DESCRIPTION AND CATCH COMPOSITION OF NORTH CAROLINA'S LONG HAUL SEINE FISHERY[1]

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Abstract: The long haul seine is a 1100-1450-m net about 3 m deep pulled by two 9.2 - 13.7-m boats for distances of up to 2 to 3 km. The fishery, unique to North Carolina, apparently started in the early 1900's. Since 1956, the number of haul crews has varied between 30 to 60 and there is no clear relationship between that number and the total annual catch. Since 1972 landings have tended to increase, with a record 10,250t landed in 1979. Much of this increase can be attributed to croaker landings, which increased 45-fold from 1971 to 1979. Sixty-one long haul seine catches were sampled during April-October 1979 in Pamlico and Core Sounds and Neuse, Pamlico, and Pungo Rivers, North Carolina. A total of 53 species of fish, 4 species of invertebrates, and 2 species of turtles were observed in the catches. Together, spot, croaker, menhaden, and weakfish comprised 90 percent by number and 88 percent by weight of the samples. Preliminary ageing indicates a large majority of spot, croaker, and weakfish in the long haul catches are ages I and II.

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The long haul seine fishery is one of the most important estuarine fin-fish fisheries in North Carolina, with total landings[2] in 1979 of about 10,250 metric tons (t) valued at almost $3.5 million. Very few studies have been made of this unique, important fishery. Higgins and Pearson (1928) examined both the long haul and pound net fisheries in North Carolina and gave excellent descriptions of the gear and its use, catch composition, and the problem of destruction of undersized fish. Guthrie et al. (1973) also described long haul seine gear and its use and included notes on the history of the fishery. In 1978 the North Carolina Division of Marine Fisheries initiated a study of this fishery. Sholar (1979) reported the first year's results of this project, and this paper summarizes much of the data obtained during the second year. Topics discussed herein include a brief description of the fishery and its history; species, size, and age composition of the catch; and problems facing the fishery.

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Description and History of the Fishery

The long haul seine is a 1100 - 1450-m net about 3 m deep pulled by two 9.2 - 13.7-m boats for distances of up to 2-3 kilometers. The net is fished in 2.4 - 6.1 m of water and

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[2]All landings data for the years 1976-1979 presented herein are preliminary and subject to revision.

bunted or hardened up in water 1 - 1.2 m deep.

This gear can be extremely effective, catching practically all demersal fishes in its path. Catches of 13-18t occur regularly, although often a large proportion is too small to sell. One of the catches sampled contained about 63.5t of fish, and another catch containing 100t was reported. Guthrie et al. (1973) reported that a catch of 117t of spot was the largest known in modern times.

The long haul seine fishery apparently started in North Carolina in the early 1900's. Smith (1907) made no mention of such a fishery, although some of the procedures he described for other types of seining were eventually incorporated in long hauling. By 1925 the long haul fishery was well established (Higgins and Pearson 1928). According to older fishermen, the fishery started around Atlantic, NC (Core Sound) in about 1910 and was initially conducted only in October and November, primarily for spot (Guthrie et al. 1973). Landings statistics were gathered specifically on the long haul fishery from 1928 to 1940, in 1945, and since 1964. From 1950 to 1963, landings of common (landed on shore) and long haul seines were combined.

