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Seasonal Composition of Finfish in Waters Behind the Virginia Barrier Islands

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ABSTRACT

Semi-monthly sampling of finfish was conducted in the lagoons and marshes behind Parramore and Cedar Islands at Wachapreague Inlet, Cobb and Wreck Islands at Sand Shoal Inlet, and on the northwest side of Fisherman Island from September 1986 through September 1987. Although all life-stages were collected, the study was designed to focus on utilization of this area by juvenile finfish. Sixty-nine species of finfish were collected. Species diversity and abundance fluctuated widely among seasons. Both were highest in the fall and lowest in the winter. The most abundant species over all seasons and locations were silversides (*Menidia menidia*) and bay anchovy (*Anchoa mitchilli*). The most abundant commercially and recreationally important species collected were summer flounder (*Paralichthys dentatus*) and the sciaenids, croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*) and weakfish (*Cynoscion regalis*). As adults, these species migrate inward in the spring and leave in the fall, but newly recruited juveniles were found utilizing these areas almost all year. Comparisons were made with results from the only other directed study in this area (Richards and Castagna, 1970). Differences between the results of these two studies can be attributed to gear (size of trawl net mesh) and site (salinity and relative position in marsh).

Key words: fish, ecology, Virginia.

INTRODUCTION

Much of what is known about the fish fauna on the seaside of the Delmarva Peninsula is a compilation of ancillary data from species-specific studies (Hoese, 1962; Musick and Colvocoresses, 1987), site specific studies (Cowan and Birdsong, 1985; Kimmel, 1973), recreational and commercial fishing (Richards, 1965; Burrell *et al.*, 1972; Marshall and Lucy, 1981), or information gained from local watermen. Only one study, conducted for 12 months in 1965-66, has been directed at the ecology of finfish in this area. That survey covered a larger geographic area, Metompkin Bay to Fishermans Island, and a broader spectrum of habitats, inlets, channels, inshore beaches and tidal creeks (Richards and Castagna, 1970). The

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present study evaluated fewer sites, but in a more intensive manner with semi-monthly sampling of the same stations for 13 months.

The objective of this project was to describe the abundance, distribution, and seasonality of finfish species captured in waters behind the barrier islands of Virginia, with emphasis on utilization of these waters by juvenile fish, especially new recruits. It has been speculated that the seaside bays of the eastern shore of Virginia are primary nursery grounds for juvenile flatfish (Poole, 1966), however, this has never been documented with direct observations. Although the marsh areas of the Chesapeake Bay, Virginia (Weinstein and Brooks, 1983; Weinstein *et al.*, 1980; Smith *et al.*, 1984) and the open sand areas of Pamlico Sound, North Carolina (Powell and Schwartz, 1977), have been well studied and established as important nursery habitat for juvenile finfish, no analogous research has been conducted in the lagoonal areas behind the Virginia Barrier Islands. Therefore, the purpose of this study was to document the presence or absence of juvenile finfish over a 13-month period as a foundation for future research on the importance of this habitat.

METHODS

The eastern shore of Virginia forms the lower end of the Delmarva Peninsula, which is oriented in a north-south direction and separates the Atlantic Ocean from the Chesapeake Bay. The seaside of the peninsula is a contiguous system of shallow bays, extensive saltmarshes and barrier islands. The bays and saltmarshes are transected by main channels approximately 400-1000 m wide near inlets and 40-250 m wide at the upstream end (D. Wyanski, pers. comm.). Channel depths range from 3-20 m at Mean High Water (MHW).

Preliminary sampling at many eastern shore sites was conducted March through August 1986 (Norcross, 1987). Based on presence of juvenile finfish, accessibility, and diversity of habitat, three sites were selected for this study: Wachapreague [W] Channel and Inlet between Cedar and Parramore Islands; Sand Shoal [S] Channel and Inlet between Cobb and Wreck Islands; and Fishermans [F] Island (Figures 1-4). Since there is no background information on distribution of juvenile finfish in this area, a systematic survey was employed as appropriate for exploratory studies under such circumstances (Doubleday and Rivard, 1981). Therefore, the sites were chosen to cover a widespread geographic area which could be intensively sampled within a short period of time. Selected sites were similar with regard to proximity of barrier islands, extent of marshes, water depth, and creek size. Inherent differences in the morphology of the islands may affect the hydrography and, hence, the composition and distribution of fish.

