

Nursery Area Survey of Northern Pamlico
Sound and Tributaries

Completion Report

For

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ABSTRACT

A project was initiated in northern Pamlico Sound, North Carolina, to identify nursery areas for economically-important species of finfish and crustaceans. During the 12-month study period from July, 1974 through June 1975, a total of 709 samples was collected. Fifty-five species of finfish and seven species of invertebrates were taken. Twenty species of finfish and four species of invertebrates were considered to be of economic importance. Nursery areas were designated on maps for five species of finfish (menhaden, weakfish, spot, croaker, southern flounder) and three species of invertebrates (brown shrimp, white shrimp, blue crab).

INTRODUCTION

Pamlico Sound lies between the mainland and Outer Banks of North Carolina, covering approximately 440,300 ha (Figure 1). The combined freshwater inflows of the Neuse and Tar-Pamlico Rivers counteract the tidal influx through the three ocean inlets, resulting in a lack of lunar tides throughout the sound, except near the inlets.

This large brackish body of water supports some of North Carolina's most important fisheries; shrimp, blue crabs, spot, croaker, flounders, mullet, bluefish, and American shad fisheries are centered or emphasized mostly in Pamlico Sound. Statistics on the commercial catch during the period 1969-1972 for Pamlico Sound (Table 1) show the relationship between Pamlico Sound landings and the total landings for North Carolina. Of all the commercially-important species in the North Carolina landings, only menhaden catches are centered outside the estuary, but the menhaden itself is an estuarine-dependent species.

Despite the importance of Pamlico Sound to North Carolina's fisheries, little management-oriented research has been conducted in the area. Roelofs (1950) and Wolff (1972) investigated the scrap fishery and the effects of trawling on small fish and shrimp. McCoy (1968, 1972) and Purvis and McCoy (1974) studied migration, growth, and mortality of shrimp in western Pamlico Sound. Based on McCoy's work and on current studies, the North Carolina Division of Marine Fisheries is attempting to manage the important shrimp fishery in Pamlico Sound. Management has not been attempted for any other species of finfish or crustaceans in the sound because of an almost total lack of management-oriented data.

Godwin, Street, and Rickman (1971 a,b), in their study of North Carolina fishery problems and priorities, recommended a coastal estuarine inventory program. The first federal aid project initiated was to survey and identify the important nursery areas in the western Pamlico Sound region (Spitsbergen and Wolff, 1974). The project covered in this report was initiated to continue the survey of important nursery areas to include the northern Pamlico Sound region during July 1974 - June 1975.

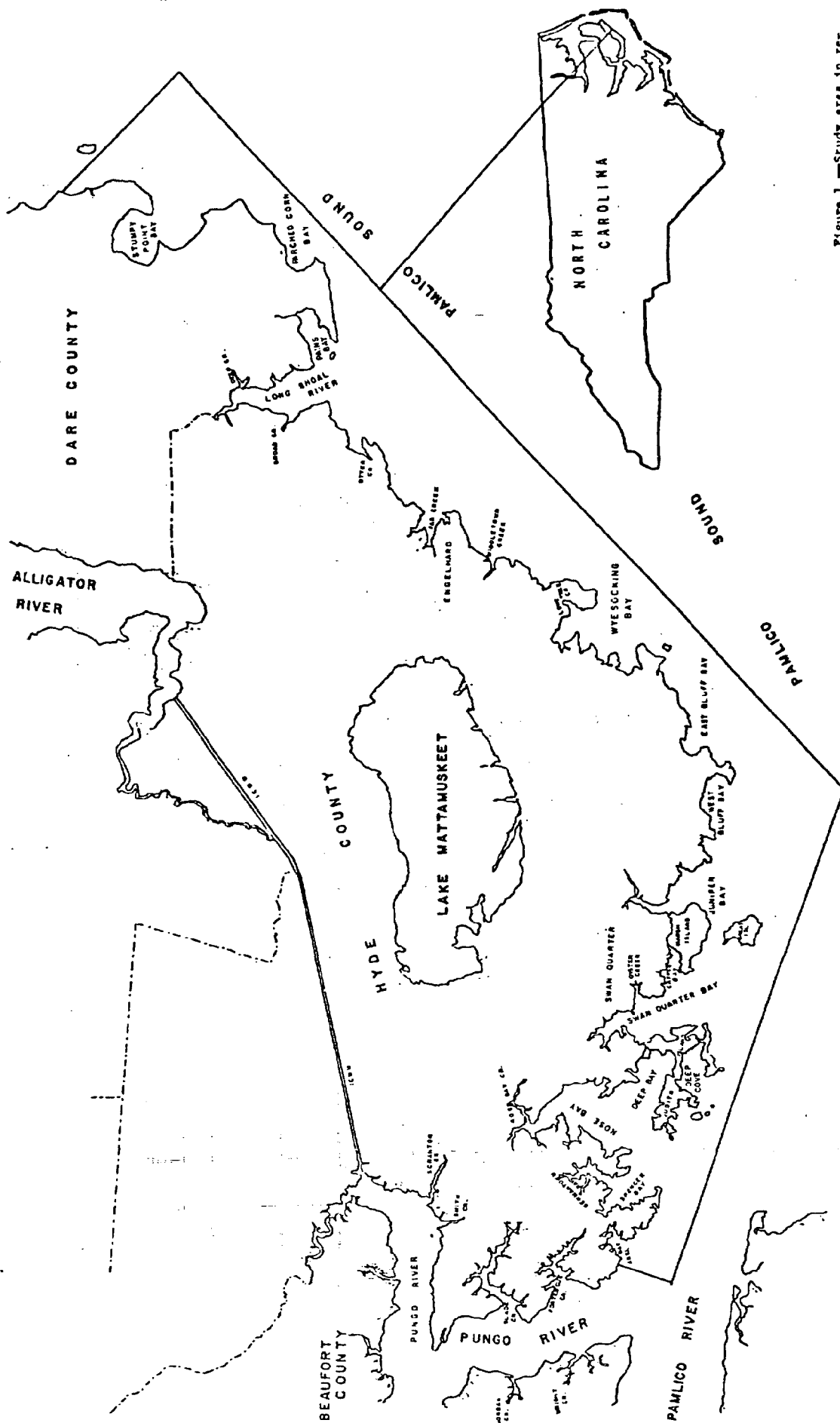


Figure 1.—Study area in re-
lation to coastal North Carolina.

TABLE 1.—Statewide landings of commercial fish, shrimp and crabs, and percent total from Pamlico Sound, 1969 through 1972. (Pounds x 1000)

Species	1969			1970			1971			1972		
	State- wide	Pamlico Sound	% State total	State- wide	Pamlico Sound	% State total	State- wide	Pamlico Sound	% State total	State- wide	Pamlico Sound	% State wide total
Alewife &												
Blueback	19,762	2	0.0	11,521		0.0	12,722	1	0.0	11,237		0.0
Bluefish	891	170.4	19.1	496	128.8	26.0	578	122.4	21.2	1,167	48.3	4.1
Butterfish	130	14.2	10.9	133	1.1	.8	58	2.7	4.7	88	2	2.3
Croaker	1,369	57.6	4.2	807	123.9	15.4	948	139.1	14.7	4,108	241.9	5.9
Drum, red		.9			2.7		17	2.2	12.9	42	14.7	35.0
Flounder	2,766	355.4	12.8	3,163	158.6	5.0	4,011	159.3	4.0	4,655	240.9	5.2
Harvestfish	25	18.2	72.8	27	17	63.0	48	26.5	55.2	57	14.8	26.0
Kingfish	843	41.7	4.9	563	31.6	5.6	478	37.9	7.9	683	21	3.1
Mullet	1,090		0.0	1,123	108.8	9.7	713	56	7.9	1,176	12.7	1.1
Pigfish	181	54.1	29.9	181	69	38.1	257	84.1	32.7	171	24.2	14.2
Spotted trout	189	47	24.9	405	104.2	25.7	338	111.1	32.9	502	132.1	26.3
Spot	1,488	255.2	17.2	1,529	46.3	3.0	1,190	370.3	31.1	3,902	193.6	5.0
Spanish												
Mackerel	89	68.8	77.3	63	38.4	61.0	95	21.3	22.4	96	2.1	2.2
Sturgeon		1.9			.7		78	4.7	6.0	154	3.2	2.1
Puffer- fish		1.8			2.8		43	3.7	8.6	55		0.0
White perch	207	.7	.3	211	2.5	1.2	367	10	2.7	201	5.9	2.9
Eel	18		0.0	16		0.0	167		0.0	77		0.0
Weakfish	1,539	136.3	8.9	2,441	119.4	4.9	3,645	110.3	3.0	7,372	102.9	1.4
Shad	719	124.9	17.4	953	432.1	45.3	680	189.4	27.9	468	78.7	16.8
Menhaden	145,235		0.0	108,235		0.0	79,488		0.0	84,692		0.0
Shrimp	7,854	4,627.8	58.9	5,054	2,564.8	50.7	7,615	3,398.3	44.6	5,563	1,871.7	33.6
Blue crab	22,159	12,187	55.0	20,880	11,644.1	55.8	14,472	8,858.6	61.2	13,479	7,421.6	55.1

Data compiled from Branch of Statistics, National Marine Fisheries Service, Pivers Island, Beaufort, N.C.

General criteria for designation of nursery areas have been developed for the estuarine waters of western Pamlico Sound. As evidenced by these criteria, the various classifications are based to some extent on salinities and bottom type. For purposes of Pamlico Sound management application and standardization, catch-effort densities required for designation of nursery areas for western Pamlico were utilized for this project.

Area Type I - Primary nursery

These are areas in the system (usually shallow tributaries, low salinity, mud and/or mud-grass bottom) where initial post-larval development takes place. Primary nurseries are usually located in the uppermost sections of a system and where populations were uniformly very early juveniles.

Area Type II - Secondary nursery

These are in the mid-portion of a system (usually shallow bays or navigation channels; moderate depths, slightly higher salinities, and sand and/or sand-grass bottoms) where juvenile development takes place. Populations were usually developing juveniles of similar size.

Area Type III - Temporary nursery or transport area

These are the lower portions of a system where young-of-the-year and adults mix. Of the three types, these usually have the greatest depth and highest salinity with sand bottoms. Type III areas are utilized as late-stage gathering areas prior to migration or as a migration route to and from the ocean.

DESCRIPTION OF ESTUARINE STUDY AREA

The study area consisted of all waters in northern Pamlico Sound located between Abel's Bay and Stumpy Point Bay under the jurisdiction of the Division of Marine Fisheries (Figure 1). In order to observe each tributary system separately and also to aid in data processing, the total area was divided into 10 sub-areas. The sub-areas consisted of the major tributary systems

with the exception of the "P-stations" which were representative of Pamlico Sound proper. Each sub-area had an adequate number of stations to sample the representative ecological and hydrological conditions existing in that area (Figure 2).

The study area totaled approximately 17,485 ha of estuarine waters. The area is characterized by low-lying pine pocosin drainages, bordered along the estuarine zone primarily by black needlerush (*Juncus roemerianus*).

Extensive agricultural land clearing and drainage operations surround the area. The conversion of large areas from swamp to farmland, even though known by State officials to be economically-beneficial, caused concern about damage to the environment. Of major concern are changes in the water quality of the sounds and estuaries, caused by rapid runoff of water. Although this problem cannot be completely avoided, some of its effects can be minimized by the application of sound management policies based on water-resources technology now available.

Spencer Bay Study Area

This area, located where the Pamlico and Pungo Rivers converge, consists of Spencer's Bay, Germantown Bay, and Abel's Bay. The area contains 1,037 ha of water and 5 stations were selected as sampling sites. Commercial activity consisted primarily of crab-potting, long haul seining, and peak-season trawling for shrimp and crabs also occurred. Mean salinity for the area was 11 parts per thousand (ppt). Mean high was in November, 1974 at 15 ppt, while the mean low of 8 ppt occurred in June, 1975.

Rose Bay Study Area

Deep Bay and Deep Cove are included in this tributary system of Pamlico Sound. Rose Bay is one of the State's better oyster-producing areas and the best in northern Pamlico Sound. Commercial activity was seasonal with oyster-dredging in winter, shrimp-trawling in summer, and crab-trawling in fall and spring. Crab pots covered the upper bay and tributaries. For this area, 10 sampling stations were selected. Base year mean salinity was 11 ppt. Mean high was in December, 1974 at 15 ppt, and the mean low was 8 ppt in May, 1975.

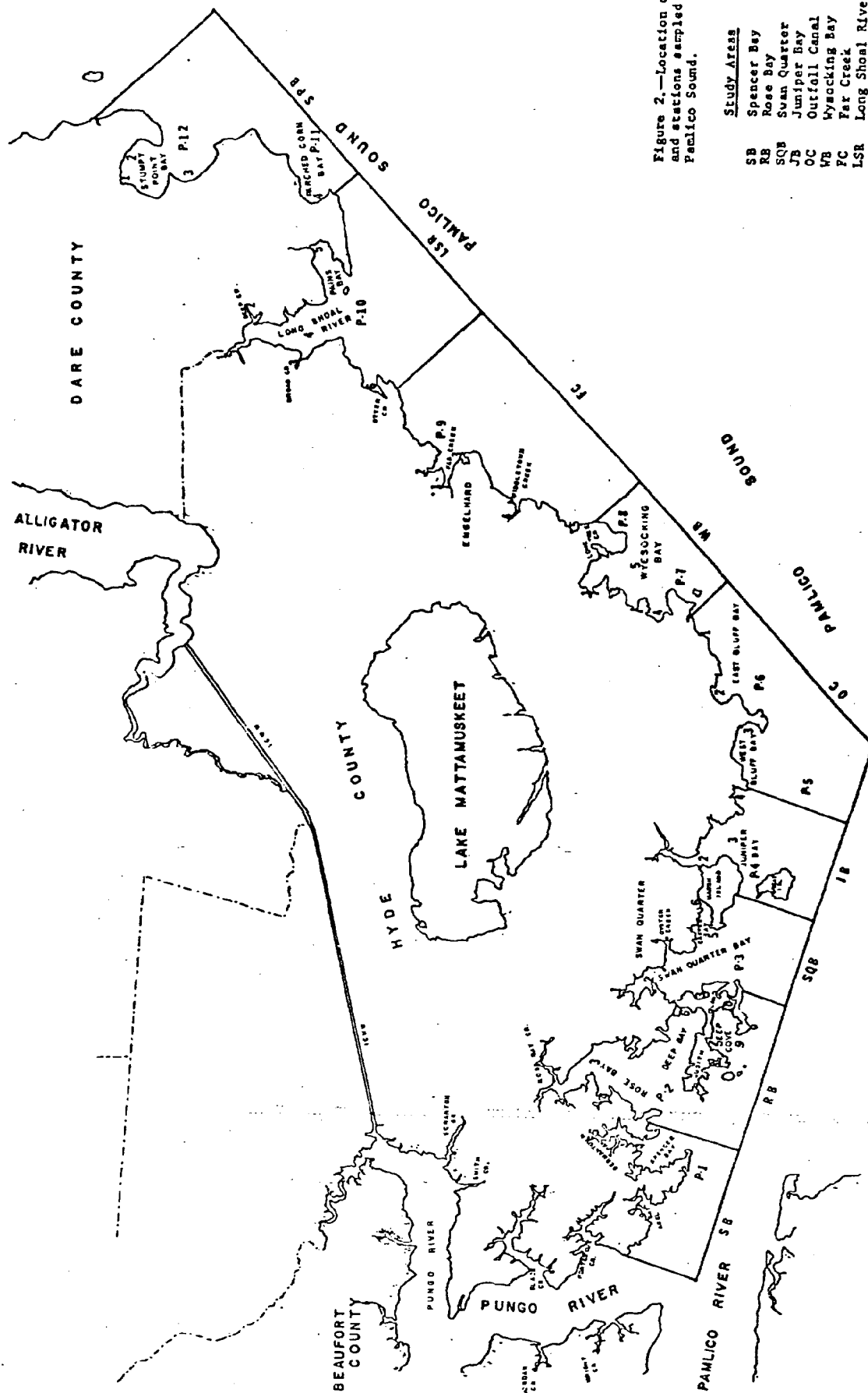


Figure 2.—Location of sub-area and stations sampled in northern Pamlico Sound.

