by month and sampling site of the pound net catch, 1976.

Sample area Species	September		October		November		Total	
	N	Percent	N	Percent	N	Percent	N	Percent
Pledger Landing Southern	100	100	100	100			200	100
Manns Harbor Southern			100	100	99	95.2	199	97.6
Summer					5	4.8	5	2.4
North Bay Southern			79	95.2			79	95.2
Summer			2	2.4			2	2.4
Gulf			2	2.4			2	2.4
Cedar Island Southern			100	100			100	100
Harkers Island Southern			100	97.1	82	79.6	182	88.3
Summer					21	20.4	21	10.2
Gulf			3	2.9			3	1.5
TOTAL								
Southern	100	100	479	98.6	181	87.4	760	95.8
Summer			2	0.4	26	12.6	28	3.5
Gulf			5	1.0			5	0.7

totalled 3.5 percent, and *P. albigutta* was 0.7 percent of the total. Table 2 presents data on species composition at each sampling site by month. The southern flounder dominated all of the samples taken, particularly those at lower salinities. Only at Harkers Island, where the fishery is conducted in higher salinity waters, does another species (summer flounder) make up a significant portion of the catch.

Powell (1974) reported the distribution of *P. dentatus* in the Pamlico and Albemarle Sound areas within a salinity range of 0 to 35 ppt, but found spatial differences between *P. dentatus* and *P. lethostigma* in relation to salinity. At salinities below 12 ppt, *P. lethostigma* was dominant.

The appearance of age I and II (185-245 mm) summer flounder at Manns Harbor in November at a salinity of 5 ppt was considered to be an unusual occurrence.

Monthly mean length and length ranges for each species are presented in Table 3. Summer flounder had a mean length of 360 mm, 378 mm, and 406 mm during the months of September, October, and November respectively. The catch of 185 to 245 mm *P. dentatus* at Manns Harbor was considered very unusual both as to species and size. Generally, *P. dentatus* particularly of that size, does not enter the pound net catch at Manns Harbor (J. Burrus, per. comm.).

One hundred and twenty-four *P. lethostigma* were sexed and 64 were determined to be females and 60 were identified as males. Mean length for females was 456 mm, while males averaged 328 mm. No flounder in excess of 405 mm were identified as male southern flounder, and very few males longer than 355 mm were observed.

True catch/effort data were all but impossible to obtain. Most sets were fished on an every other day basis, and the fishermen could only give an approximate total weight figure until they were tallied at the fish house.

Table 3.--Total length range (mm) and mean length (mm) for each species of flounder in the pound net catch, 1976.

Species	September	October	November	TOTAL
	Length range Mean length	Length range Mean length	Length range Mean length	by species
<i>P. lethostigma</i>	285-515 360	225-705 378	235-705 406	225-705 382
<i>P. dentatus</i>		375 375	185-415 284	185-415 291
<i>P. albiguta</i>		315-415 339		315-415 339
TOTAL by month	285-515 360	225-705 378	185-705 391	185-705 379

A total of 5,150 lb was landed in five samples where accurate weights could be calculated. This is a little over 1000 lb per landing or 500 lb/net-day. Given the variables of net size, set differences, and length of fishing time, these numbers are all but meaningless at this time.

Pound nets are registered by the Law Enforcement Section of the Division. Information is gathered on the owner's name, set location, number of pounds per set, lead length, date of set, and approximate termination date. During the 1976-77 pound net season, 47 individual fishermen registered 96 pound net sets. These sets contained 391 pounds with 82,025 yd of leads, an average lead of approximately 200 yds/pound. Over two-thirds of the sets and pounds by number were located between Portsmouth Island and Nelson Bay in Core Sound (Figure 1).