At each site, sample stations were located in channels directly behind the barrier islands and adjacent to the marsh complex. Because of the lack of information regarding this area as a potential nursery for finfish, station positions were chosen to encompass a variety of depths, habitats and substrates. Sand substrate was found at inlets, creek mouths and along river margins. Mud substrate predominated in the creeks of the saltmarshes.

A bottom trawl is the preferred gear for collecting demersal fish (Hemmings, 1969) over unobstructed bottom. This study was conducted with a 4.9 m semi-balloon otter trawl with 19 mm bar mesh in the wings and upper body, 6.4 mm delta

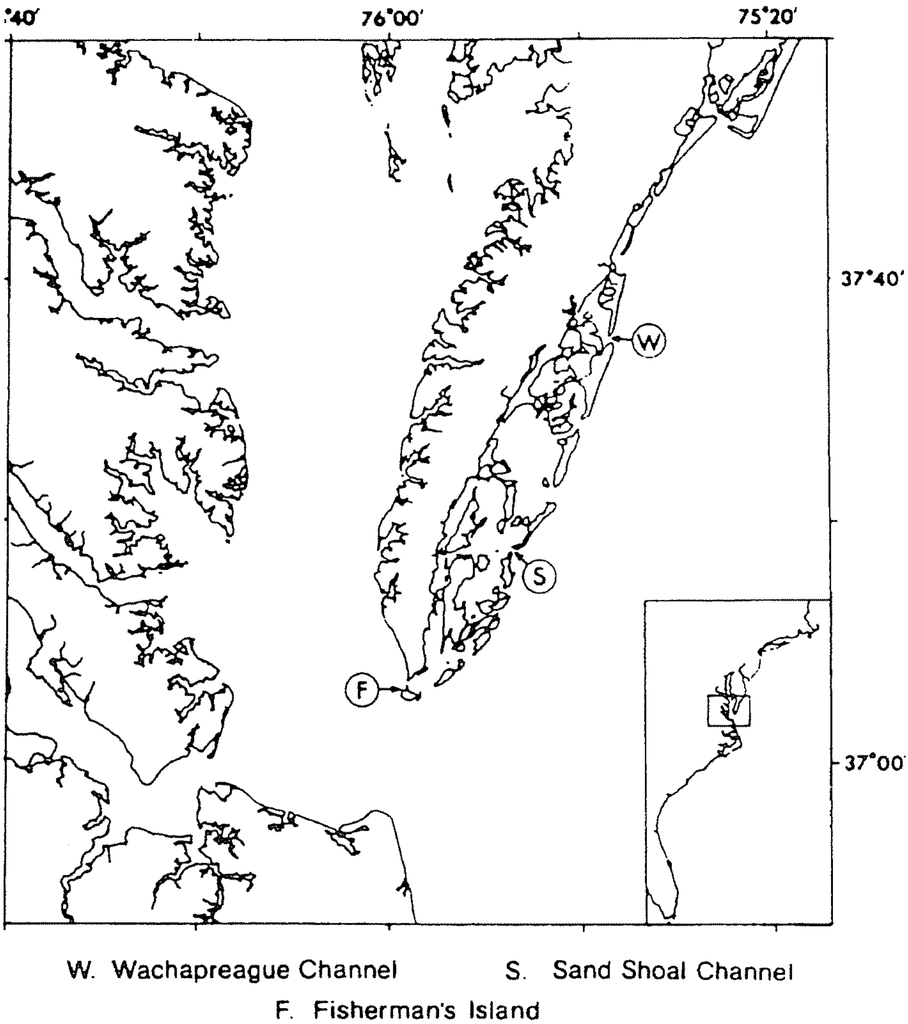

FIGURE 1. Location of sampling sites on the eastern shore of Virginia: Wachapreague, Sand Shoal and Fisherman Island.

mesh in the lower body and codend, and 3.2 mm delta mesh liner. This small mesh was chosen for this study specifically to capture newly recruited fish <30 mm. The doors were 30.5 cm x 61 cm and weighed 6.4 kg each. A 4.8 mm link tickler chain was added, since the addition of a tickler chain to a trawl results in statistically significant increases in catches of demersal organisms (Chittenden and Van Engel, 1972; Creutzberg *et al.*, 1987). The trawl was deployed using 4.8 mm wire cable from an electric winch and a free-swinging davit aboard a 6.4 m open Privateer.