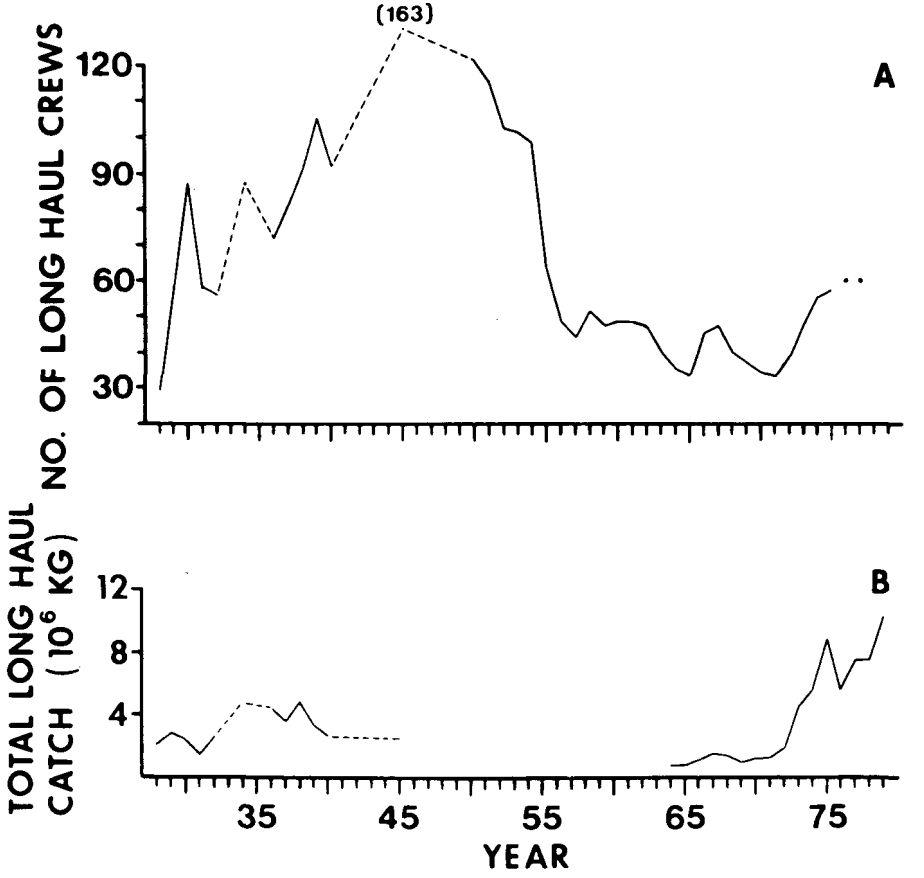

Fig. 1. Total number of long haul crews and annual long haul catch, 1928-1979. The values for 1978 and 1979 crews are estimates. The broken line indicates no data were available. Long haul landings from 1946-1963 were combined with common seine landings.

The number of long haul crews, a crude estimate of effort, has varied considerably since 1928—from a high of 163 in 1945 to a low of 29 in 1928 (Fig. 1a). Since 1956, the number has varied between 30 and 60 crews. Historical data suggests no clear relationship between the number of long haul crews and the total annual catch, except possibly during 1971-1975, when both catch and effort increased substantially (Fig. 1a and 1b). Total annual landings from 1928 to 1945 averaged 2,900t and ranged from 1,400 to 4,800t. From 1964 to 1972, landings varied little and were quite low, ranging from 900 to 1,400t. Since