Study Area	No. of Stations
SB Spencer Bay	5
RB Rose Bay	10
SQB Swan Quarter	6
JB Juniper Bay	4
OC Outfall Canal	3
WB Wysocking Bay	3
PC Far Creek	5
LSR Long Shoal River	5
SPB Stumpy Point Bay	6
P Open Waters of Pamlico Sound	4
	12

Swanquarter Bay Study Area

Swanquarter Bay, Oyster Creek, and Caffee Bay make up this study area which contains 2,073 ha of water. Six stations were selected as sampling sites. Like Rose Bay, Swanquarter Bay is a heavy oyster-producer. Concentrated commercial activity included shrimp-and crab-trawling, long haul-seining, and crab-potting. This area also supports heavy sport fishing activity. Mean salinity for the area was 12 ppt. Mean high was in December, 1974 at 16 ppt and the mean low was 8 ppt in April, 1975.

Juniper Bay Study Area

This area, including an unnamed tributary at Juniper Bay Pt., contains 1,700 ha. Four sampling sites were selected for this area. Commercial activity would be labeled as moderate when compared with Rose and Swanquarter Bays. The activity was primarily crab-trawling with some shrimp-trawling during the peak of the season. Long haul crews and crab-potters occasionally utilize the area. Base year salinity was 11 ppt. Mean high was 15 ppt in November, 1974 and the mean low was 8 ppt in April, 1975.

Outfall Canal Study Area

This area encompasses the mouth of Outfall Canal, West Bluff Bay, and East Bluff Bay. Three sites were selected to sample the 1,264 ha of water contained in the area. Commercial activity was predominately crab-potting. Base year mean salinity was 13 ppt. Mean high was 16 ppt in November, 1974, and the mean low was 10 ppt in May, 1975.

Wysocking Bay Study Area

Wysocking Bay Study Area is comprised of Mt. Pleasant Bay, Douglas Bay, and Long Tree Creek. This area contains 1,544 ha of water, and 5 sampling sites were selected. Moderate commercial activity included shrimp- and crab-trawling with most emphasis being placed on crab-potting. Base year mean salinity was 14 ppt. Mean high was 17 ppt in November, 1974 and the mean low was 10 ppt in April, 1975.

Far Creek Study Area

Middletown Anchorage, tributary to Pamlico Sound, and Waupopin Creek, tributary to Far Creek, were included in this area. There were 5 stations located throughout the 321 ha area. This area has been closed to all trawling activity for three years, and provided an excellent opportunity to study populations not affected by trawling activities. Base year mean salinity was 15 ppt. Mean high was 18 ppt in November, 1974, and the mean low was 10 ppt in April, 1975.

Long Shoal River Study Area

Otter Creek, Broad Creek, Deep Creek, and Pains Bay were tributaries of Long Shoal River included in the study area. This area is the largest open body of water in the entire study area. Moderate commercial activity includes peak shrimp- and crab-trawling, long haul-seining, pound-netting, and crab-potting. Six sampling stations were needed to adequately represent the 1,793 ha of water contained in the area. Base year mean salinity was 12 ppt. Mean high was 16 ppt in December, 1974, and the mean low was 8 ppt in May, 1975.

Stumpy Point Bay Study Area

This area is composed of Parched Corn Bay and Stumpy Point Bay. For this area, four sampling stations were selected. Moderate to heavy commercial activity includes shrimp- and crab-trawling, crab-potting, long haul seines, and pound-netting. Base year mean salinity was 12 ppt. Mean high was 17 ppt in January, 1975, and the mean low was 5 ppt in April, 1975.

P - Stations

The P-stations, totaling twelve, consisted of all the stations worked in the open waters of Pamlico River, Long Shoal River, Pamlico Sound, and the mouths of the bays included in the study area. Due to inoperative Division vessels, the project was amended in September, 1974, moving the P-stations closer inshore to allow sampling from smaller skiffs. Data presented are

based on total collections from both P-station locations as it is felt that both locations were quite similar and representative of the open water habitat. Commercial activity was primarily shrimp- and crab-trawling. Base year mean salinity was 14 ppt. Mean high salinity was 17 ppt in January, 1975, and the mean low salinity was 10 ppt in April, 1975.

SAMPLING METHODS AND MATERIALS

Standard gear and sampling procedures used in this study were based on previously-initiated Division studies of the North Carolina estuaries. The basic gear and its use is standard for all the estuarine areas of the State now under study so that quantitative data may be compared.

The basic gear was a 3.96 m (13 ft) headrope, flat otter trawl with 6.4 mm (1/4 in) bar mesh knotted wings and body, and 6.4 mm (1/4 in) bar mesh knitted tail bag and extension.

The trawl was towed by a 17 ft outboard skiff for one to five minutes at approximately three knots.

A minimum of 30 specimens of economically-important species were measured in 10 mm size groups, weighed, and a count made of the remainder. A size range and total count was made of those species not considered of commercial or recreational importance in North Carolina.

Fork length (FL) from the tip of the snout to the posterior edge of the caudal fork, was used to measure most finfish collected. On fishes without a forked tail (e.g. Atlantic croaker), total length (TL) was measured. For shrimp, total length measurement was taken from the anterior tip of the rostrum to the posterior tip of the telson. Carapace width between the tips of the lateral spines was used on all crabs. All length measurements were in millimeters (mm) and weights were recorded in grams (g).

At each station, surface and bottom salinity and temperature were recorded using a YSI Model 33 S-C-T meter. Bottom type and vegetation were also noted. There were 60 trawl stations sampled monthly during the study.

RESULTS AND DISCUSSION

During the 12 month study period from July, 1974 through June, 1975, 709 samples were collected. Fifty-five species of finfish and seven species of invertebrates were collected during the study (Appendix I). Twenty species of finfish and four species of invertebrates were considered to be of economic importance (Appendix II).

Nursery areas for some of the economically-important species were designated and will be discussed by species. The basic criteria that were used to designate nursery areas were the catch-effort relationship of juveniles in habitat types and the proportion of juveniles per catch in each type of area. Each species captured is discussed below.

FINFISH

LEPISOSTEIDAE

Lepisosteus osseus - Longnose gar

Only one specimen (675 mm) was collected. It was taken in the Rose Bay study area (Station RB-1), May, 1975 at a temperature of 22°C, and a salinity of 10 ppt.

Swingle (1971) reported this species as the most abundant gar in the tidal rivers of Alabama and recorded it in a salinity range of 0.2 to 21.7 ppt. Dahlberg (1972) reported this species as having been collected offshore in Georgia.

ELOPIDAE

Elops saurus - Ladyfish

The eleven specimens of ladyfish collected had a size range of 45 to 205 mm. They occurred most abundantly in the Long Shoal River study area with nine being captured. Swanquarter Bay and Far Creek study areas also produced specimens.

Ladyfish were taken at a temperature range of 24 to 29°C, and a salinity range of 11 ppt to 14 ppt. Dahlberg (1972) found small ladyfish in a salinity range of 0.1 ppt to 28.7 ppt in Georgia.

ANGUILLIDAE

Anguilla rostrata - American eel

A total of 32 American eels was collected. This species was taken from each of the three nursery area types. American eels are catadromous and, according to Bigelow and Schroeder (1953), spawn in mid-winter, thus explaining the lack of adults in the estuary during the months of October through January.

Dahlberg (1972) suggested gradation by size in relation to salinity, with smaller specimens being collected at lower salinities. In this study, eels in the range of 95 to 625 mm were found at a range of 2 to 19 ppt of salinity. Eels were taken at a temperature range of 11 to 33°C.

CLUPEIDAE

Alosa aestivalis - Blueback herring

A total of 103 blueback herring was collected (November through February) with 71 (68.9 percent) being taken in December, 1974. The length range was 25 to 165 mm, with 94.2 percent of those measured being in the 55 to 75 mm range of young-of-the-year. Williams and Deubler (1968 a) reported that young blueback could be collected in the Pamlico Sound complex in all months except April, May, October, and December. Length-frequency data indicated no change in the modal group (65 mm) during the period they were collected.

Blueback were collected in a salinity range of 10 to 20 ppt, and a temperature range of 9 to 14°C. This species made up 0.15 percent by number of the commercial species caught (Appendix II).

Blueback herring were not abundant enough in the catches to designate nursery areas. Highest catch rates were in Long Shoal River study area (8/min), and Wysocking Bay study area (7/min). Specimens were captured at only 12 of the 60 stations sampled. Blueback herring were considerably more abundant in the Type I areas than in other areas.

In general, juvenile blueback herring utilized some of the shallow tributaries of northeastern Pamlico Sound as a secondary nursery area during migration from freshwater primary areas to the ocean. It is believed that the juveniles migrated from Albemarle Sound which is a major spawning and nursery area. The Wysocking Bay concentration was probably due to an isolated spawning population that migrates to upper Wysocking Bay. Davis and Cheek (1967) suggested that seaward migration of this species was stimulated by the first significant decrease in water temperature, usually during October and November.

Alosa pseudoharengus - Alewife

A total of 26 alewife was collected from November, 1974 to January, 1975 with 69.2 percent being taken during the month of December. Williams and Deubler (1968 a) reported taking alewife during March and April. Spitsbergen and Wolff (1974) reported collections during the months of November through March. Length range of the alewife was 85-125 mm, with 57.7 percent being in the 95 mm size group. Alewife were collected in a salinity range of 14 to 18 ppt, and a temperature range of 7 to 10°C.

Alewife were not abundant enough in the catches to designate nursery areas. Spencer Bay and Rose Bay study areas were most utilized. Alewife appeared to utilize these areas as secondary nursery areas during migration to the ocean from spawning areas located in the upper extremes of the Pamlico and Pungo Rivers. Holland and Yelverton (1973) reported that juveniles predominated in the alewife catches offshore in January and early February.

Brevoortia tyrannus - Atlantic menhaden

A total of 9,840 menhaden was collected during this study. This species was the third most abundant in numbers of commercial finfish and comprised 15.18 percent of the economically-important finfish collected (Appendix II). Menhaden were taken during all months of the study, with the greatest number (2,864 - 22.6 percent) collected in May, 1975, and the fewest specimens (16)

taken in December, 1974. Lengths of menhaden ranged from 15 to 215 mm. Collections were taken in temperature and salinity ranges of 6°C to 33°C and 1 to 20 ppt, respectively.

Length-frequency data indicate major recruitment of postlarval menhaden into the study area during February through June (Table 2), resulting in 84.8 percent of the total menhaden catch. Based on the length-frequency data, 98 percent of the specimens were juveniles. Spitsbergen and Wolff (1974) reported a similar condition existing in western Pamlico Sound. Lewis and Mann (1971) reported collecting larval menhaden near Beaufort Inlet, N.C. from November through April, with the major influx coming in the last half of March.

Spitsbergen and Wolff, 1974 suggested a catch rate of 21/min. or greater for designation of a primary nursery area for menhaden (Figure 3). Major concentrations were encountered in every study area, with catches in all but two of the sixty stations sampled. Some of the better areas were Swanquarter Bay study area (Station SQB-1) which produced 335/min, Juniper Bay study area (JB-1) produced 390/min., Rose Bay study area (RB-2) yielded 376/min., and Spencer Bay study area produced 294/min. It is well to note that all the above peak catches were obtained in the Type I nursery areas. In general, the areas of prime concentrations of juvenile menhaden consisted of those low-salinity, shallow *Juncus*-bordered creeks with soft mud bottoms and considerable detritus.

Dorosoma petenense - Threadfin shad

Of the 50 threadfin shad collected, 42 (84 percent) were taken during the months of November through March. Spitsbergen and Wolff (1974) reported a similar situation in western Pamlico Sound, with 96.7 percent of their catch being taken during the same time frame. This species was collected in a salinity range of 3 ppt to 19 ppt and a temperature range of 7 to 26°C. The size range was 65 to 125 mm.