Two five-minute trawls were performed at each station, oriented with and against the current. Five-minute tows were chosen considering the mesh size of the liner, high biomass of the summer/fall fish catch, and shortness of winter days. Tow speed was 100-150 cm/sec over the bottom, following the convention of other

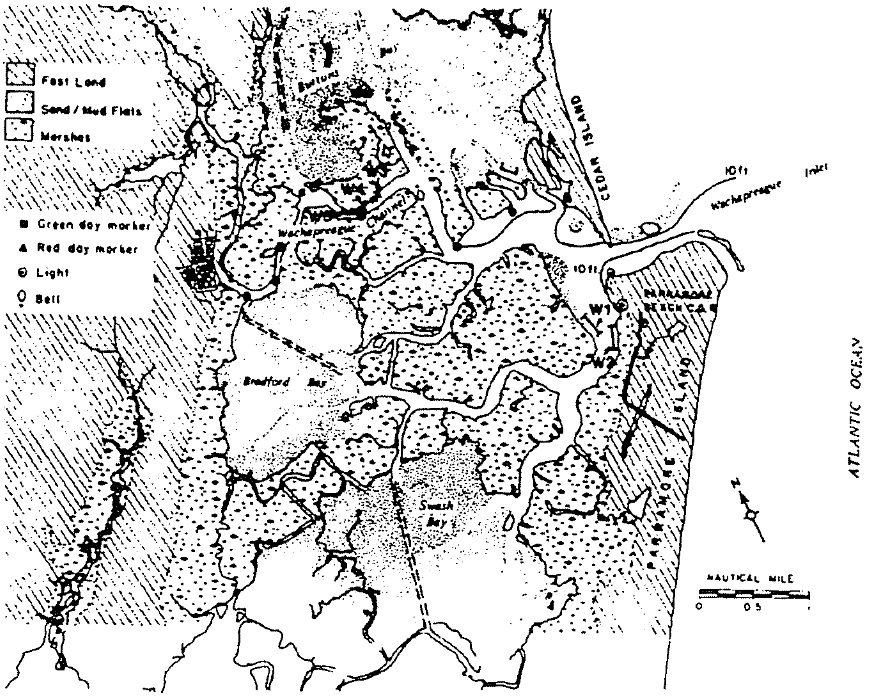

FIGURE 2. Location of sampling stations at Wachapreague Inlet: W1 - deep sand; W2 - shallow sand; W3 - mud seine; W4 - shallow mud; W5 - deep mud.

studies using the same size trawl (Orth and Heck, 1980; Weinstein and Brooks, 1983).

Seining is a commonly accepted method for assessing the abundance of juvenile fish (Lyons, 1986). Two seine hauls, 25 m in length, were made parallel to the shore at each site, one with the current and one against the current. A 6.1 m bag seine (3.2 mm delta mesh) was modified by the addition of a 3.2 mm link chain to the leadline which acted as a tickler chain. This enabled the seine to disturb the top 1 cm of substrate, enhancing the capture of very small (< 25 mm) flatfish.

The sampling protocol for each site included four trawl stations, at deep (8.5-11.3 m) and shallow (1.2-1.8 m) sand substrates and deep (6.4-9.8 m) and shallow (1.2-1.8 m) mud substrates, and one seine station in < 1 m of water on mud substrate. Specific locations of sample stations are shown in Figures 2 - 4. Seining was the only sampling method employed at Fisherman Island because of limited water depth. Tide stage controlled when certain locations could be sampled. All seine stations had to be sampled at or near low tide. Mud stations were sampled near low tide, and sand stations were sampled near high tide. Samples were collected twice monthly from September 1986 through mid-September 1987, for a total of 25 collections at each site. The frequency of the sampling was designed to capture newly recruiting juveniles. All fish were identified, enumerated, and discarded. Total length was measured for all flatfish and all sciaenids. Air, surface,