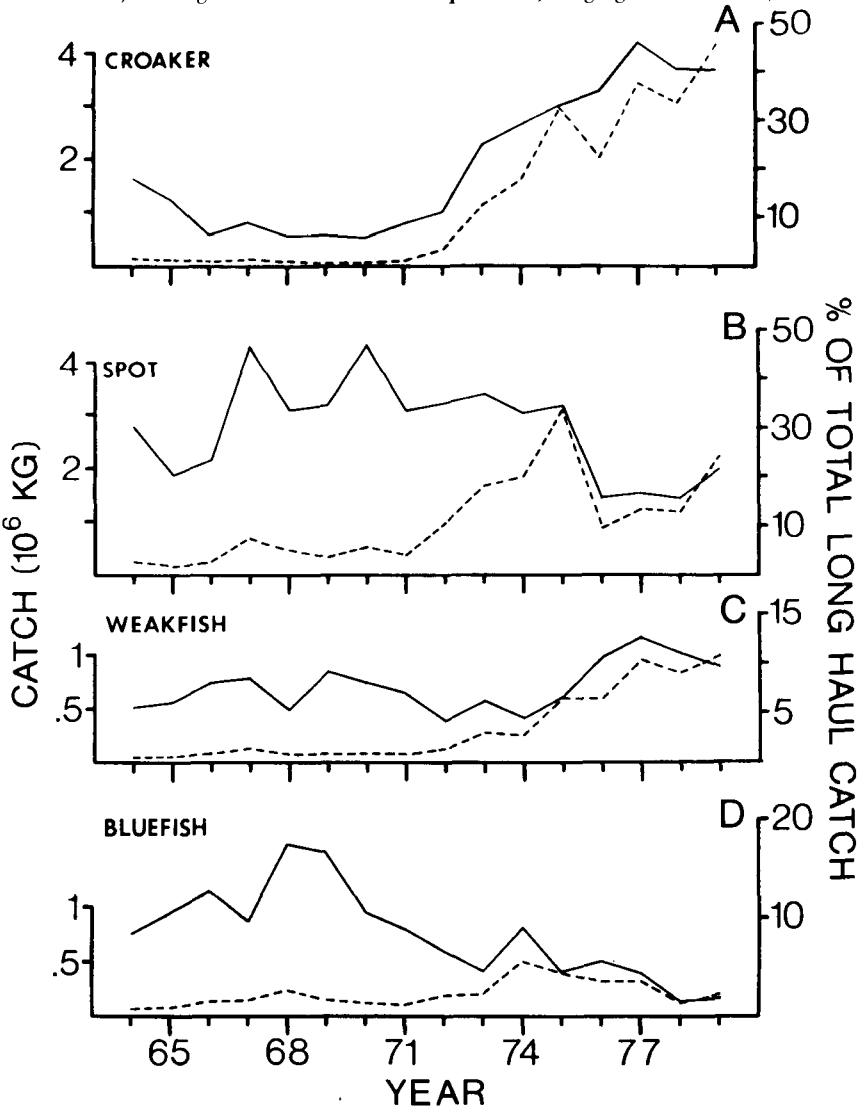

Fig. 2. Annual long haul landings by species, 1964-1979. The solid line represents the percent of the total long haul landings the species comprised. The broken line depicts the annual long haul landings for that species.

1974, the overall trend has been toward increased landings with a record 10,250t landed in 1979 (Fig. 1).

Much of the increase in long haul landings since 1973 can be attributed to huge increases in croaker landings. From 1964 to 1971 landings varied only slightly and averaged 90.5t (Fig. 2a). From 1971 to 1979, croaker landings increased 45 fold to a record 4,130t. The proportion of croaker in the long haul landings also greatly increased from 1971 (about 10%) to 1979 (about 40%).

Spot landings also rose sharply after 1971, with a peak in 1975 of about 3,040t (Fig 2b). The next year spot landings dropped 70 percent and have slowly increased since then. The proportion of spot in the long haul landings ranged from 33 to 47 percent from 1967 to 1975, but has since fallen to about 15 to 20 percent.

The pattern of weakfish landings parallels that of croaker with about a 10-fold increase from 1971 to 1979, when 978t were landed (Fig. 2c). The proportion of weakfish has remained stable since 1964, ranging between about 5 and 12 percent. Landings of bluefish, the only other commercially valuable species landed in significant numbers, have varied little since 1974 (Fig. 2d). The percentage of bluefish in the landings since 1964 peaked in 1968 at 17.3 percent, then steadily declined to about 2 percent in 1979.

METHODS

Sixty-one commercial long haul seine catches were sampled during April-October 1979 in Pamlico and Core Sounds and Neuse, Pamlico, and Pungo Rivers, North Carolina (Fig. 3). Pamlico Sound, with an area of about 435,100 ha, is the largest estuary behind a barrier island on the Atlantic Coast. It has a mean depth of about 4.6 - 6.1 m and salinities ranging from 10 to 20 ppt except near the inlets and the mouths of its largest tributaries (Roelofs and Bumpus 1953). The bottom is quite uniform and typically sand or mud. The Neuse, Pamlico, and Pungo Rivers are large, slow-moving coastal rivers tributary to Pamlico Sound. Core Sound, which adjoins southern Pamlico Sound and extends to Cape Lookout, has an area of about 24,087 ha and an average depth of 1 - 1.2 m with a maximum of about 3 m (Roelofs and Bumpus 1953). Salinities usually run from 20 - 30 ppt and the bottom is sand and/or sea grass.

At least 1 unculled 36 kg (80 lb) fish basket sample was obtained from each catch as it was being transferred from the net into the "run" or "buy" boat for delivery to the fish house. Whenever possible, as many additional samples as time allowed were taken. All fish in the sample were identified to species and measured to the nearest mm, fork or total length, depending on the shape of the tail for a given species. Total weight to the nearest 0.2 kg (0.5 lb) was taken from each sample for Atlantic croaker *(Micropoganias undulatus)*, spot *(Leiostomus xanthurus)*, weakfish *(Cynoscion regalis)*, Atlantic menhaden *(Brevoortia tyrannus)*, and all remaining species combined. When time permitted, scales were taken from croaker, spot, and weakfish from the area below the lateral line just posterior to the pectoral fin. Scales were washed with water and examined with a microfiche reader. Preliminary estimates of croaker and weakfish age composition were made using length frequencies and estimates of size at age given in the literature.

RESULTS

Species Composition

A total of 53 species of fish, 4 species of invertebrates, and 2 species of turtles were observed in the long haul catches (Table 1). Of these, 35 species of fish and 2 species of invertebrates were present in the samples. The incidence of occurrence for all species each month is shown in Table 2. Together, spot, croaker, menhaden, and weakfish comprised 90.2 percent by number and 88.0 percent by weight of the samples.