TABLE 2. Length - frequency distribution of Atlantic menhaden (*Brevoortia tyrannus*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974					1975								TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE		
5														
10														
15														
20														
25	4							249	139	32	30		454	
30														
35	61	12						173	179	366	377	283	1451	
40														
45	193	78	11	1			1			80	244	91	699	
50														
55	17	47	36	16	1	1	3			6	17	29	173	
65	3	15	12	49	1	2	1	3	1			2	89	
75			2	19	17	4	6	19	2		1		70	
85				9	24	4	2	61	11	4	3		118	
95		2	1	4	10	4		26	3	4	3		57	
105				1	7		1	15	1	2			27	
115		2		1	7		3	2					15	
125	1	1	1		21		4	1					29	
135					12								12	
145					10	1	3						14	
155					7		3						10	
165														
175														
185														
195														
205														
215		1											1	
225														
235														
245														
255														
265														
275														
285														
298														
305														
No. measured	279	158	63	100	117	16	27	549	336	494	675	405	3219	
No. collected	508	220	95	100	532	16	27	2068	648	1729	2864	1033	9840	

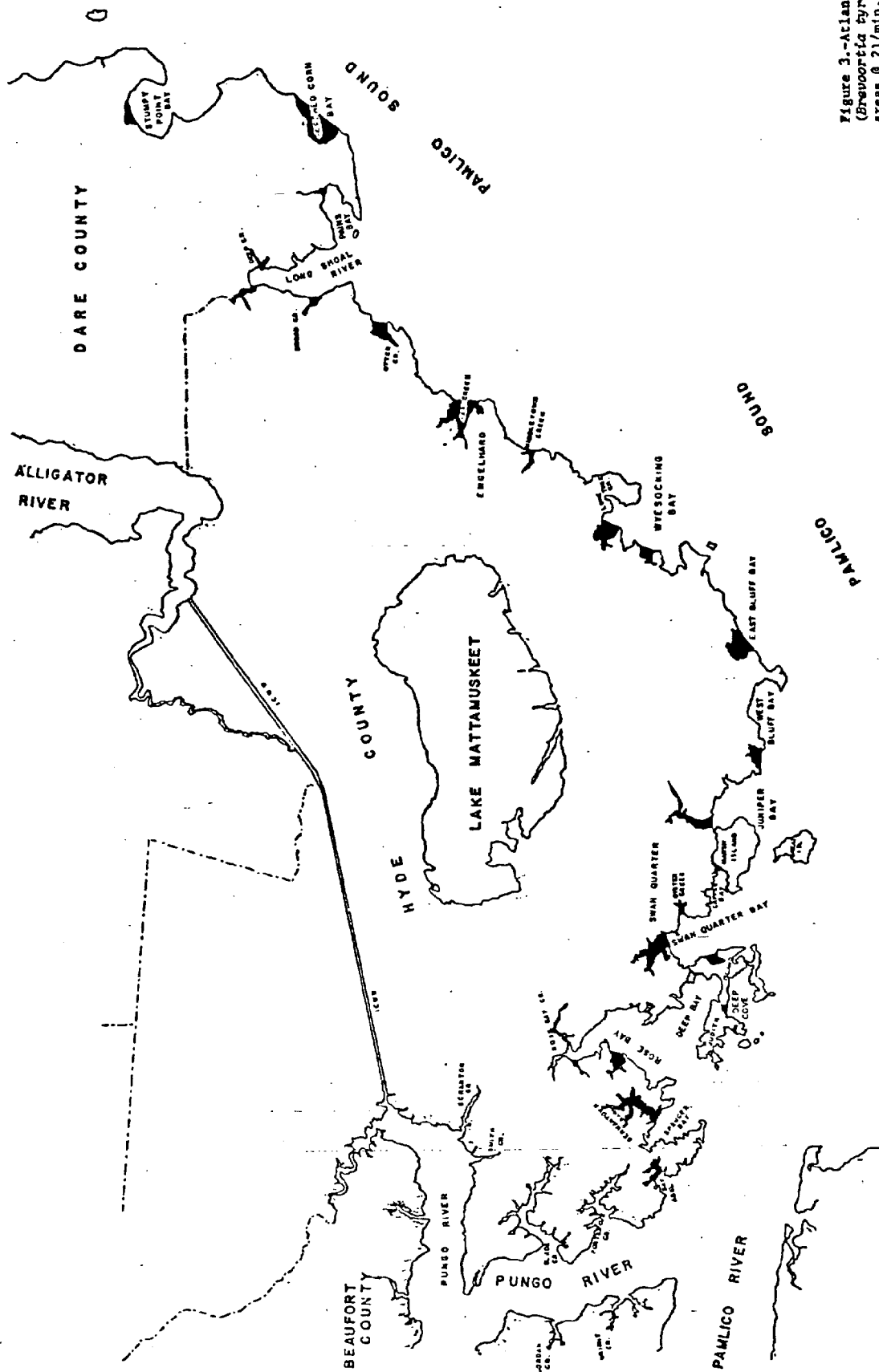


Figure 3.-Atlantic menhaden (*Brevortia tyrannus*) nursery areas @ 21/min. or greater

Nursery area

Personnel of the North Carolina Wildlife Resources Commission, Division of Inland Fisheries, revealed that largescale introductions of *Dorosoma petenense* took place in reservoirs of the Atlantic drainage, particularly the Roanoke River drainage, in the late 1950s to 1960s.

Studies similar to the present one in other states have collected *Dorosoma petenense* at salinities of 0 to 35 ppt, with most collected below 5 ppt (Perret, et al, 1971; Springer and Woodburn, 1960; Swingle 1971; and Dahlberg, 1972).

ENGRAULIDAE

Anchoa hepsetus - Striped anchovy

A total of 46 striped anchovy was collected, ranging from 45 to 115 mm in length. Of those taken, 35 (67.8 percent) were captured during the period July-September. *Anchoa hepsetus* were captured in a salinity of 2 to 19 ppt and a temperature range of 7 to 30°C. Perrett, et al (1971) reported striped anchovies in Louisiana at a salinity range of 7 ppt to 29.9 ppt, with the highest occurrence above 15 ppt, and at a temperature range of 19.5 to 34.9°C. Dahlberg (1972) collected this species only during the months of May through November in Georgia and at a temperature range of 15 to 30.8°C.

Anchoa mitchilli - Bay anchovy

The bay anchovy was the most abundant species collected during this study, with a total of 174,267 being taken. This species was taken during all months of the year, and all sixty stations sampled produced catches. Gunter and Hall (in Perret, et al, 1972) suggested that this species probably has the greatest biomass of any fish in the south Atlantic and Gulf of Mexico estuaries. This was also the most abundant species taken by Spitsbergen and Wolff (1974) in western Pamlico Sound and by Swingle (1971) in Alabama.

Bay anchovies were collected in a salinity range of 2 to 20 ppt and at a temperature range of 6 to 31°C. This species had a size range of 15 to 85 mm. Springer and Woodburn (1960) collected bay anchovies in a salinity range of 5 to 35 ppt and a temperature range of 10.8 to 32.5°C.

SYNODONTIDAE

Synodus foetens - Inshore lizardfish

Five lizardfish were collected during the study. This species was found in a salinity range of 14 to 18 ppt and a temperature range of 21 to 28°C. The size range was 45 to 245 mm. Dahlberg (1972) reported collection of this species in Georgia in a salinity range of 16.7 to 32.0 ppt. Gunter (1945) reported a temperature range of 14.4 to 30.5°C, and a salinity range of 13.7 to 36.7 ppt. Spitsbergen and Wolff (1974) reported a salinity range of 15 to 20 ppt and a temperature range of 9 to 27.5°C for western Pamlico Sound specimens.

BATRACHOIDIDAE

Opsanus tau - Oyster toadfish

Three oyster toadfish were collected; two in August, 1974 and one in April, 1975. These specimens were collected at a temperature range of 20 to 26°C, and a salinity range of 9 to 16 ppt. The length range was 105 to 315 mm. Dahlberg (1972) reported oyster toadfish in a temperature range of 28.4 to 30.8°C, and a salinity range of 12.4 to 32.0 ppt. Richards and Costagna (1970) collected this species at a temperature range of 14.6 to 32.0°C, and a salinity range of 9.3 to 32.8 ppt. Spitsbergen and Wolff (1974) reported a temperature range of 25 to 26°C, and a salinity range of 14 to 19 ppt for western Pamlico Sound collections.

GOBIESOCIDAE

Gobiosox strumosus - Skilletfish

One skilletfish was caught at station FC-3 in Far Creek at a size of 35 mm. The specimen was collected at a temperature of 10°C and a salinity of 19 ppt. Spitsbergen and Wolff (1974) reported collections at a temperature range of 12 to 15°C and a salinity range of 4 to 16 ppt.

GADIDAE

Urophycis regius - Spotted hake

Five spotted hake were collected in the study area during February-April, 1975. All specimens were taken in Type III nursery areas. Spotted hake were collected in a temperature range of 11 to 19°C, and a salinity range of 9 to 17 ppt. They had a length range of 105 to 165 mm.

Dahlberg (1972) reported this species in the lower and middle reaches of the estuary from January to May, and collected it in a temperature range of 8.2 to 24.3°C and a salinity range of 14.5 to 31.1 ppt. Barans (1972) suggested salinity as a limiting factor of up-river movement of spotted hake, and reported 7.0 ppt as the lowest salinity in which this species was collected. He also reported a temperature range of 6.5 to 24.8°C for *Urophycis regius*.

CYPRINODONTIDAE

Cyprinodon variegatus - Sheepshead minnow

Three sheepshead minnows were collected, all from the Rose Bay study area; one in November, 1974 and two in December, 1974. This species was collected in a temperature range of 7 to 10°C and a salinity range of 12 to 15 ppt. The size range was 25 to 95 mm.

Dahlberg (1972) reported this species mainly from shallow water habitat throughout the year, in a salinity range of 0.8 to 34 ppt and a temperature range of 7.9 to 31.9°C.

Fundulus majalis - Striped killifish

Four striped killifish were collected from the Wysocking Bay study area; three in January, 1975 and one in April, 1975. This species was collected in a temperature range of 10 to 20°C, and a salinity range of 10 to 18 ppt. The length range was 25 to 45 mm.

Lucania parva - Rainwater killifish

Fifteen rainwater killifish were collected at station RB-5, Rose Bay study area, in April, 1975. These specimens were captured at a temperature of 19°C and a salinity of 7 ppt. All had a length of 35 mm.

ATHERINIDAE

Menidia beryllina - Tidewater silverside

A total of 471 tidewater silverside was taken. The Wysocking Bay study area was the only area that produced catches consistently. This species was probably equally available all months, but was only taken abundantly by the trawl during the cold months of December, 1974 through February, 1975. Tidewater silverside were collected at a temperature range of 6 to 20°C, and a salinity range of 4 to 16 ppt. Their size range was 35 to 105 mm.

Springer and Woodburn (1960) reported that this species was one of the most common in the Tampa Bay area, and that only a few specimens were collected by means other than seines. Dahlberg (1962) reported tidewater silversides common at salinities of 0 to 7.9 ppt. Division of Marine Fisheries sampling in the Albemarle Sound area, N.C., has shown that seines catch far more tidewater silversides than trawls.

Menidia menidia - Atlantic silverside

A total of 61 Atlantic silversides was collected during January, 1975 in the Long Shoal River and Far Creek areas. Spitsbergen and Wolff (1974) reported highest catches in January with no catch during July through September. This species was collected in a salinity range of 12 to 19 ppt and a temperature range of 10 to 13°C. The size range was 75 to 125 mm.

GASTEROSTEIDAE

Apeltes quadracus - Fourspine stickleback

A single specimen 45 mm in length was collected in February, 1975 at Stumpy Point Bay study area station SPB-1. At the time of collection, the

salinity was 14 ppt and the temperature was 12°C. A survey of the literature indicates that this is probably the first reported capture of this species in North Carolina. Chesapeake Bay had been considered the southern end of the range.

SYNGNATHIDAE

Syngnathus fuscus - Northern pipefish

A total of 15 northern pipefish was collected during the months of July through October, 1974 and May through June, 1975. Station RB-8 (Rose Bay study area) produced consistent catches which were probably due to the shallow water and thick bottom vegetation that is usually associated with pipefish. This species was collected in a salinity range of 9 to 18 ppt and a temperature range of 18 to 28°C. The size range was 75 to 285 mm.

Hildebrand and Schroeder (1928) reported northern pipefish abundant in seine samples from April to October, but more common in deep water during cold months. Dahlberg (1972) reported this species at a salinity range of 0 to 31.3 ppt.

PERCICHTHYIDAE

Morone americana - White perch

Fifty-four white perch were collected during all months except July, August, and December of 1974, and June, 1975. White perch were collected at a salinity range of 1 to 19 ppt and at a temperature range of 5 to 32°C. They had a size range of 55 mm to 255 mm. Mansueti (1951) regarded this species as semi-anadromous, moving from brackish to freshwater in April and May to spawn. This spawning migration may explain the absence of white perch in the study area in June, July, and August. Spitsbergen and Wolff (1974) reported an absence of white perch in western Pamlico Sound during June and July. Length-frequency data indicate the utilization of the nursery area by juveniles during January - April (Table 3).

TABLE 3. Length - frequency distribution of white perch (*Morone americana*) measured from all stations July, 1974 - June, 1975.

	1974					1975							
LENGTH (mm)	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
5													
10													
15													
20													
25													
30													
35													
40													
45													
50													
55									1				1
65							3		2	2			7
75									2	5			7
85													
95							1			2			3
105													
115			1										1
125							5						5
135							3	1					4
145							2						2
155							1						1
165					1								1
175			1					1					2
185					1			1					2
195					1		1						2
205					1		1						2
215					1		1	1			1		4
225				1	2				1				4
235					2		1						3
245					1								1
255				1									1
265													
275													
285													
295													
305													
No. measured			2	2	10		19	4	6	9	1		53
No. collected			2	2	10		19	4	6	9	1		53

CENTRARCHIDAE

Erneacanthus gloriosus - Bluespotted sunfish

One 55 mm bluespotted sunfish was taken during the study. It was collected at station RB-1 (Rose Bay study area) during December, 1974. The salinity was 12 ppt and the temperature was 7°C.

North Carolina state stream surveys (Bayless and Smith, 1962; Bayless and Shannon, 1965) found the bluespotted sunfish to be common in brackish (0-7 ppt), weedy streams of the Neuse and Pamlico drainages. Swingle (1971) reported bluespotted sunfish at a salinity range of 3.8 to 10.8 ppt.

Lepomis gibbosus - Pumpkinseed

Three pumpkinseed were captured as follows: one in November, 1974 (Station RB-1) and two in April, 1975 (Station SQB-4). Pumpkinseed were collected at 4 to 9 ppt salinities and 10 to 14°C temperatures, and had a length range of 125 to 175 mm.

State stream surveys (Bayless and Smith, 1962; Bayless and Shannon, 1965) found the pumpkinseed to be very common in both the Neuse and Pamlico drainages, particularly in the brackish and blackwater tributaries. Bayless and Shannon (1965) theorized that salinities of 1.75 to 7.00 ppt constitute the optimum for *Lepomis gibbosus*, as this species grows to a larger size under those conditions than they normally do in strictly freshwater.

POMATOMIDAE

Pomatomus saltatrix - Bluefish

A total of 42 bluefish were collected, with none coming during the fall and winter months of October, 1974 through February, 1975. Bluefish had a length range of 25 to 185 mm; however, 80 percent were in the 35 to 115 mm range. A number of juveniles in the 35 to 55 mm range were taken in May, suggesting a spring spawning. Spitsbergen and Wolff (1974) reported juveniles during May in western Pamlico Sound. Bluefish were collected in a salinity range of 3 to 15 ppt and a temperature range of 16 to 29°C. Lund and Maltezos (1970) suggested that snapper blues are not tolerant of water temperatures below 10°C.

The bluefish is of considerable commercial and recreational importance and utilized the study area to some extent. Not enough, however, were collected to designate nursery areas for this species. Highest single catch was six at Station JB-4 (Juniper Bay study area) in June, 1975.