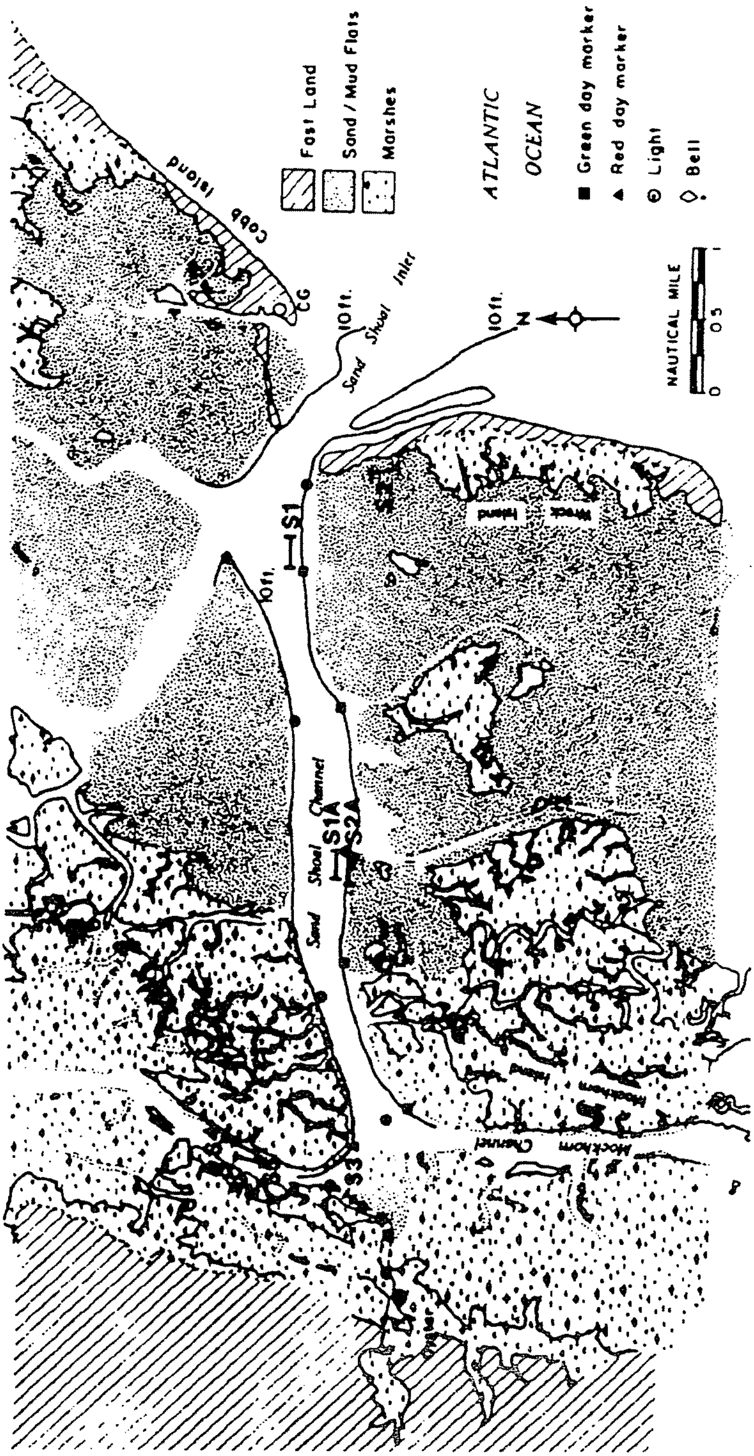

FIGURE 3. Location of sampling stations at Sand Shoal Inlet: S1 - deep sand; S1A n- alternate S1; S2 - shallow sand; S2A - alternate; S3 - mud seine; S4 - shallow mud; S5 - deep mud.