Spot was the most abundant species in number and weight, comprising 44.0 percent by number and 39.8 percent by weight (Table 1). These figures are considerably higher than

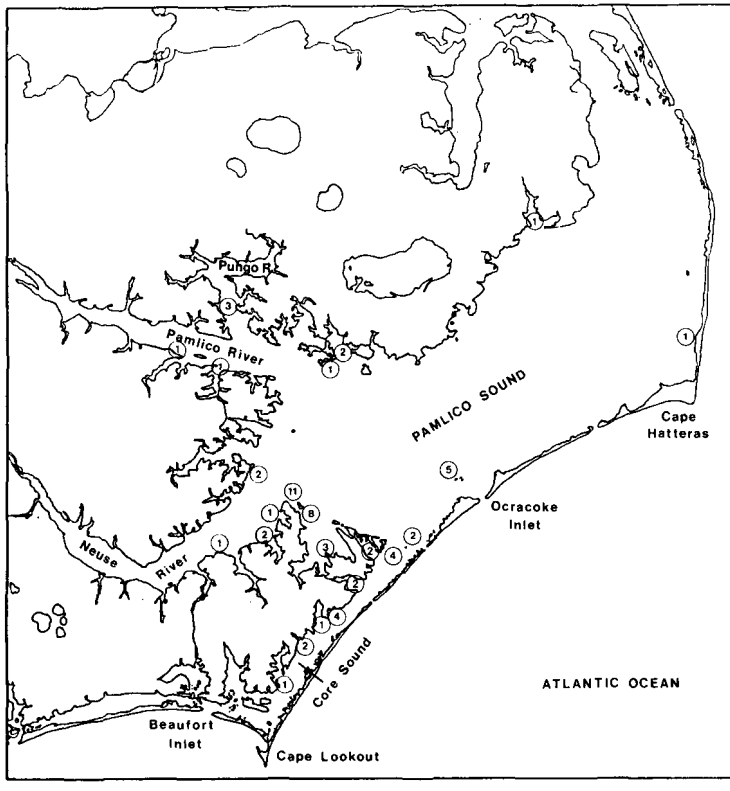

Fig. 3. Long haul sampling sites in North Carolina, April-October 1979. Numbers within the circles represent the number of catches sampled at that site.

Higgins and Pearson's (1928) 18.0 percent and Sholar's (1979) 27.2 percent by number. Significant increases in gear efficiency and changes in fishing areas since Higgins and Pearson's study, fluctuations in year class strength, and probably most importantly, variations in sampling effort could explain these differences. Sholar (1979) did not sample in Core Sound, where very large catches of spot are made each fall, and where much sampling effort was directed during October 1979. Landings data for 1979 show that spot comprised the second largest proportion (about 20 percent) of the total long haul landings, while croaker made up the largest proportion with about 40 percent (Fig. 2a, and 2b).

Croaker was the second most abundant species in number and weight, comprising 29.4 and 29.8 percent, respectively. Both Higgins and Pearson (1928) and Sholar (1979) found croaker to be the most abundant species, comprising 37.8 and 42.4 percent by number, respectively.

Menhaden and weakfish ranked third and fourth by number (8.8 and 8.0%, respectively), with the ranking reversed by weight (12.2% for weakfish and 6.2% for menhaden). Sholar (1979) also found menhaden and weakfish ranked third and fourth by number, but Higgins and Pearson (1928) found spotted seatrout, *Cynoscion nebulosus*, ranked third and weakfish fourth by number. The latter authors' ranking of third and mean composition of 17.9 percent for spotted seatrout contrasts sharply with our ranking of sixteenth and composition of 0.1 percent and Sholar's (1979) of sixth and 0.7 percent. It

Table 1. Species composition of samples from 61 long haul seine catches (April-October 1979) from Pamlico Sound, its tributaries, and Core Sound, NC. No Weights were taken on 6 of 61 catches sampled and no spot weight was recorded on one additional catch.