CARANGIDAE

Caranx hippos - Crevalle jack

A total of 39 crevalle jack was collected during July, August, and November, 1974 and April through June, 1975. This species was collected in a temperature range of 18 to 26°C and a salinity range of 6 to 16 ppt, and had a length range of 25 to 65 mm. Crevalle jacks appeared more often in the Spencer Bay study area than in any other location.

Gunter (1945) collected crevalle jacks in a salinity range of 4.8 to 36.4 ppt; they were more common above 15 ppt and in a temperature range of 25.5 to 30.5°C. Dahlberg (1972) reported juveniles in summer and fall, with the lowest salinity recorded at 10.8 ppt.

Selene vomer - Lookdown

A total of three lookdowns was collected during July, August, and November, 1974; all came from open water areas. This species was collected in a salinity range of 14 to 18 ppt, and a temperature range of 14 to 29°C, and had a length range of 55 to 85 mm. Perret, et al (1971) reported this species at a temperature range of 15 to 31.9°C, and a salinity range 8.0 to 29.9 ppt, with most specimens occurring at salinities above 20 ppt.

Trachinotus falcatus - Permit

A single specimen, 115 mm in length, was collected in the Far Creek study area, Station FC-1 in September, 1974. At the time of capture, salinity was 16 ppt, and the temperature was 20°C.

LUTJANIDAE

Lutjanus griseus - Gray snapper

A total of 78 gray snappers was collected during August through October, 1974. All but one specimen were captured in either the Rose Bay study area (Station RB-8) or the Wysocking Bay study area (Stations WB-1, WB-2). These areas are characterized by shallow water and heavy bottom vegetation. This species was taken in a salinity range of 13 to 16 ppt and a temperature range of 17 to 27°C, and had a length range of 25 to 75 mm. This species was collected in Georgia from August through November, with the lowest salinity recorded at 13.1 ppt (Dahlberg 1972).

GERREIDAE

Diapterus olisthostomus - Irish pompano

A total of 173 Irish pompano was collected during the months of July through November, 1974 and June, 1975. This species was taken in a salinity range of 3 to 16 ppt and a temperature range of 20 to 30°C. The size range was 15 to 105 mm. Irish pompano were most abundant in the Juniper Bay study area (111 specimens) followed by the Long Shoal River study area with 39 specimens.

POMADASYIDAE

Orthopristis chrysoptera - Pigfish

Twelve pigfish were collected during July through September, 1974. Pigfish had a length range of 65 to 235 mm, and were collected at a temperature range of 18 to 26°C, and a salinity range of 16 to 18 ppt. Six specimens were captured from the Wysocking Bay study area and six from the P-Stations (P-6, P-10). Dahlberg (1972) reported a minimum salinity of 10.0 to 24.9 ppt and a temperature range of 25 to 34.9°C. Springer and Woodburn (1960) found this species most abundant in June and July in Florida.

Pigfish enter the commercial and recreational catches in North Carolina in modest numbers, particularly in the fall. Studies conducted in 1969-1971 showed that pigfish made up about 10 percent, by weight, of the scrap fish catch in North Carolina (Wolff, 1972).

SPARIDAE

Archosargus probatocephalus - Sheepshead

Ten sheepshead were collected in the study area. This species was taken at a salinity range of 5 to 19 ppt and a temperature range of 11 to 27°C, and had a size range of 75 to 225 mm. All specimens were collected from Area Type I - primary nursery.

Lagodon rhomboides - Pinfish

A total of 1,705 pinfish was collected, making it the fourth most abundant non-commercial finfish. Spitsbergen and Wolff (1972) also reported pinfish to be the fourth most abundant non-commercial species for western Pamlico Sound. Pinfish were collected all months of the year, but were most abundant during May. Juveniles (15 to 55 mm) of this species were collected during May and June. Pinfish were taken in a salinity range of 5 to 19 ppt and a temperature range of 10 to 29°C, and had a size range of 15 to 145 mm.

SCIAENIDAE

Bairdiella chrysura - Silver perch

A total of 3,570 silver perch was collected, making it the third most abundant non-commercial finfish. This species was collected every month, but July and August catches comprised 87.6 percent of the total. The majority of those collected were young-of-the-year (range 15 to 95 mm). Silver perch were collected in a salinity range of 1 to 25 ppt, and a temperature range of 9 to 33°C. They had a length range of 15 to 195 mm.

Dahlberg (1972) reported silver perch spawning in Georgia in April and May, and collected this species in a temperature range of 7.5 to 32.0°C and a salinity range of 1.3 to 34.1 ppt. Perret, et al (1971) found this species most abundant in Louisiana during April, and June through August.

Silver perch are not considered to be of commercial importance in North Carolina. However, this species is taken to some extent in recreational fishing. Wolff (1972) found silver perch the fourth most common species in scrap fish catches.

Cynoscion nebulosus - Spotted seatrout

There were 172 spotted seatrout collected, of which 148 (86 percent) were taken during July - September, 1974. Length frequency data (Table 4) show that 97.7 percent of the specimens were in the 25 to 105 mm range and that spawning probably occurs from June through August. Spotted seatrout had a size range of 25 to 225 mm and were collected in a salinity range of 3 to 20 ppt and a temperature range of 10 to 29°C.

Hildebrand and Cable (1934) suggested that spawning for this species occurs from May to August in the Beaufort, North Carolina area. Perret, et al (1971) collected seatrout in a salinity range of 0.2 to 35 ppt, but noted that largest catches were made in salinities of 15 ppt or higher. Dahlberg (1972) reported a minimum salinity for this species of 0.5 ppt.

The total catch of 172 specimens did not constitute a high enough catch to designate nursery areas. However, the data indicate that the Area Type I - Primary nursery is most utilized. The P-stations produced no catches. Rose Bay study area, Station RB-8, produced 51 fish and had a catch effort of 14.6/min. during July through September, 1974. This station is characterized by thick bottom vegetation. This species contributed only 0.21 percent to the total catch of economically-important species, but is of considerable commercial and recreational importance on the North Carolina coast.

Cynoscion regalis - Weakfish

Weakfish were collected during all months of the year except February and March, with highest catches occurring in July, 1974. Fifty-four of the 60

TABLE 4. Length - frequency distribution of spotted seatrout (*Cynoscion nebulosus*) measured from all stations July, 1974 - June, 1975.

	1974					1975							
LENGTH (mm)	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
5													
10													
15													
20													
25	10	18	2										30
30													
35	10	29	9	2								11	61
40													
45	8	9	6										23
50													
55	4	4	7										15
65	1	2	6	1	1								11
75	3	1	6	1									11
85		1	6	1	1								9
95			4	1	1								6
105			1		1								2
115													
125					1								1
135		1											1
145													
155													
165							1						1
175													
185													
195													
205													
215													
225								1					1
245													
255													
265													
275													
285													
295													
305													
No. measured	36	65	47	6	5		1	1				11	172
No. collected	36	65	47	6	5		1	1				11	172

sampling stations produced catches which would indicate that this species does not adhere to a typical nursery area pattern.

Juveniles appeared to prefer more open waters for nursery areas, showing the highest catch/effort in the Type II and III habitat. The highest open water catch occurred in July, 1974 at P-Station 8: 130/min. Channels also appeared to be desirable habitat for juvenile weakfish. Stumpy Point Bay Channel (Station SPB-1) produced catches of 42/min and 45/min during August and September. During the same months, catches of 38/min and 21/min were observed in the Far Creek Channel (Station FC-3). Figure 4 indicates areas in which concentrations of 5/min or greater were taken.

Length-frequency data (Table 5) indicate that spawning occurs from June through August and that the majority of specimens taken in this study were of 0-age class. Weakfish were collected in a salinity range of 2 to 25 ppt and in a temperature range of 9 to 33°C. They had a size range of 15 to 345 mm.

Welsh and Breder (1924) reported an extended spawning season for weakfish of May through September, with the majority spawning from mid-May to mid-June. Dahlberg (1972) reported weakfish at minimum salinity of 6.6 ppt, and found this species least abundant from December to April.

Weakfish accounted for 4.49 percent of the total economically-important species caught and is of considerable recreational and commercial importance on the North Carolina coast. Weakfish comprised nearly 15 percent of the scrap fish landings in North Carolina, ranking second among all species in a study during 1969-1971 (Wolff, 1972).

Leiostomus xanthurus - Spot

Spot were the most abundant commercial vertebrate collected, accounting for 55.5 percent of the economically-important species. A total of 35,954 was collected, with every month producing significant numbers except December. Fork length of spot taken ranged from 15 to 225 mm. Salinities ranged from 2 to 20 ppt, and temperature ranged from 9 to 33°C at the time collected.

Dawson (1958) reported spot taken at a temperature as low as 6°C, but suggested considerable increase in numbers at temperatures above 10°C.

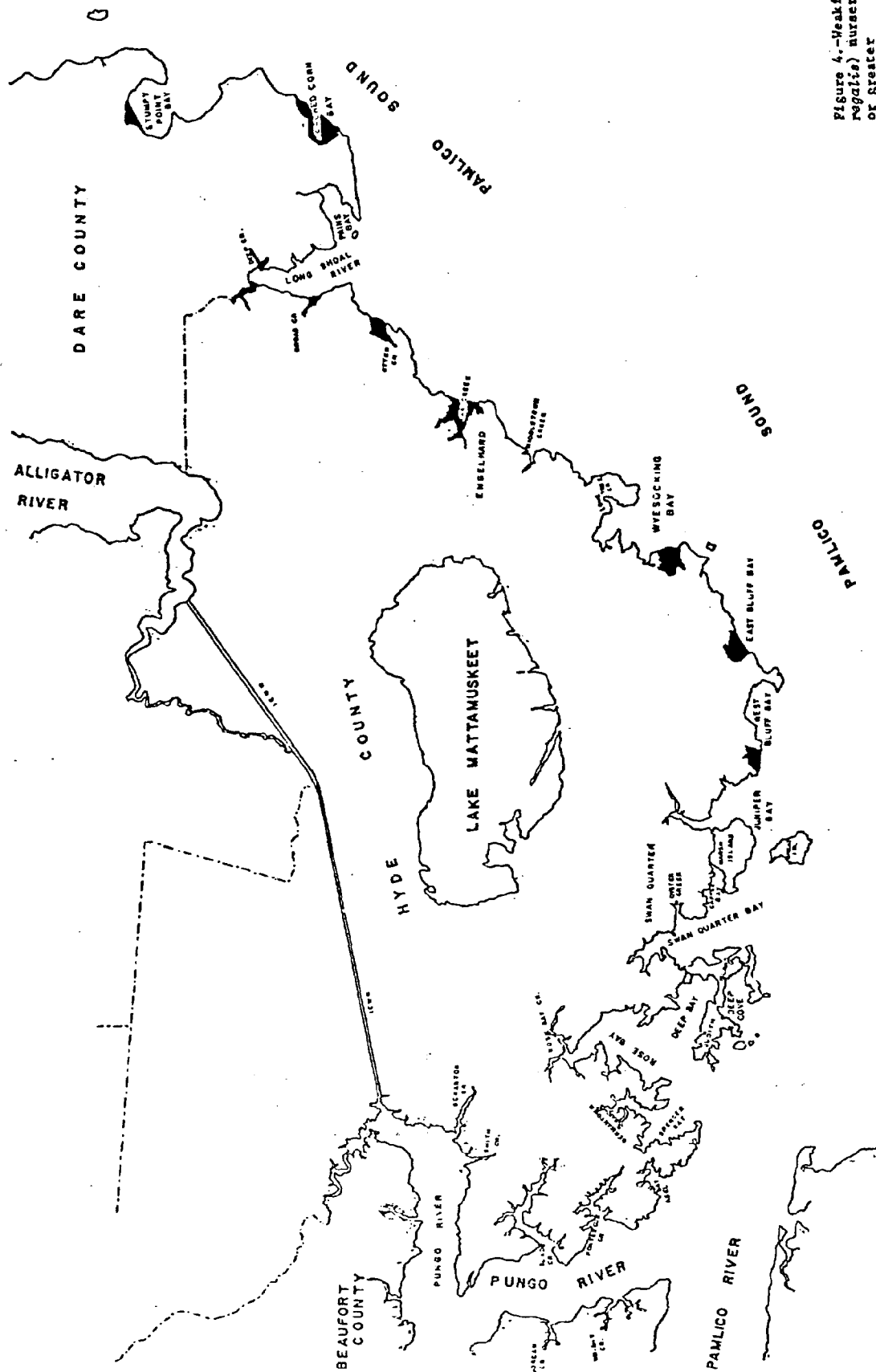


Figure 4.-Weakfish (*Cynoscion regalis*) nursery areas @ 5/sq. mi. or greater

Nursery area

TABLE 5. Length - frequency distribution of weakfish (*Cynoscion regalis*) measured from all stations July, 1974 - June, 1975.

	1974						1975						
LENGTH (mm)	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
5													
10													
15	7	2											9
20													
25	19	4	5										28
30													
35	38	25	22	2								94	181
40													
45	80	30	10	3								141	264
50													
55	110	32	18	1								39	200
65	67	25	17	1								3	113
75	51	43	17	3	2							2	118
85	17	21	25	10	2							1	76
95	7	21	9	8	3								48
105	1	16	1	16	1								35
115		16	3	5	2								26
125		10	4		6								20
135		4	2	1	6								13
145		4	6	3							1		14
155		1	1	3	2	1				1			9
165		7	3	1	4								15
175		3	2	3	3	1							12
185		2	4	4	1						1		12
195			3	2	2							1	8
205			1	1							4		6
215										1	2	2	6
225	1											1	2
235		1											1
245													
255	1			1									2
265				1									1
275	1											1	2
285													
295	1												1
305				<u>345</u>			<u>325</u>						2
				1			1						
No. measured	401	267	153	71	34	2	1			2	8	285	1224
No. collected	1816	295	183	71	34	2	1			2	8	392	2804

Fork length-frequency data indicate that major spawning occurs in the winter with 15 to 25 mm juveniles entering the samples by February and March (Table 6). Juvenile spot utilized the study areas until late summer, which suggests that young-of-the-year spot occupy the Type I nursery areas, then migrate toward the open sound by autumn. As evidenced by Table 6, the large majority of captured spot were young-of-the-year specimens.

Catch-effort data suggest that a rate of 31/min or greater indicates an abundance of spot sufficient for primary nursery area designation (Figure 5). High concentrations were taken in Swanquarter Bay study area (Station SQB-6, 1295/min, Station SQB-1, 1190/min); Rose Bay study area (Station RB-4, 795/min, Station RB-8, 704/min); and Spencer Bay study area (Station SB-1, 574/min, Station SB-3, 541/min).