Since the pound net is a rather non-selective piece of gear which appears to fish with equal effectiveness on all species moving by, notes were taken on associated species occurring along with paralichthid flounders. Species observed in the pound net catch in descending order by number were:

- | | |
|----------------------|---------------------|
| 1. weakfish | 9. striped bass |
| 2. Atlantic croaker | 10. harvestfish |
| 3. gizzard shad | 11. lookdown |
| 4. blue crab | 12. sheepshead |
| 5. Atlantic menhaden | 13. spot |
| 6. pinfish | 14. Florida pompano |
| 7. bluefish | 15. black drum |
| 8. red drum | 16. burrfish |

SURVEY OF MINOR TRAWL FISHERIES

Description of the Fishery

At the present time, it is unlawful in North Carolina to use a trawl net for the taking of finfish in any of the coastal waters of the State, except in the Atlantic Ocean [15 NCAC 3B .0305 (1)] (North Carolina Department of Natural Resources and Community Development, 1977). At the same time, regulations allow the taking of crabs in inside waters by trawl. While the same section prohibits using a crab trawl for the purpose of taking any fish species, other than crabs, it does allow a tolerance limit of 25 percent by volume or weight [15 NCAC 3B .0801 (3)(A)(B)] (ibid.).

As the winter trawl fishery for blue crabs has grown over the past few years into a important fishery for some crabbers, the incidental catch of flounders has risen to become a major component of winter revenue for these fishermen. The greatest portion of this fishing activity takes place in the Pamlico, Neuse, and New Rivers, and to a much lesser extent, the Cape Fear River (Figure 2). In the recent past, this activity has commenced in October and continued through February, or even April, depending on water temperatures. The factors limiting this activity appear to be (1) water temperature, (2) crab prices, (3) flounder availability, and (4) the size of the overwintering pink shrimp population which fishermen begin harvesting as soon as they become available in the spring.

Sampling Methods

Trawlers were sampled in the areas where minor trawl fisheries occurred in conjunction with blue crab sampling under another P.L. 88-309 project, 2-292-R. Data were collected on species composition, size ranges, and magnitude of the flounder catch.