	Number	Percent	Weight (kg)	Percent
Leiostomus xanthurus	8,520	44.0	974.7	39.8
Micropogonias undulatus	5,694	29.4	728.9	29.8
Brevoortia tyrannus	1,709	8.8	152.5	6.2
Cynoscion regalis	1,557	8.0	299.3	12.2
Lagodon rhomboides	954	4.9		
Pomatomus saltatrix	191	1.0	Wt. for all remaining species:	
Orthopristis chrysoptera	171	0.9	291.6	11.9
Bairdiella chrysoura	124	0.6		
Peprilus alepidotus	106	0.5		
Menticirrhus americanus	54	0.3		
Prionotus evolans	42	0.2		
Callinectes sapidus	39	0.2		
Paralichthys dentatus	38	0.2		
Rhinoptera bonasus	27	0.1		
Opisthonema oglinum	27	0.1		
Cynoscion nebulosus	23	0.1		
Monacanthus hispidus	20	0.1		
Paralichthys lethostigma	18	0.1		
Selene vomer	17	0.1		
Dasyatis sabina	15	0.1		
Peprilus triacanthus	13	0.1		
Dorosoma cepedianum	11	0.1		
Caranx hippos	8	< 0.1		
Chaetodipterus faber	8	< 0.1		
Citharichthys spilopterus	5	< 0.1		
Prionotus tribulus	4	< 0.1		
Synodus foetens	4	< 0.1		
Opsanus tau	3	< 0.1		
Etropus crossotus	3	< 0.1		
Chloroscombrus chrysurus	2	< 0.1		
Sphoeroides maculatus	2	< 0.1		
Prionotus scitulus	1	< 0.1		
Alosa aestivalis	1	< 0.1		
Menticirrhus saxatilis	1	< 0.1		
Menticirrhus spp.	1	< 0.1		
Archosargus probatocephalus	1	< 0.1		
Chilomycterus schoepfi	1	< 0.1		
Penaeus duorarum	1	< 0.1		

Table 1. Cont.

Species Observed but not Present in any Sample

Penaeus aztecus	*Trachinotus carolinus*
Limulus polyphemus	*Lutjanus griseus*
Carcharhinus milberti	*Diapterus auratus*
Carcharhinus spp.	*Eucinostomus* spp.
Mustelus canis	*Pogonias cromis*
Raja eglanteria	*Sciaenops ocellatus*
Dasyatis sayi	*Scomberomorus maculatus*
Dasyatis spp.	*Paralichthys* spp.
Anguilla rostrata	*Symphurus plagiusa*
Anchoa hepsetus	*Aluterus schoepfi*
Ictalurus catus	*Caretta caretta*
Strongylura marina	*Malaclemys terrapin*
Rachycentron canadum	

is possible fishermen in the 1920's directed their effort towards spotted seatrout and/or this species was much more abundant then. Total spotted seatrout landings for all gears decreased 49 percent from 1976 to 1977 and 85 percent from 1976 to 1978. Figures for 1979 were very similar to those of 1978.

Age and Length Composition

A first reading of scales from 920 spot collected in or near the study area suggests that the bulk of the catch was composed of 2 age classes (I and II). This agrees with Sholar's (1979) findings. Monthly length frequency distributions were not so clear, although there was a hint of bimodality in June (Fig. 4). Of the 9189 spot sampled, 99 percent ranged from 100 to 260 mm FL, with the largest measuring 292 mm FL. Length frequencies (Higgins and Pearson 1928) indicate that size composition has changed little since the 1920's. The length frequencies do show the recruitment of young-of-the-year when about 100 mm FL as early as June with a peak in the fall.

The length frequency distributions for croaker suggest 2 age classes (I and II) comprised the majority of the catch (Fig. 5). This is in agreement with Sholar's (1979) findings. May was the only month when large numbers of both age I and II fish were present, and April was the only other month when age II fish were taken in numbers. Young-of-the-year were recruited from July through October when about 130 - 190 mm TL, which is similar to the recruitment pattern of spot. Most of the croakers ranged from 150 to 320 mm TL, with few larger taken. This range is similar to that found by Higgins and Pearson (1928).

The total length frequency distribution for weakfish suggests the long haul catch was comprised primarily of age I and II fish (Table 3), using Merriner's (1973) back-calculated estimates of 185 - 193 mm FL at age I and 264 - 274 mm FL at age II. Sholar (1979) found age I and II weakfish made up over 90 percent of the long haul catch. Weakfish were recruited at about 170 - 190 mm FL and few larger than 350 mm FL were taken. Total length frequencies for all species except croaker and spot which comprised at least 0.1 percent of the samples are presented in Table 3.

DISCUSSION

The long haul seine fishery is unique to the large sounds and bays of North Carolina. Neighboring states have small haul seine fisheries, but the gear is fished differently—only 1 end is pulled by boat, the other is anchored in some fashion. Possible reasons why this

Table 2. Monthly occurrence of all species observed in North Carolina long haul seine catches, April-October 1979, expressed as: No. catches species occurred in sample/No. catches species present in sample or observed in catch.