All three types of areas were used to some extent by juvenile spot; however, they were most abundant in Type I areas. Type II habitat showed reduced catches; however, a slightly higher mean length was observed. Most adult specimens were captured in the Type III habitat.

Dahlberg (1972) found juvenile spot (11-85 mm) one of the most numerous fish in a low salinity creek, and collected small fish from April to July in a salinity range of 0.2 to 3.1 ppt. Dawson (1958) collected small spot (25 mm) in April in South Carolina. Hildebrand and Cable (1930) collected numerous larval spot at Beaufort, North Carolina from December through May.

In general, most tributaries contained abundant enough concentrations of juvenile spot to be considered as nursery areas for this species. However, the areas of lower salinity appeared to indicate a higher number of smaller spot than higher salinity creeks of the same general habitat type. All the higher concentration areas mentioned above were the lower salinity tributary systems of the study area. Spitsbergen and Wolff (1974) reported that this condition exists also in the western Pamlico Sound area.

Spot are of considerable importance to the North Carolina commercial and recreational catch. In 1969-1971, spot comprised over 13 percent by weight of the North Carolina's scrap fish catch, ranking it the third most common species (Wolff, 1972).

TABLE 6. Length frequency distribution of spot (*Leiostomus xanthurus*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974						1975						TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	
5													
10													
15								30					30
20													
25								222	549	63			834
30													
35								5		531	158	3	1056
40									359				359
45	14								12	503	538	345	1412
50													
55	151	2	1						1	110	505	465	1235
65	402	44	3							17	81	258	805
75	222	224	49	3		2				3	18	87	608
85	80	350	171	28	2	12	6		2		2	19	672
95	32	151	218	150	28	17	33	14	24	1		7	675
105	13	83	142	268	107	7	64	49	111	19	7	6	876
115	3	22	65	104	108	2	45	56	80	54	18	4	561
125	4	13	24	38	50	2	20	24	43	41	19	1	279
135	12	8	4	21	21	2	12	7	11	17	8	4	127
145	12	2	5	8	17		10	2	1	6	7	1	71
155	7	3	5	3	4	2	1	4		5		2	36
165	6		2	7	6		1	1			1	1	25
175	2	1	6	6	6	1		1			1	5	28
185	3	3	2	10	3		1					1	23
195		1	1	2	2							2	8
205				2								2	4
215			2	2									4
225				1							1		2
235													
245													
255													
265													
275													
285													
295													
305													
No. measured	963	906	700	653	354	47	193	415	1193	1370	1364	1213	9371
No. collected	1574	1550	933	837	551	47	611	856	9835	8538	5655	4967	35954

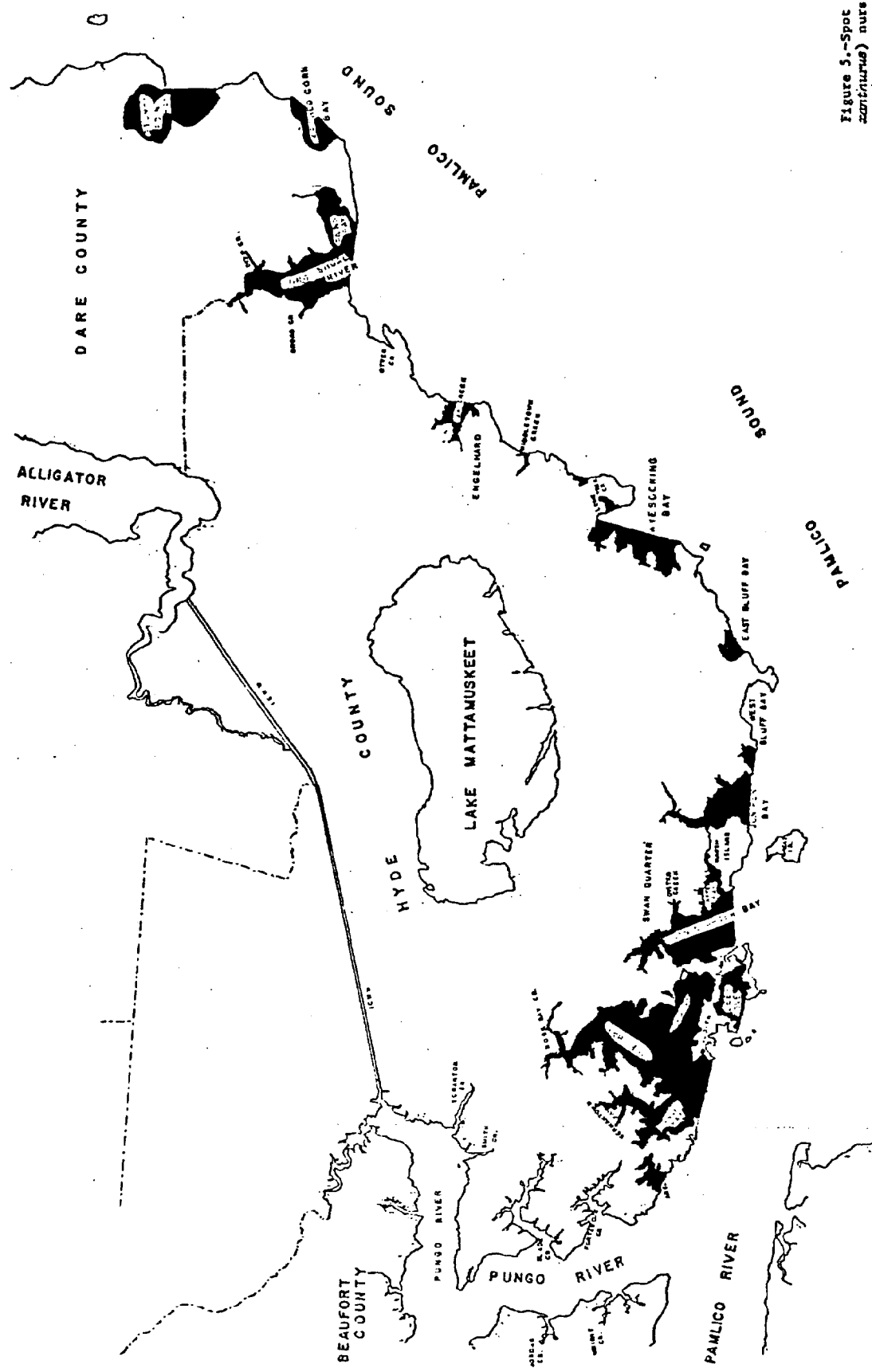


Figure 3.-Spot (*Leiostomus xanthurus*) nursery areas @ 31/mn. or greater

Nursery area

Menticirrhus americanus - Southern kingfish

Twenty southern kingfish were collected during July, 1974 and September through December, 1974. This species was taken in a salinity range of 13 to 20 ppt and a temperature range of 9 to 29°C, and had a size range of 45 to 225 mm. Thirteen (65 percent) were captured at P-stations, and only 3 specimens were recorded in Type I nursery areas.

Dahlberg (1972) reported four juvenile *Menticirrhus americanus* in a salinity range of 1.5 ppt to 7.9 ppt. Swingle (1971) reported all specimens of southern kingfish were taken at salinities above 10.0 ppt with highest catches between 25 ppt and 29.9 ppt. Hildebrand and Schroeder (1928) suggested that this species probably spawns during spring and early summer.

Menticirrhus saxatilis - Northern kingfish

A single northern kingfish was caught in the Juniper Bay study area (Station JB-4) during the month of August. The specimen was collected at a salinity of 13 ppt and a temperature of 28°C, and was 225 mm in length.

Micropogon undulatus - Atlantic croaker

The Atlantic croaker was the second most abundant commercial finfish taken in the study. A total of 14,345 was collected which accounted for 22.2 percent of the economically-important species. Croakers were taken during each month of the study and were collected at least once at every station. Croakers were collected in a salinity range of 2 to 20 ppt, with the temperature ranging from 9 to 33°C. They had a total length range of 15 to 285 mm. Highest catches occurred in July, 1974 and January through June, 1975, and the fewest (33) were taken in December.

Bearden (1964) collected croaker in a salinity range of 1.5 to 35.6 ppt in South Carolina. Perret, et al (1971) reported croaker in a salinity range of 0.0 to 30 ppt, and a temperature range of 5.5 to 34.9°C.

Post-larval croakers were in the catches from August, 1974 through June, 1975, but were most abundant in the 25 to 35 mm size range during January through May, 1975 (Table 7).

TABLE 7. Length frequency distribution of Atlantic croaker (*Micropogon undulatus*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974						1975						TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	
5													
10													
15			1	10	1	15	5	6					38
20													
25		7	2	49	31	9	124	160	69	6	2	1	460
30													
35		18	13	27	76	2	48	115	244	148	123	2	816
40													
45	3	18	1	4	38	3	23	19	65	187	190	82	633
50													
55	7		9	4	15		4	8	31	125	192	148	543
65	34	2	8	1	9			2	11	80	207	211	565
75	86	10		2	3		2	1	7	40	109	196	456
85	120	15	3		2			1	4	24	42	151	362
95	145	30	3						1	10	16	98	303
105	132	65	17	2	1	2	1			4	6	45	275
115	91	83	31	6		2	3		1	1	2	31	251
125	59	78	39	17	3		4			3	2	21	226
135	35	58	52	29	8		3	1	1	3	4	14	208
145	13	26	42	33	10		2	1	2	2	7	6	144
155	10	30	43	39	30		4	2		3	5	5	171
165	9	15	34	38	30		3	3		6	3	8	149
175	13	3	16	34	10		1	2		10	5	5	99
185	8	3	10	17	12					9	11	5	75
195	15	2	4	12	2		3			11	6	8	63
205	12	9	1	2						10	7	9	50
215	5	4					1			13	6	9	38
225	7	1	1	3						8	6	4	30
235	1	2		1						4	3		11
245				2						3	3	2	10
255										1			1
265													
275													
285	1	1											2
295													
305													
No. measured	806	480	330	332	281	33	231	321	436	711	957	1061	5979
No. collected	1109	570	415	426	322	33	2915	1546	958	1747	2066	2238	16243

Catch-effort data indicate that a rate of 21/min or greater indicates a sufficient number of croaker to delineate a primary nursery area (Figure 6). Major concentrations of croaker occurred in the Far Creek study area (Station FC-3, 450/min.; Station FC-4, 408/min.), P-Station study area (Station P-9, 360/min; Station P-12, 174/min), and Spencer Bay study area (Station SB-1, 192/min; Station SB-3, 151/min).

In general, most tributaries contained enough juvenile croaker to be designated as nursery areas. For no obvious reasons, Juniper Bay study area had very low concentrations of croaker, though general physical characteristics are similar to the other sample area.

Comparing nursery areas, it becomes evident that croaker use all these types of habitats for nursery areas. Data show an increasing graduation in size from Type I to Type III habitats which would suggest that post-larval croaker prefer Type I areas and migrate to more open water as they develop.

Croakers are a very important commercial and recreational species along the North Carolina coast. Previous studies of the North Carolina scrap fishery have shown that croaker comprised the highest percentage by both weight and number of all species in the scrap landings (Wolff, 1972).

Sciaenops ocellata - Red drum

Nineteen red drum were collected during the study. The smallest (35 mm) young-of-the-year specimens were taken during November and growth appeared to continue through June. Therefore, late summer spawning is indicated for red drum. Mansueti (1960) found juvenile red drum 20 to 80 mm in Chesapeake Bay during September through November. Dahlberg (1972) collected his smallest specimens, 36 and 37 mm, in November in Georgia.

Eleven (57.9 percent) of the specimens collected were obtained in the Rose Bay study area (Station RB-8). This station is one of few in the area that is characterized by shallow water and thick bottom vegetation.

Red drum were collected in a salinity range of 1 to 17 ppt and a temperature range of 10 to 27°C, and had a length range of 35 to 335 mm.

Red drum are not considered to be of great importance as a commercial fish, but are highly regarded as a recreational fish in North Carolina.

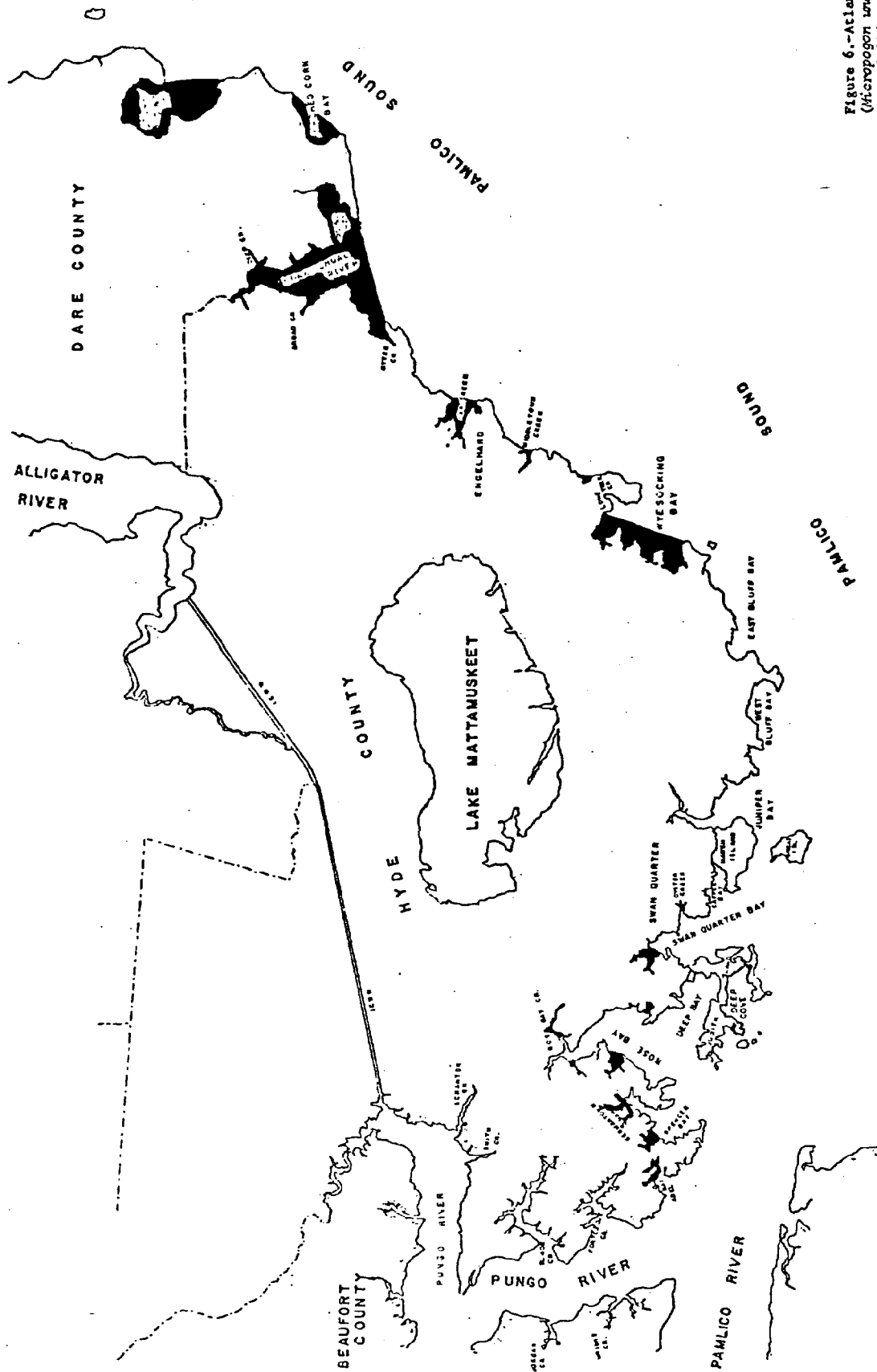


Figure 6.-Atlantic croaker
(*Micropogonias undulatus*) nursery
areas @ 21/min. or greater

Nursery area

EPHIPPIDAE

Chaetodipterus faber - Atlantic spadefish

Three Atlantic spadefish were collected in August, 1974 from the Wysocking Bay study area. These specimens were collected at a salinity of 15 ppt and a temperature of 27°C, and had a length range of 15 to 35 mm. Dahlberg (1972) collected this species from June to October in a temperature range of 20.1 to 32.0°C, and at a minimum salinity of 9.9 ppt. Gunter (1945) recorded a salinity range of 11.1 ppt to 35.8 ppt and a temperature range of 17.1 to 29.0°C.