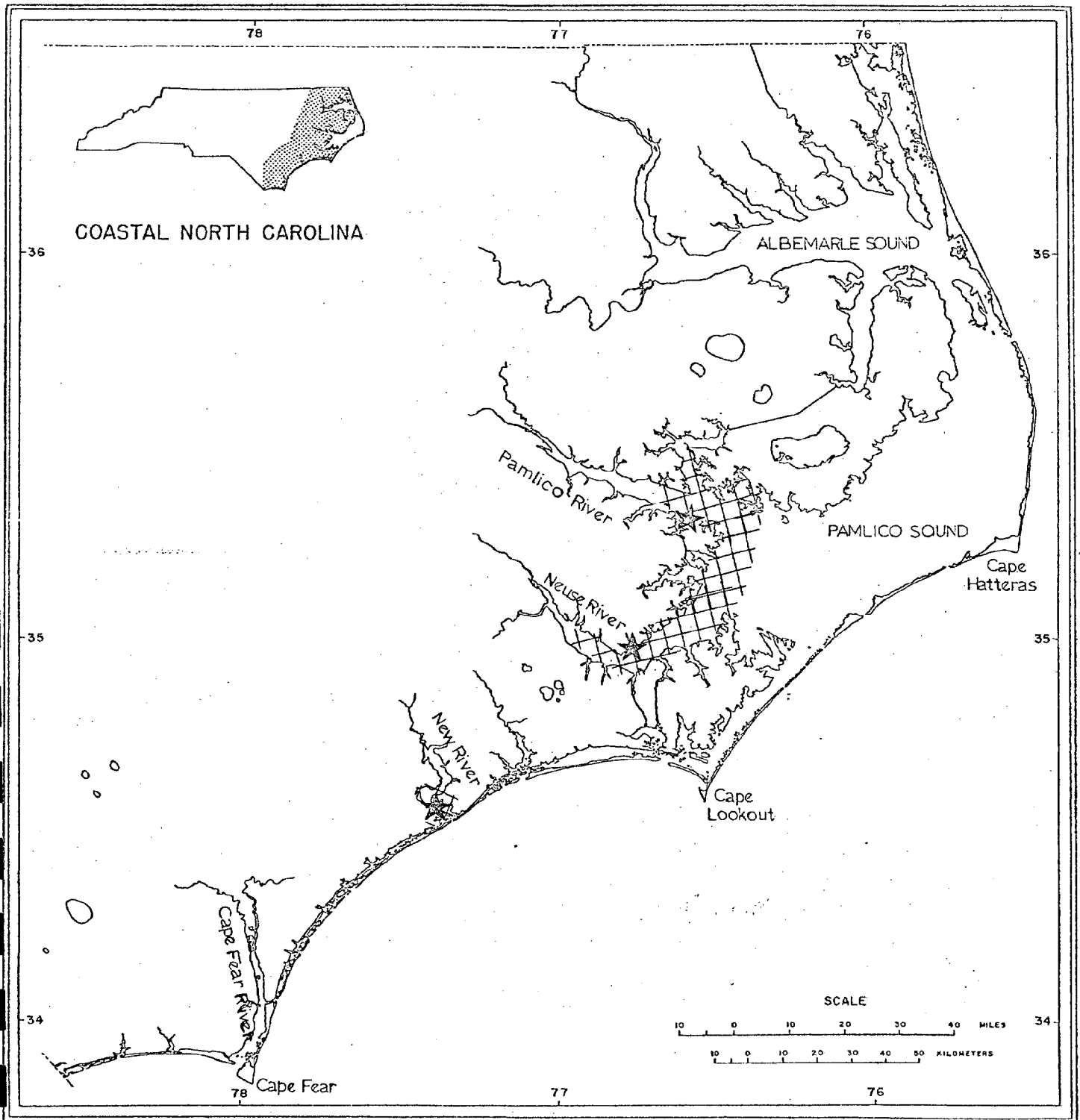


Figure 2.--Areas of activity (◇◇◇◇) and sampling (★) for the minor trawl fishery for flounder, 1976-1977.

Results

Very little effort was expended by crabbers in the Neuse and Pamlico Rivers during the fall and winter of 1976-77. Shrimp catches remained moderate into the fall, and crab prices remained low. When effort turned from shrimping to crabbing, severe cold weather forced the majority of the boats to remain at the dock. Crabbers requested the 25 percent fish tolerance regulation because they were having a poor season on the winter crabs and needed to legally keep their by-catch of fish for sale.

Four samples were taken in November and three in December in which no flounders were collected in the Neuse and Pamlico Rivers. No further samples were attempted until late March as severe weather curtailed the majority of fishing effort in this area.

No flounder were collected from inside crabbers or trawlers in the New and Cape Fear Rivers during the winter. The major factor causing the reduced inside effort was that many southern area trawlers joined the offshore fleet fishing for *P. dentatus* from Ocracoke Inlet north along the coast.

Sampling cruises were conducted aboard a Division of Marine Fisheries vessel to assess winter crab mortalities. These cruises in the Neuse and Pamlico Rivers during February, March, and April 1977, collected no flounders at sites normally supplying commercial catches.

SURVEY OF RECREATIONAL FISHERY

Description of the fishery

Recreational fishing for flounders along the North Carolina coast consists of two main components: Hook-and-line and gigs or spears. A hook-and-line recreational fishery, principally for flounders, has evolved along coastal North Carolina during the past few years. These activities occur at Drum Inlet, usually from June through October, and at Cape Hatteras and Cape Lookout from October through January. These efforts are in response to the so-called "flounder blitz" when flounder supplant bluefish, red drum, and sea trouts as the main species of interest.

Sampling Methods

Attempts were made to sample catches by each fishing method, during the time frame that comprised their peak effort. Fishing parties were contacted as they actively engaged in their respective efforts, or returned to a landing site. Species composition, size range, sex ratio, and catch/effort data were collected for captured flounders.

Sampling contacts for the hook-and-line fishery were attempted at Cape Hatteras, Drum Inlet, Cape Lookout, Bogue Inlet, and in the Wrightsville Beach vicinity. Sampling of the gig fishery was mostly directed in the Cape Lookout-Bogue Banks areas with some supplemental collections near Wrightsville Beach.

Results

The effects of the winter of 1976-77, referred to in the pound net discussion, were most severe in their alteration of previously observed patterns in the hook-and-line fishery. At no time did large concentrations of flounders populate the surf areas as in the recent past. No large catches were recorded at any of the normal "hot spots" of flounder fishing. It is believed that the severe cold temperatures forced the flounders to occupy deeper, offshore waters.