	No. Catches Sampled Each Month							
Species	7 Apr	13 May	8 Jun	14 Jul	10 Aug	2 Sep	7 Oct	61 Total
Carcharhinus milberti		0/1				0/1	0/1	0/3
Carcharhinus spp.				0/1				0/1
Mustelus canis		0/1		0/1		0/1	0/1	0/4
Raja eglanteria		0/1	0/1				0/1	0/3
Dasyatis sabina		3/3	1/3	3/6	0/4	0/2	3/6	10/26
Dasyatis sayi		0/1		0/4				0/5
Dasyatis spp.		0/1	0/1					0/2
Rhinoptera bonasus		3/8	2/6	0/2	2/3		0/4	7/23
Anguilla rostrata					0/1			0/1
Alosa aestivalis	1/2							1/2
Brevoortia tyrannus	3/5	7/11	7/7	6/6	7/8	2/2	6/7	38/46
Dorosoma cepedianum		2/2					0/1	2/3
Opisthonema oglinum		1/2		2/3	1/1		0/1	4/6
Anchoa hepsetus							0/1	0/1
Synodus foetens						1/1	2/2	3/3
Ictalurus catus	1/1							1/1
Opsanus tau	1/1				1/1		1/1	3/3
Strongylura marina				0/1	0/1			0/2
Pomatomus saltatrix	2/4	6/9	5/7	9/9	6/9	1/2	5/6	34/46
Rachycentron canadum				0/2				0/2
Caranx hippos					0/1	2/2	0/1	2/4

Table 2. Cont.

Species	No. Catches Sampled Each Month							
	7 Apr	13 May	8 Jun	14 Jul	10 Aug	2 Sep	7 Oct	61 Total
Chloroscombrus chrysurus						1/1	1/2	2/3
Selene vomer				1/3	3/5	1/2	5/5	10/15
Trachinotus carolinus			0/2	0/3	0/2		0/1	0/8
Lutjanus griseus							0/1	0/1
Diapterus auratus							0/1	0/1
Eucinostomus spp.							0/1	0/1
Orthopristis chrysoptera		1/1	2/2	3/4	4/4	2/2	7/7	19/20
Archosargus probatocephalus			1/1		0/2		0/1	1/4
Lagodon rhomboides	0/1	3/3	3/3	5/6	2/5	2/2	7/7	22/27
Bairdiella chrysoura	2/4	4/4	3/4	4/4	5/5	2/2	3/4	23/27
Cynoscion nebulosus	2/4	1/2	1/4	7/11	0/3	1/1	1/5	13/30
Cynoscion regalis	5/6	9/13	6/7	12/12	10/10	2/2	6/6	50/56
Leiostomus xanthurus	7/7	12/13	8/8	13/14	10/10	2/2	7/7	59/61
Menticirrhus americanus		3/3	2/2	3/3	1/1	2/2	3/6	14/17
Menticirrhus saxatilis				1/1				1/1
Menticirrhus spp.				1/1				1/1
Micropogonias undulatus	7/7	12/13	7/7	12/12	9/10	2/2	6/6	55/57
Pogonias cromis					0/1			0/1
Sciaenops ocellatus					0/1			0/1
Chaetodipterus faber							3/6	3/6
Scomberomorus maculatus							0/1	0/1
Peprilus alepidotus		3/3	2/3	1/1	1/1	1/1	5/5	13/14

Table 2. Cont.

Species	No. Catches Sampled Each Month							
	7 Apr	13 May	8 Jun	14 Jul	10 Aug	2 Sep	7 Oct	61 Total
Peprilus triacanthus						1/1	4/6	5/7
Prionotus evolans			4/5	7/7	3/3	2/2	2/4	18/21
Prionotus scitulus							1/3	1/3
Prionotus tribulus			1/1	2/3			1/2	4/6
Citharichthys spilopterus					0/1		2/2	2/3
Etropus crossotus							3/3	3/3
Paralichthys dentatus	1/1	0/3	3/5	8/10	2/4	1/1	2/2	17/26
Paralichthys lethostigma		1/4	1/1	3/4	1/7		0/1	6/17
Paralichthys spp.			0/1	0/1			0/2	0/4
Symphurus plagiusa				0/1				0/1
Aluterus schoepfi					0/1		0/1	0/2
Monacanthus hispidus			0/1	5/5	3/3		1/2	9/11
Sphoeroides maculatus						0/1	1/4	1/5
Chilomycterus schoepfi		1/2		1/5	0/1		0/4	2/12
Callinectes sapidus	0/1	2/5	3/6	9/9	4/6	1/1	1/4	20/32
Penaeus aztecus			0/1					0/1
Penaeus duorarum			1/1					1/1
Limulus polyphemus							0/4	0/4
Caretta caretta							0/1	0/1
Malaclemys terrapin	0/2							0/2