MUGILIDAE

Mugil cephalus - Striped mullet

A total of 471 striped mullet was collected with the majority (85.9 percent) being taken in January (99) and February (113). Striped mullet were probably abundant during all months, but were not readily available to trawl sampling gear. Juveniles (15 to 35 mm) were taken from January through May, 1975, but were most abundant in January and February. Anderson (1957) found that young (18 to 28 mm) striped mullet appeared on the outer beaches of Georgia as early as November, but usually do not enter estuarine waters until January.

Striped mullet were collected in a salinity range of 1 to 19 ppt and a temperature range of 9 to 29°C, and had a length range of 10 to 295 mm. Rose Bay study area produced 58.4 percent of the total catch of striped mullet. Young striped mullet occurred in samples in North Carolina from November through March in a study by Lewis and Mann (1971).

Striped mullet are of considerable commercial importance on the North Carolina coast. *Mugil cephalus* made up 0.43 percent of the catch of economically-important species in this study.

GOBIIDAE

Gobionellus hastatus - Sharptail goby

Ten specimens of sharptail goby were collected. These fish were captured in the Far Creek study area (Station FC-2) and the Wysocking Bay study area (Station WB-3) during July through December, 1974. Sharptail gobies had a length range of 35 to 175 mm, and were collected at a salinity range of 10 to 18 ppt and a temperature range of 11 to 32°C.

Gobiosoma boscii - Naked goby

The naked goby was the second most abundant goby in the study area, with a total of 133 being collected. This species was collected during all months of the year. Dahlberg (1972) reported this goby as being the most abundant in Georgia estuaries.

Naked gobies had a length range of 15 to 45 mm, and were collected at a salinity range of 3 to 19 ppt and a temperature range of 6 to 28°C. According to Dawson (1969) *Gobiosoma boscii* occurs in a salinity range of 0.4 to 45 ppt, but prefers salinities below 22 ppt.

Microgobius thalassinus - Green goby

The green goby was the most abundant goby, with a total of 219 being collected during the study period. *Microgobius thalassinus* was taken during all months of the year. Green gobies were taken in a salinity range of 4 to 18 ppt and a temperature range of 9 to 32°C, and had a length range 15 to 85 mm. Schwartz (1971) recorded a salinity range of 8 to 23.4 ppt and a temperature range of 8 to 27.2°C for this species.

SCOMBRIDAE

Scomberomorus maculatus - Spanish mackerel

Four Spanish mackerel were collected during July, 1974. This species was collected at a salinity range of 11 to 14 ppt and a temperature range of 25 to 29°C, and had a length range of 75 to 105 mm.

STROMATEIDAE

Peprilus alepidotus - Harvestfish

Eight harvestfish were collected during July through September, 1974. This species was collected at a salinity range of 14 to 18 ppt and a temperature range of 20 to 27°C, and had a length range of 25 to 85 mm. The stations at which specimens were caught were in Type II and III nursery areas.

Peprilus triacanthus - Butterfish

One butterfish was collected. This specimen, 65 mm in length, was taken in April, 1975, at P-Station 8. Salinity at the time of collection was 13 ppt, and the temperature was 20°C.

TRIGLIDAE

Prionotus carolinus - Northern searobin

Twenty-three specimens were collected during the study. The northern searobin was collected in a salinity range of 8 to 17 ppt and a temperature range of 17 to 25°C, and had a length range of 35 to 125 mm. The data indicate a preference for Type III nursery areas. Dahlberg (1972) reported *Prionotus carolinus* only in the lower reaches of the estuary and a minimum salinity of 15.3 ppt for any species of searobin.

BOTHIDAE

Citharichthys spilopterus - Bay whiff

This species was taken during July through September, 1974 and June, 1975, with a total of 26 being collected. The bay whiff was collected in a salinity range of 3 to 18 ppt and a temperature of 20 to 33°C, and had a length range of 25 to 125 mm. Dahlberg (1972) reported taking this species only during the months of May to October at a temperature range of 26.0 to 31.5°C. Swingle (1971) collected bay whiffs in a salinity range of 0 to 30 ppt and found them most abundant from May through September.

Paralichthys dentatus - Summer flounder

Forty-seven summer flounder were collected. This species was collected during the months of July, 1974 through February, 1975, and June, 1975. Twenty-eight (59.6 percent) were collected in the open waters of the P-Stations. No catches were made in the Type I nursery area.

Tagatz and Dudley (1961) reported specimens in the 26 to 48 mm range in the Neuse River in March. Summer flounder were collected in a salinity range of 13 to 25 ppt and a temperature range of 9 to 29°C, and had a length range of 115-295 mm.

The data indicates a general distributional difference between *Paralichthys dentatus* and *Paralichthys lethostigma* in relation to salinity. At salinities below 12 ppt *Paralichthys lethostigma* were far more abundant, whereas at salinities greater than 12 ppt, *Paralichthys dentatus* was the dominant estuarine paralichthid.

Paralichthys dentatus supports the most important winter trawl fishery on the North Carolina coast. This study, however, was unable to designate nursery areas for this species, probably because of the low salinity of the study area.

Paralichthys lethostigma - Southern flounder

Southern flounder were much more abundant in the study area than *Paralichthys dentatus*, with a total of 770 being collected; thus making up 1.18 percent by number of those species considered to be of commercial importance (Appendix II). Juveniles, 15 to 35 mm were taken from February to June, indicating a fairly long spawning season. Length-frequency data (Table 8) indicate that those specimens collected were mostly young-of-the-year.

Catch/effort data indicate that the Type I nursery area was most utilized, with catches as follows: Swanquarter Bay study area, 48/min at Station SQB-1; Far Creek study area, 42/min at Station FC-4; and Wysocking Bay study area, 36/min at Station WB-1. Figure 7 shows areas in which a catch-per-effort of 2/min or greater were found. Preferred area for juveniles of this species appears to be shallow, muddy creeks. Southern flounder were collected in a salinity range of 1 to 19 ppt and a temperature range of 5 to 32°C, and had a size range of 15 to 265 mm.

TABLE 8. Length - frequency distribution of southern flounder (*Paralichthys lethostigma*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974					1975							TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	
5													
10													
15								7	4				11
20													
25								31	47	3			81
30													
35									70	44	59	3	176
40													
45									30	28	61	14	133
50													
55	1								7	24	47	13	92
65	8								1	10	10	10	39
75	14									4	4	2	24
85	11	6	1							3	1		22
95	12	13	10							1	2	2	40
105	4	4	6	9	5	2	1			1			32
115		2	6	5	6	4	2				1	1	27
125	2	1		5	3	1	2				4	1	19
135	2		1		3	2	3				1		12
145				1	4								5
155				3			2			1		4	10
165	1	1	1	1	3	2	2						11
175					2	1							3
185		1	1		1					1			4
195				1									1
205													
215			1		1					1		1	4
225				1	1								2
235													
245													
255	1												1
265											1		1
275													
285													
295													
305													
No. measured	56	28	27	26	29	12	12	38	159	121	191	51	750
No. collected	56	28	27	26	29	12	12	38	159	121	209	51	768

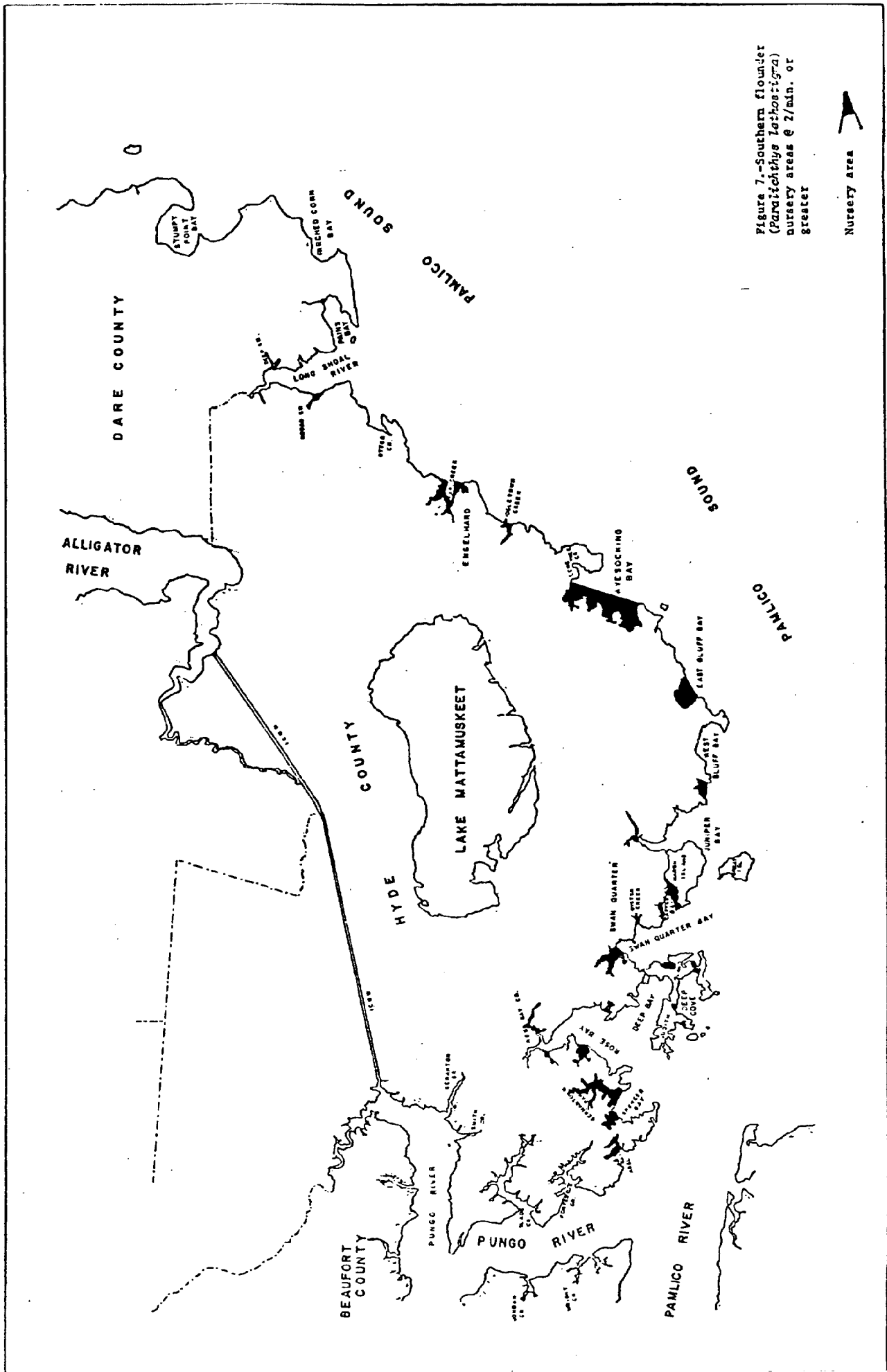


Figure 7.-Southern flounder
(*Paralichthys lethostigma*)
nursery areas @ 2/min. or
greater

Nursery area

Dahlberg (1972) reported that southern flounder were more abundant in the middle reaches of the estuaries in Georgia, and were often collected in freshwater. Tagatz and Dudley (1971) also recorded a salinity range of 0 to 33.6°C.

SOLEIDAE

Trinectes maculatus - Hogchoker

Hogchokers were collected during all months of the year with the highest concentrations in spring and summer. A total of 373 was collected, making this the fifth most abundant non-commercial species. Hogchokers were collected in a salinity range of 1 to 19 ppt and a temperature range of 5 to 32°C, and had a size range of 15 to 155 mm. Swingle (1971) collected hogchokers in a salinity range of 0 to over 30 ppt, but found them most abundant in salinities from 0 to 15 ppt. This species was collected in all three habitat types; however, juveniles were predominately found in the Type I nursery area.

CYNOGLOSSIDAE

Symphurus plagiatus - Blackcheek tonguefish

A total of 43 blackcheek tonguefish was collected during the study. Thirty-three (76.7 percent) of those obtained were from the open water P-Stations. This species was collected in a salinity range of 4 to 25 ppt and a temperature range of 10 to 27°C, and had a size range of 25 to 185 mm.

Swingle (1971) found this species more abundant in higher salinity waters and collected 60 percent of his specimens in salinities above 25 ppt. Springer and Woodburn (1960) recorded a salinity range of 5.0 to 33.0 ppt, and a temperature range of 14.5 to 32.5°C for this species.

BALISTIDAE

Aluterus schoepfi - Orange filefish

Two specimens of orange filefish were collected. One specimen, 205 mm in length, was taken in August, 1974 (salinity-15 ppt, temperature-26°C) at

P-Station 4. The other specimen, 155 mm long, was collected in Far Creek study area (Station FC-3) (salinity-17 ppt, temperature 20°C) in September, 1974.

CRUSTACEA

PENAEIDAE

Penaeus aztecus - Brown shrimp

Brown shrimp were the most abundant commercial shrimp collected during the study. A total of 6,623 brown shrimp comprised 71.35 percent of the commercial shrimp captured (Table 9). Brown shrimp were taken in a salinity range of 3 to 25 ppt, with the majority being collected in a range of 5 to 15 ppt. Temperatures varied from 18 to 33°C, and total length of brown shrimp ranged from 15 to 145 mm.