Sampling trips were conducted at Drum Inlet, Cape Hatteras, and Cape Lookout from June through October, and not once were large groups of fishermen observed making extensive catches of flounder. After October, severe cold weather curtailed all beach and inlet fishing until late spring.

The gig or spear fishery has traditionally been concentrated around Morehead City, though by no means is it exclusive to this area. Gig fishing is usually carried out from August through December as the weather will allow. Generally, at Cape Lookout and along Bogue Banks, a northerly wind is necessary in order for the surf to calm sufficiently to carry out this activity (Warlen, 1975).

I made several fishing attempts and contacted other recreational and commercial gig fishermen from late August through October. After that time, severe cold weather curtailed all fishing attempts. Never were more than three flounders collected at any one time.

Species composition and size range were determined for fishes that were collected in eight sampling trips (Table 4). Many other sampling attempts secured no flounders.

The gig season for flounders did not materialize during 1976-77 as it had in the recent past. Once again, this failure of flounders to concentrate inshore along the beaches was attributed to the severe cold temperatures which probably forced the fish further offshore into deeper waters.

Table 4.--Species composition and size ranges (mm) of flounders collected by gig sampling, 1976.

Month	Location	<i>P. lethostigma</i>	<i>P. dentatus</i>	<i>P. albigutta</i>
August	Wrightsville Beach	345-635 (N = 8)	355 (N = 1)	
September	Morehead City		415 (N = 1)	315-345 (N = 2)
	Wrightsville Beach	515 (N = 1)	305-525 (N = 8)	325 (N = 1)
	Cape Lookout	415 (N = 1)	365-505 (N = 2)	
October	Wrightsville Beach	285-495 (N = 19)	295-335 (N = 2)	
	Cape Lookout			305-315 (N = 2)
	Morehead City		255 (N = 1)	
November	Morehead City		405 (N = 1)	
TOTALS		285-635 (N = 29)	255-525 (N = 16)	305-345 (N = 5)

SUMMARY AND CONCLUSIONS

1. The species composition of the pound net catch was 95.8 percent *P. lethostigma*, 3.5 percent *P. dentatus*, and 0.7 percent *P. albigutta*.
2. The mean length for *P. lethostigma* in the pound net catch was 383 mm.
3. The mean length for *P. lethostigma* for September, October, and November in the pound net catch was 360 mm, 378 mm, and 406 mm respectively.
4. Female *P. lethostigma* averaged larger (456 mm) than males (328 mm) in the pound net catch.
5. No male *P. lethostigma* larger than 405 mm were recorded.
6. Catch/effort data were unobtainable during the study period.
7. Pound nets fished for flounder catch other species as well, with weakfish, Atlantic croaker, gizzard shad, and blue crab being the most prevalent by number.
8. The severe winter of 1976-77 sharply curtailed the length of the pound net season and the availability of flounders to the pound net fishermen.
9. Minor trawl fisheries in the Neuse and Pamlico Rivers for flounders and crabs did not take place as in previous years, probably because of the severe winter.
10. Recreational hook-and-line fishing did not produce flounders in sufficient numbers for sampling during the fall, 1976.
11. Sampling of gig fishermen showed that *P. lethostigma* was the most prevalent flounder, particularly south of Morehead City.
12. Both hook-and-line and gig fishing were severely affected by very low winter temperatures.

RECOMMENDATIONS

1. Initiate a statistics program based on catch/effort for all flounder fisheries.
2. A program of tagging 150 to 255 mm *P. lethostigma* should be conducted during the summer in Pamlico Sound, Neuse River, and Pamlico River, to learn more about migration patterns and harvest pressures on the major species taken by the inshore fishery.
3. A similar tagging program should be instituted for *P. dentatus* in an effort to determine to what extent the Pamlico Sound complex serves as a nursery area for Atlantic coast stocks.
4. Monitoring of minor trawl fisheries, wherever these occur, should be continued by Division of Marine Fisheries area fisheries personnel.
5. A recreational fishing program should be instituted to enable the Division of Marine Fisheries to determine the magnitude of the recreational fishing pressure and harvest.
6. Valid management decisions cannot be reached without all of the above working as one unit through the Division of Marine Fisheries.

ACKNOWLEDGEMENTS

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