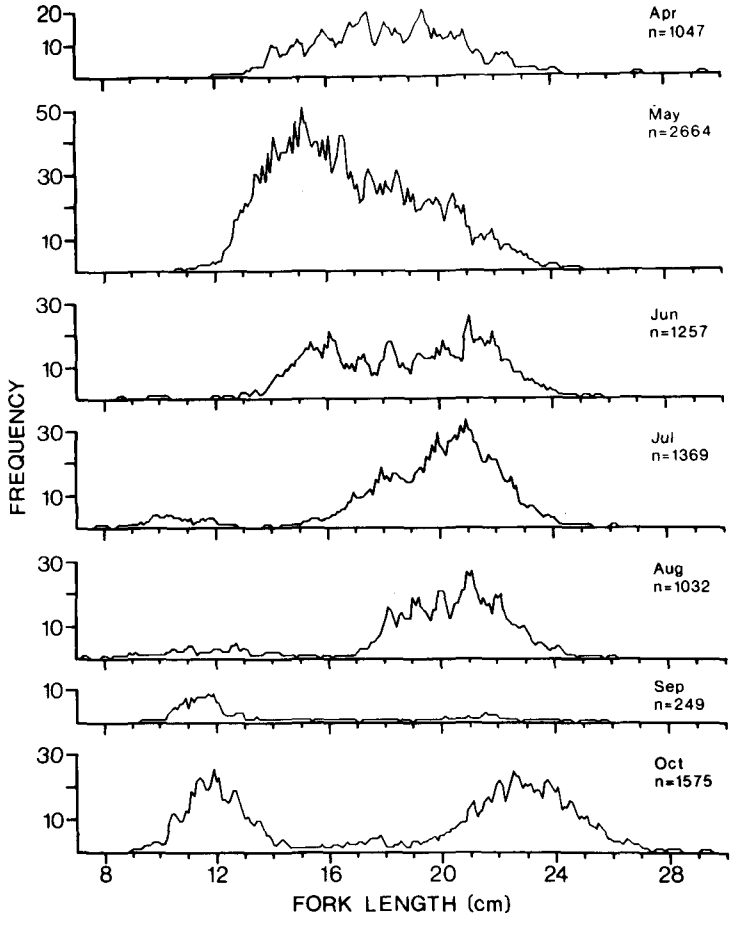

Fig. 4. Monthly length frequencies of *Leiostomus xanthurus*, captured in long haul seines in North Carolina, April-October 1979. Frequencies are moving averages of 3. Frequencies were rounded to a minimum value of 1 if specimens were captured.

fishery has not spread to other states include: (1) absence of very large, smooth-bottomed estuaries which are needed because of the size of the nets and the lengths of the tows, (2) absence of large populations of commercial, demersal fishes such as the sciaenid populations in Pamlico Sound, and/or (3) opposition by sport fishermen and other commercial fishermen.

Long haulers do face several problems, including those of natural, man-made, and social origin. The most notable natural problems, at least in the southern part of Pamlico Sound, are the presence in some months of large numbers of cownose rays and jellyfish in the haul areas. The rays, ranging from 2 to 14 kg, must be handled carefully because of their poisonous spine and they create extra work because they must be individually removed from the catch, usually with a gaff. Jellyfish, besides the obvious problem caused by stinging, are so abundant at times that they clog the net, making it extremely difficult to tow and sometimes causing it to plane off the bottom. Large numbers of small menhaden gilled in the net cause similar problems.