Brown shrimp occurred in the samples during July through October, 1974 and April through June, 1975 (Table 10). Juvenile brown shrimp entered the catch in April and recruitment appeared to continue until July.

Brown shrimp were collected at all sixty stations, and all three habitat types were utilized. However, catch/effort data show that peak catches of juveniles occurred in the Type I nursery area: Far Creek study area, Station FC-3, 487/min; Swanquarter Bay study area, Station SQB-4, 282/min.; and Rose Bay study area, Station RB-8, 222/min. The Type II and III nursery areas produced reduced catches of juveniles (15 to 95 mm), however, a noticeable size increase was observed. These data indicate that the majority of brown shrimp remained in Type I areas until they exceeded 95 mm, after which migration began out of the study area, and brown shrimp were less available to our sampling. Catch/effort data indicate that primary nursery areas are located in areas having a catch rate of 5/min or greater for brown shrimp (Figure 8).

Penaeus duorarum - Pink shrimp

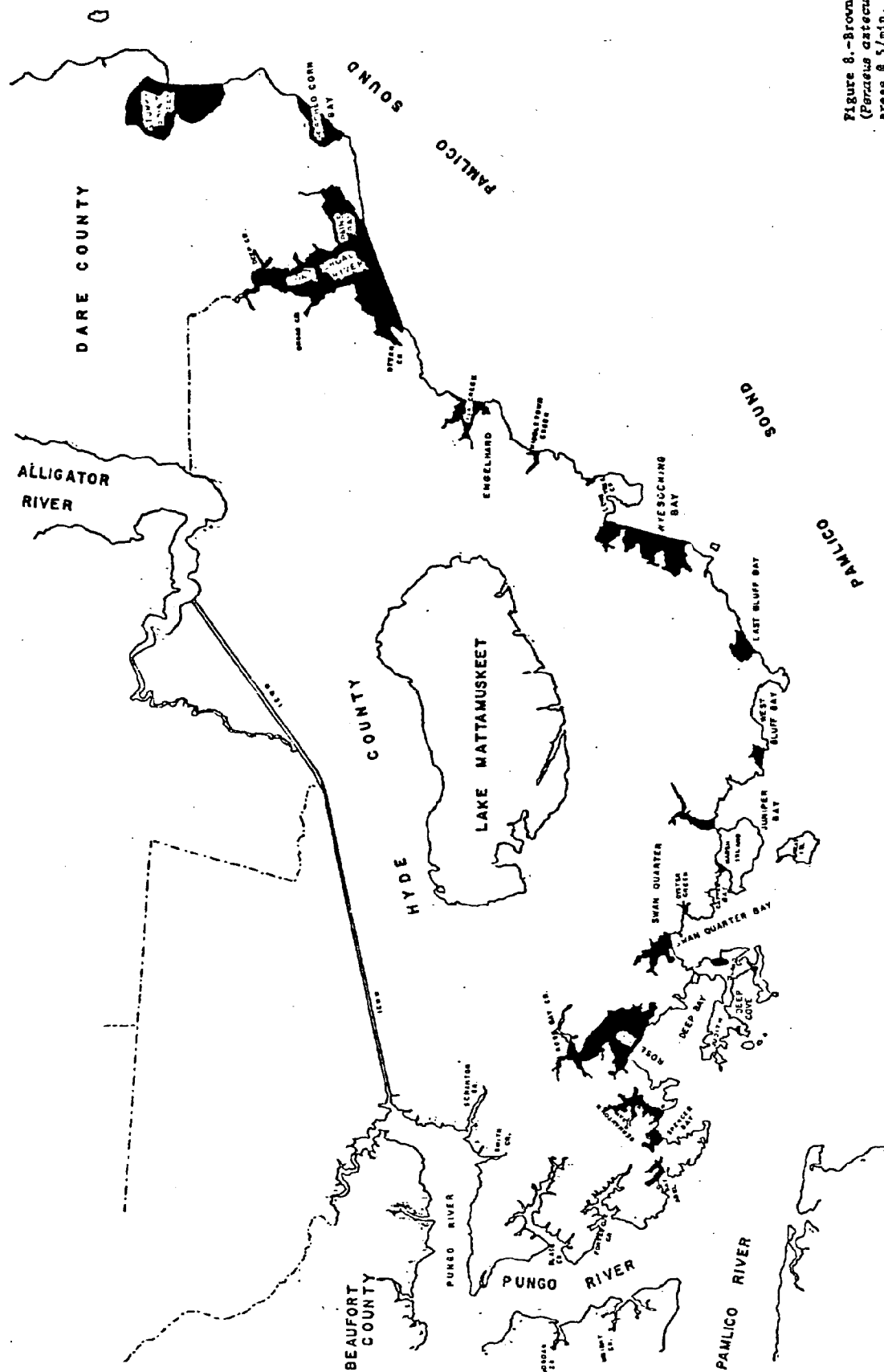
A total of 753 pink shrimp was collected during the study period, accounting for 8.11 percent of the commercial shrimp catch (Table 9 and Appendix II). Pink shrimp were collected in a temperature range of 7 to 30°C and a salinity

TABLE 9. Total catch of commercial shrimp by month for northern Pamlico Sound study area, July 1974 - June 1975

MONTH	BROWN SHRIMP	PINK SHRIMP	WHITE SHRIMP
July, 1974	3587	-	3
August	1115	67	1157
September	88	329	360
October	2	163	351
November	-	103	31
December	-	22	2
January, 1975	-	14	-
February	-	14	-
March	-	6	-
April	3	10	-
May	795	23	-
June	1033	2	2
TOTAL CATCH	6623	753	1906
PERCENT	71.35	8.11	20.53

TABLE 10. Length - frequency distribution of brown shrimp (*Penaeus aztecus*)
measured from all stations July, 1974 - June, 1975.

	1974					1975							
LENGTH (mm)	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
5													
10													
15											49		49
20													
25	67									3	186		256
30													
35	171	7									202	76	456
40													
45	325	15	1								166	232	739
50													
55	404	26	1								60	196	687
65	524	38	11								13	205	791
75	457	66	17								9	146	695
85	398	83	22									90	593
95	317	128	11									55	511
105	174	136	6	1								16	333
115	63	103	9	1								6	182
125	10	41	7										58
135	1	14	3										18
145		3											3
155													
165													
175													
185													
195													
205													
215													
225													
235													
245													
255													
265													
275													
285													
295													
305													
No. measured	2911	660	88	2						3	685	1022	5371
No. collected	3587	1115	88	2						3	795	1033	6623



range of 3 to 20 ppt, and had a size range of 10 to 125 mm. Pink shrimp were collected every month of the study period except July, 1974; but were most abundant during August through November when 87.9 percent of the total was taken.

Pink shrimp are nocturnal and it was felt that the daytime samples taken during this study would not adequately represent the pink shrimp population present; therefore, nursery areas were not designated for this species. Areas which did contain some concentrations were the Wysocking Bay study area, Station WB-2, 59/min; Far Creek study area, Station FC-4, 20/min; and the P-Station area, Station P-10, 9/min. These samples were taken in September and the salinity was 16 ppt for all three areas. Williams (1965) summarizing the research of other workers, suggested that in North Carolina, pink shrimp are most abundant in areas where salinities are above 20 ppt and where there is a possibility of tidal transport. The data indicate no preference of this species for a Type I nursery area.

Penaeus setiferus - White shrimp

A total of 1,906 white shrimp was collected, accounting for 20.53 percent of the commercial shrimp taken. This species was collected within a temperature range of 10 to 33°C and a salinity range of 2 to 19 ppt, and had a length range of 25 to 145 mm.

Length-frequency data indicate that juvenile white shrimp entered the study area in July and were collected through November (Table 11). *Penaeus setiferus* were most abundant from August through October when 98 percent of the total was collected.

White shrimp were most abundant in Type I nursery areas. Juvenile concentrations were found in the Wysocking Bay study area, Station WB-1, 326/min; Long Shoal River study area, Station LSR-6, 142/min; and Stumpy Point Bay study area, Station SPB-1, 110/min. Juveniles of this species were also taken in Type II nursery areas, but were considerably less abundant. Type III nursery areas produced primarily adults of the species. Catch/effort data indicate that a catch rate of 5/min or greater is sufficient to designate primary nursery areas for this species (Figure 9).

TABLE 11. Length - frequency distribution of white shrimp (*Penaeus setiferus*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974						1975						TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	
5													
10													
15													
20													
25	1	63	10	2									76
30													
35	2	216	53	16	2							2	291
40													
45		215	74	33	7								329
50													
55		213	39	46	4								302
65		180	41	39	3	2							265
75		66	42	20	2								130
85		29	34	23	8								94
95		23	33	19	2								77
105		11	18	13	1								43
115		2	9	2									13
125		1	5		1								7
135			1										1
145			1										1
155													
165					1								1
175													
185													
195													
205													
215													
225													
235													
245													
255													
265													
275													
285													
295													
305													
No. measured	3	1019	360	213	31	2						2	1630
No. collected	3	1157	360	351	31	2						2	1906

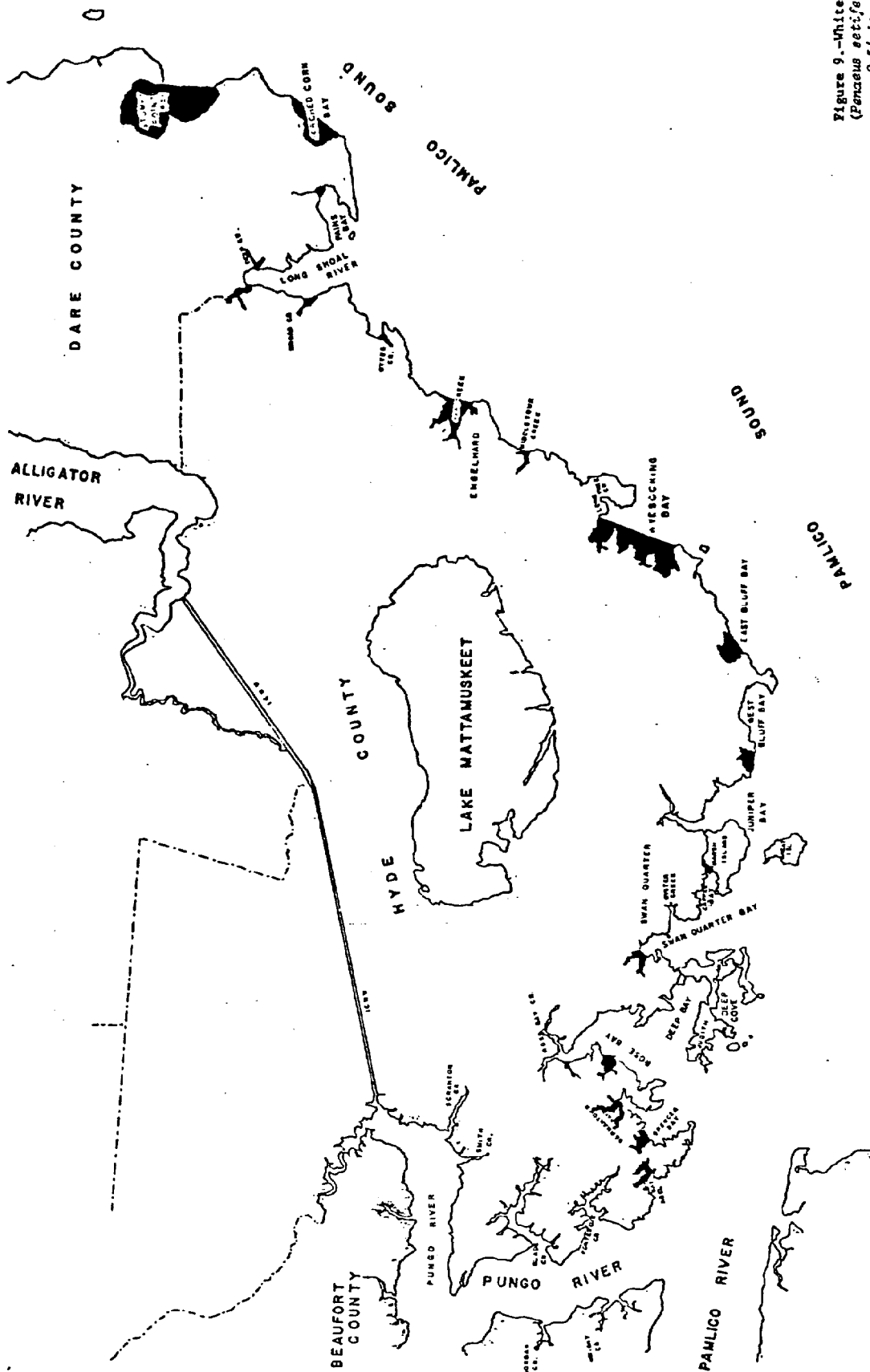


Figure 9.—White shrimp (*Penaeus setiferus*) nursery areas @ 5/min. or greater

Nursery area

Although not as abundant, white shrimp appear to utilize much the same nursery areas as the brown shrimp, *Penaeus aztecus*. Recruitment of white shrimp follows a pattern similar to brown shrimp, but occurs two or three months later.

Trachypeneus constrictus - Roughneck shrimp

Two specimens of roughneck shrimp were collected at P-Station 9 in July, 1974. This species was collected at a salinity of 18 ppt and a temperature of 25°C, and both were 25 mm in length. Perret, et al (1971) collected this species in a temperature range of 10 to 21.7°C and a salinity range of 16.0 to 30.7 ppt, but reported highest catches above 20 ppt.

PALAEEMONIDAE

Palaeomanetes spp. - Grass shrimp

A total of 9,519 grass shrimp was collected, making them the most abundant non-commercial invertebrates. Grass shrimp were taken during all months, but were most abundant in April and May. Station RB-8, Rose Bay study area, was the biggest producer, with 58.9 percent of the total number. This was the only sampling station with heavy bottom vegetation. All three species were collected, but *P. pugio* was by far the most abundant. *Palaeomanetes* were taken in a salinity range of 2 to 19 ppt and a temperature range of 7 to 31°C. The size range was 15 to 35 mm. Williams and Deubler (1968) reported *Palaeomanetes* as the most abundant shrimp in the estuary and suggested that the population was made up chiefly of *P. pugio*.

PORTUNIDAE

Callinectes sapidus - Blue crab

The blue crab is North Carolina's only commercial crab, and 2,730 were collected in the study (Appendix II). Blue crabs were collected in a salinity range of 1 to 25 ppt and a temperature range of 7 to 33°C. They had a length range of 5 to 195 mm.

The greatest number were smaller crabs (Table 12), caught in the lower salinity areas, while the larger individuals were taken in the higher salinity areas. Specimens were collected at all stations at least once during the study.

Catch/effort data suggest that a catch rate of 3/min would indicate primary nursery areas for blue crabs (Figure 10). Areas of especially high concentrations were Wysocking Bay study area, Station WB-4, 196/min; Far Creek study area, Station FC-4, 126/min; and Spencer Bay study area, Station SB-1, 60/min.

Callinectes similis

One specimen of *Callinectes similis* (55 mm) was collected in July, 1974, at P-Station 9. Salinity at the time of collection was 18 ppt and the temperature was 25°C.

SUMMARY

There were 60 trawl stations selected for a base yearsurvey in the northern Pamlico Sound study area. A total of 55 species of fishes and 7 species of invertebrates were collected in 709 samples taken from July, 1974 through June, 1975.

Twenty of the 55 species of finfish and 4 of the 7 species of invertebrates were considered of marine or estuarine economic importance. The Atlantic menhaden, spot, and Atlantic croaker comprised approximately 93 percent of the commercial fishes caught. The brown and white shrimp supplied over 91 percent of the commercial shrimp catch.

The spot was the most abundant commercial fish collected, with 35,954 taken. These comprised 55.46 percent of the economically-important species.

Eight species of sciaenids and four species of clupeids were taken. Fishes in the family *Sciaenidae* were caught in the greatest number.

Penaeid shrimps made up the bulk, by number, of the invertebrate catch. Three species were taken - white, pink, and brown, with the brown shrimp comprising 71 percent of the total shrimp catch.

TABLE 12. Length - frequency distribution of blue crab (*Callinectes sapidus*) measured from all stations July, 1974 - June, 1975.

LENGTH (mm)	1974						1975						TOTAL
	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	
5	8	4	7	34	53	24	40	59	74	74	48	8	433
10	33	11	1	6	49	36	97	60	110	64	81	22	570
15	2	4	15	7	6	8	25	20	37	28	32	12	196
20													
25	9	1	2	3	7	7	32	19	25	17	36	7	165
30													
35	9		1	1	2	1	8	6	7	6	37	13	91
40													
45	40	5	3	8	5	7	3	5	9	2	15	31	133
50													
55	37	7		3	3	8	8	2	6	5	20	23	122
65	38	13	1	4	4	1	8	6	7	6	9	22	119
75	46	14	8	3	11	4	4	3	6	7	9	12	127
85	29	14	5	2	7		3	3	5	3	9	9	89
95	27	10	4	2	8	1	2		1	5	8	5	73
105	29	22	11	2	4	1	1	1	1	7	3	4	86
115	6	9	6	3	1		1		1	3	5	3	38
125	16	13	5	4	2	4		1	1	5	4	7	62
135	11	9	5		1					3	1	5	35
145	10	11	8	2	2						5	6	44
155	4	12	4	2	2						1	6	31
165	6	7	2	3	1					1		5	25
175	1	2		2						1			6
185				1									1
195				1									1
205													
215													
225													
235													
245													
255													
265													
275													
285													
295													
305													
No. measured	363	168	80	93	168	102	232	185	290	237	323	200	2441
No. collected	390	168	80	93	168	104	254	215	306	349	391	212	2730

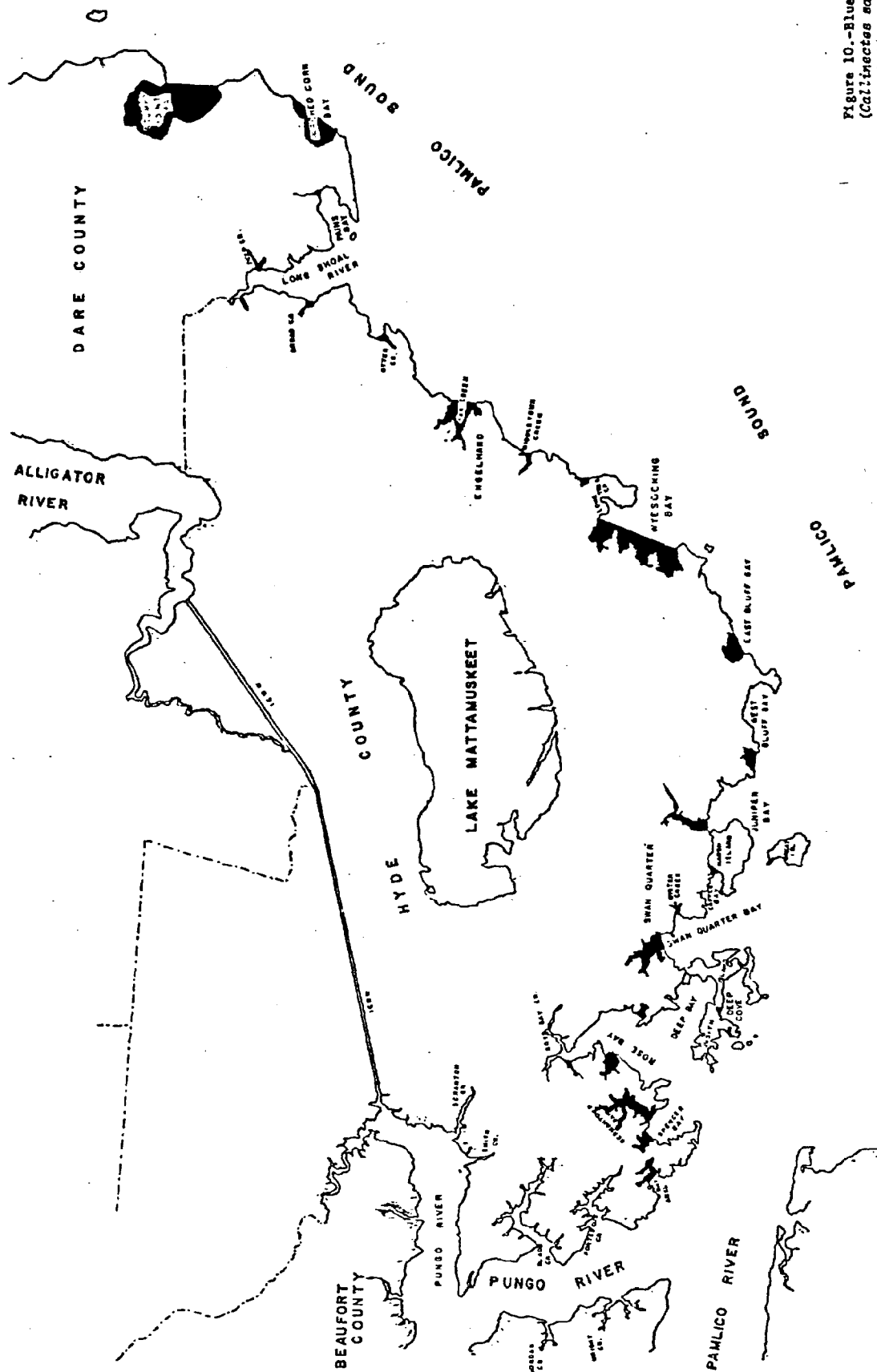


Figure 10.-Blue crab (*Callinectes sapidus*) nursery areas @ 3/min. or greater

Nursery area

The three most abundant fishes, and the four commercial invertebrates, which together account for approximately 94 percent of the total catch, are all estuarine-dependent. Therefore, those areas which have been designated primary nurseries for various estuarine-dependent species must be protected if the production of these valuable species is to continue. Any destruction or alteration that occurs in these areas will have far-reaching effects, not just on the area itself, but also on those species which are dependent on the area during some part of their life cycle.

This study has attempted to enumerate the importance of the northern Pamlico Sound study area to the species that contribute to North Carolina's fisheries.

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APPENDIX I. Salinity, temperature, and length ranges of all finfishes collected in northern Pamlico Sound study, July, 1974 through June, 1975.

Species	Common Name	Length	Sal. (ppt)	Temp. (C°)
<u>Lepisosteus osseus</u>	Longnose gar	675	10	22
<u>Elops saurus</u>	Ladyfish	45-205	11-14	24-29
<u>Anguilla rostrata</u>	American eel	95-625	2-19	11-33
<u>Alosa aestivalis</u>	Blueback herring	25-165	10-20	9-14
<u>Alosa pseudoharengus</u>	Alewife	75-125	14-18	7-10
<u>Brevoortia tyrannus</u>	Atlantic Menhaden	25-215	1-20	6-33
<u>Dorosoma petenense</u>	Threadfin shad	65-125	3-19	7-26
<u>Anchoa hepsetus</u>	Striped anchovy	45-115	2-19	7-30
<u>Anchoa mitchilli</u>	Bay Anchovy	15-85	2-20	6-31
<u>Synodus foetens</u>	Inshore lizardfish	185-245	14-18	21-28
<u>Opsanus tau</u>	Oyster toadfish	105-315	9-16	20-26
<u>Gobiesox strumosus</u>	Skilletfish	35	19	10
<u>Urophycis regius</u>	Spotted hake	105-165	9-17	11-19
<u>Cyprinodon variegatus</u>	Sheepshead minnow	25-95	12-15	7-10
<u>Fundulus majalis</u>	Striped killifish	25-45	10-18	10-20
<u>Lucania parva</u>	Rainwater killifish	35	7	19
<u>Menidia beryllina</u>	Tidewater silverside	35-105	2-18	10-20
<u>Menidia menidia</u>	Atlantic silverside	75-125	12-19	10-13
<u>Apeltes quadracus</u>	Fourspined stickleback	45	8-14	12
<u>Syngnathus fuscus</u>	Northern pipefish	75-285	9-16	18-28
<u>Morone americana</u>	White perch	55-255	1-19	11-28
<u>Enneacanthus gloriosus</u>	Bluespotted sunfish	55	12	7-8
<u>Lepomis gibbosus</u>	Pumpkinseed	125-175	4-9	10-14
<u>Pomatomus saltatrix</u>	Bluefish	25-185	3-15	16-29
<u>Caranx hippos</u>	Creville jack	25-65	6-16	21-28
<u>Selene vomer</u>	Lookdown	55-85	14-18	14-29
<u>Trachinotus falcatus</u>	Permit	115	16	20
<u>Lutjanus griseus</u>	Grey snapper	25-75	13-16	17-27
<u>Diapterus olisthostomus</u>	Irish pompano	15-105	13-16	17-27
<u>Orthopristis chrysoptera</u>	Pigfish	65-235	16-25	18-26
<u>Archosargus probatocephalus</u>	Sheepshead	75-225	5-19	11-25
<u>Lagodon rhomboides</u>	Pinfish	15-145	5-19	10-29
<u>Bairdiella chrysura</u>	Silver perch	15-195	1-25	9-33
<u>Cynoscion nebulosus</u>	Spotted seatrout	25-225	3-20	10-29
<u>Cynoscion regalis</u>	Weakfish	15-345	2-25	9-33
<u>Leiostomus xanthurus</u>	Spot	15-225	2-20	9-33
<u>Menticirrhus americanus</u>	Southern kingfish	45-225	13-20	9-29
<u>Menticirrhus saxatilis</u>	Northern kingfish	225	13	27-28
<u>Micropogon undulatus</u>	Atlantic croaker	15-285	2-20	9-33
<u>Sciaenops ocellata</u>	Red drum	35-335	1-17	10-27
<u>Chaetodipterus faber</u>	Atlantic spadefish	35	15	27
<u>Mugil cephalus</u>	Striped mullet	10-295	1-19	9-29
<u>Gobionellus hastatus</u>	Sharptail goby	35-175	10-18	11-32
<u>Gobiosoma bosci</u>	Naked goby	15-45	3-19	6-28
<u>Microgobius thalassinus</u>	Green goby	15-85	4-18	9-32
<u>Scomberomorus maculatus</u>	Spanish mackerel	75-105	11-14	25-29
<u>Peprilus alepidotus</u>	Harvestfish	25-85	14-18	20-27
<u>Peprilus triacanthus</u>	Butterfish	65	13	20
<u>Prionotus carolinus</u>	Northern searobin	35-125	8-17	17-25

<u>Species</u>	<u>Common Name</u>	<u>Length</u>	<u>Sal. (ppt)</u>	<u>Temp. (C°)</u>
<u>Citharichthys spilopterus</u>	Bay whiff	25-125	3-18	20-33
<u>Paralichthys dentatus</u>	Summer flounder	115-295	13-25	9-29
<u>Paralichthys lethostigma</u>	Southern flounder	15-265	1-19	5-32
<u>Trinectes maculatus</u>	Hogchoker	15-155	1-19	5-32
<u>Symphurus plagiusa</u>	Blackcheek tonguefish	25-185	4-25	10-27
<u>Aluterus schoepfi</u>	Orange filefish	155-205	15-17	20-26

APPENDIX II. Total catch and percent of the total of economically-important species of finfishes, shrimp and crabs, northern Pamlico Sound, July, 1974 - June, 1975.

FINFISH

Common Name	Scientific Name	Total Number	Percent of Total Number
Alewife	<u>Alosa pseudoharengus</u>	26	.04
Blueback herring	<u>Alosa aestivalis</u>	103	.15
Bluefish	<u>Pomatomus saltatrix</u>	36	.05
Red drum	<u>Sciaenops ocellatus</u>	19	.02
Atlantic croaker	<u>Micropogon undulatus</u>	14345	22.13
Weakfish	<u>Cynoscion regalis</u>	2904	4.48
Menhanden	<u>Brevoortia tyrannus</u>	9840	15.18
Summer flounder	<u>Paralichthys dentatus</u>	47	.07
Southern flounder	<u>Paralichthys lethostigma</u>	770	1.18
Northern kingfish	<u>Menticirrhus saxatilis</u>	1	-
Southern kingfish	<u>Menticirrhus americanus</u>	20	.03
Spanish mackerel	<u>Scomberomorus maculatus</u>	4	-
Spotted seatrout	<u>Cynoscion nebulosus</u>	172	.26
Spot	<u>Leiostomus xanthurus</u>	35954	55.46
Striped mullet	<u>Mugil cephalus</u>	477	.73
White perch	<u>Morone americana</u>	53	.08
American eel	<u>Anguilla rostrata</u>	27	.04
Butterfish	<u>Peprilus triacanthus</u>	1	-
Harvestfish	<u>Peprilus alepidotus</u>	9	.01
Pigfish	<u>Orthopristis chrysoptera</u>	12	.01

SHRIMP

White shrimp	<u>Penaeus setiferus</u>	1906	20.53
Pink shrimp	<u>Penaeus duorarum</u>	753	8.11
Brown shrimp	<u>Penaeus aztecus</u>	6623	71.35

CRABS

Blue crab	<u>Callinectes sapidus</u>	2730	100
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