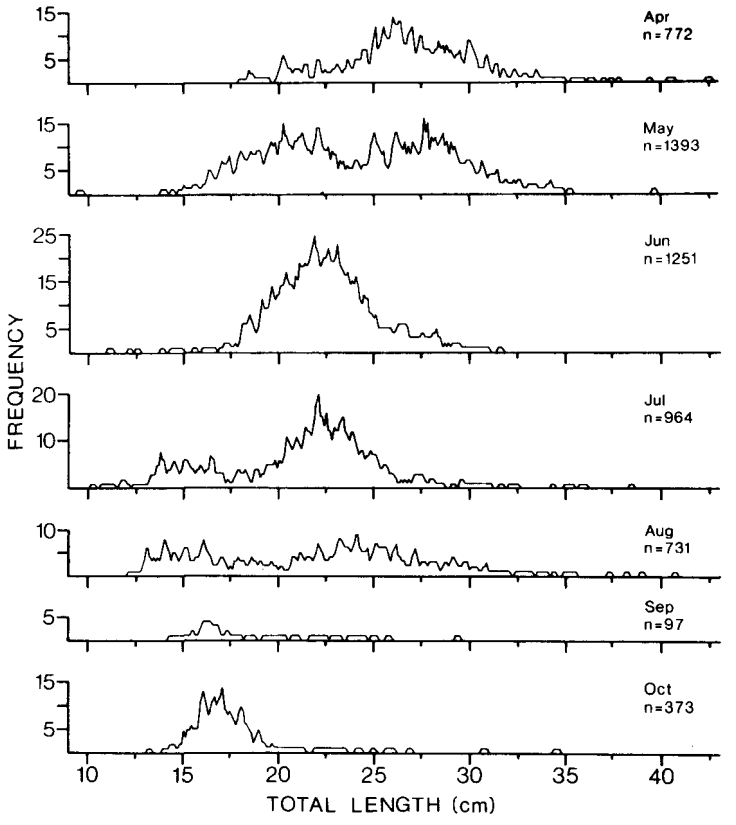

Fig. 5. Monthly length frequencies of *Micropogonias undulatus* captured in long haul seines in North Carolina, April-October 1979. Frequencies are moving averages of 3. Frequencies were rounded to a minimum value of 1 if specimens were captured.

Abandoned, broken-off pound net stakes and pound net stakes left in place from season to season exclude long haulers from large areas, especially in Core Sound. A very large increase in the number of crab and eel pot fishermen has resulted in ever increasing friction with haul seiners, who cannot haul in areas filled with pots. Potters are mainly interested in shoal waters, which long haulers need only to bunt or harden up their seine. The NC Division of Marine Fisheries is trying to determine if methods exist to bunt or harden up a long haul seine in deeper water (2-3 m). If they do exist and if long haulers can be convinced to adopt the new methods, much of the problem could be eliminated.

One other growing problem in the Pamlico-Pungo River area is a conflict with recreational anglers who fear long haulers are depleting stocks of sport fish. Already angry sportfishermen have allegedly dumped an engine block and barbed wire in traditional haul net areas. Hopefully, this problem will not spread as rapidly as competition with other commercial fishermen because of the vastness of North Carolina's estuarine fishing areas, which limits the contact between sportfishermen and long haulers.

Table 3. Length frequencies of species (excluding spot and croaker) comprising 0.1 percent or more of the samples from 61 long haul seine catches during 1979 in Pamlico and Core Sounds and tributaries.

Species	Length (mm)																	
	90	90-109	110-129	130-149	150-169	170-189	190-209	210-229	230-249	250-269	270-289	290-309	310-329	330-349	350-369	370-389	390-409	409
Dasyatis sabina[1]						4	4		2	1	1	3						
Rhinoptera bonasus[1]														1		1		25
Brevoortia tyrannus[2]		41	69	113	493	518	274	82	60	18								
Dorosoma cepedianum[2]				1	2	1	5	2										
Opisthonema oglinum[2]			4	5	14	4												
Pomatomus saltatrix[2]		2	1	2	4	5	11	13	16	17	17	26	14	10	11	20	7	6
Orthopristis chrysoptera[2]		18	61	39	15	15	17	5	1									
Lagodon rhomboides[2]	4	294	191	34	112	41	6	1										
Bairdiella chrysoura[3]		1	7	9	39	37	31											
Cynoscion nebulosus[3]			1				1		1	2	1	3		1	4	4	2	3
Cynoscion regalis[3]					8	56	150	231	216	209	442	328	141	79	40	21	13	21
Menticirrhus americanus[3]						4	6	2	6	10	5	6	5	9	1			
Peprilus alepidotus[2]	30	35	27	7	6	1												
Prionotus evolans[2]			3	18	7	8	4	1										
Paralichthys dentatus[3]		1	2	3	5	1	1	5	3	1	2	4	1	2	1			1
Paralichthys lethostigma[3]						1		1	1	2	3	1	3	2	2	1		1
Monacanthus hispidus[3]	13	4	3															

[1]Disc width.

[2]Fork length.

[3]Total length.

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