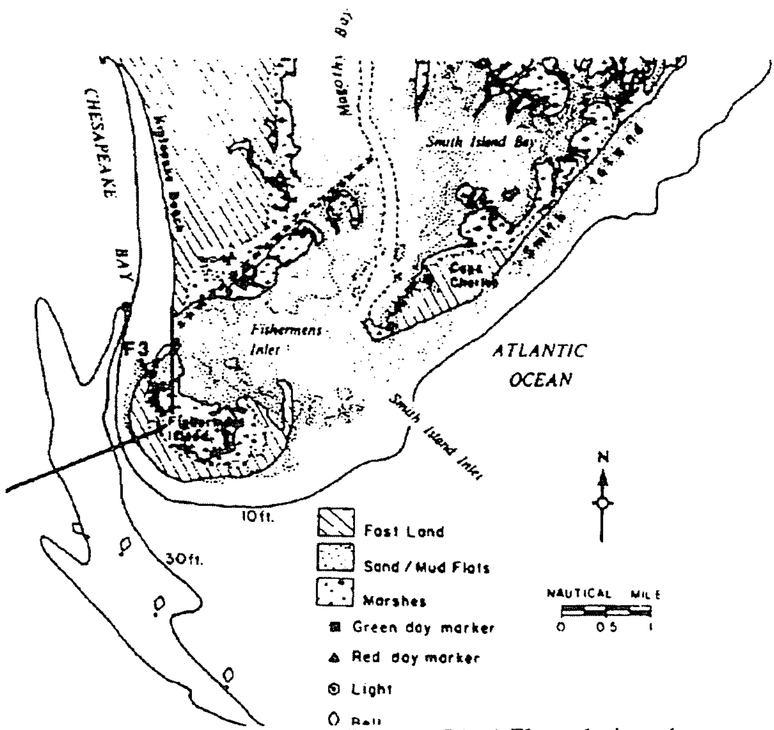

FIGURE 4. Location of sampling station at Fisherman Island: F3 - mud seine only.

and bottom water temperatures and surface and bottom salinities were recorded at each station.

The protocol employed by Richards and Castagna (1970) sampled 20 stations for a total of 376 samples between 22 June 1965 and 7 July 1966. No sampling was conducted in January. Eight trawl stations were sampled monthly October through March, and at two- to three-week intervals the remainder of the year. The depth of the trawl stations ranged from 1.8 to 12.2 (average 7.4 m). Tows were double the time (ten minutes) using a 4.9 m trawl with much larger mesh (32 mm bag, 13 mm liner) than that used in the present study. No seining was conducted October through April. Twelve seine stations with depth ranges of 1.0 - 1.7 m (average - 1.4 m) were occupied at two- to three-week intervals the remainder of the year. The mesh size (6.4 mm) of their seine was twice that used in the present study.

RESULTS

A total of 80 taxa of finfish were collected at all three sites, with 69 identified to species. When species identification was uncertain, fish were identified to the lowest taxonomic level possible, therefore, eight were classified to genus and three to order. Compared with Richards and Castagna (1970), our total missed 15 species, but included 15 additional species not captured by them. There was an overlap of 54 species. The top 28 most abundant species also were captured in the previous study. Comparison of our results with those of Richards and Castagna

TABLE 1. Fish species collected from the barrier island lagoons of the seaside of Virginia's eastern shore (nomenclature after Robins *et al.*, 1980).

Species collected Taxonomic Group		This Study	Richards & Castagna (1970)
TRIAKIDAE	Smoothhound sharks		
Mustelus canis	smooth dogfish	30	18
RAJIIDAE	Skates		
Raja eglanteria	clearnose skate	43	28
DASYATIDAE	Stingrays		
Dasyatid sp.		1	0
Dasyatis sayi	bluntnose stingray	13	1
Dasyatis americana	southern stingray	0	1
Dasyatis centroura	roughtail stingray	0	5
Gymnura micrura	smooth butterfly ray	0	4
MYLIOBATIDAE	Eagle rays		
Myliobatis fremenvillei	bullnose ray	1	0
ELOPIDAE	Tarpons		
Elops saurus	ladyfish	1	1
ANGUILLIFORMES			
Leptocephalus larvae	unidentified	10	0
Glass eel	unidentified	14	0
ANGUILLIDAE	Freshwater eels		
	Anguilla rostrata American eel		21
CONGRIDAE	Conger eels		
Conger oceanicus	conger eel	16	2
CLUPEIDAE	Herrings		
Alosa aestivalis	blueback herring	3	41
Alosa pseudoharengus	alewife	5	2
Alosa sapidissima	American shad	2	1
Brevoortia tyrannus	Atlantic menhaden	18	1057
Clupea harengus	Atlantic herring	0	11
ENGRAULIDAE	Anchovies		
Anchoa hepsetus	striped anchovy	6	175
Anchoa mitchilli	bay anchovy	3214	3840
SYNODONTIDAE	Lizardfishes		
Synodus foetens	inshore lizardfish	8	6

BATRACHOIDIDAE	Toadfishes		
Opsanus tau	oyster toadfish	53	50
GADIDAE	Codfishes		
Urophysis chuss	red hake	41	9
Urophysis regia	spotted hake	337	20
Urophysis tenuis	white hake	4	0
	Pollachius virens	pollock	0
OPHIDIIDAE	Cusk-eels		
Ophidiid sp.		2	0
Lepophidium cervinum	fawn cusk-eel	34	0
Ophidion marginatum	striped cusk-eel	62	2
EXOCOETIDAE	Flying fishes		
Hyporhamphus unifasciatus	halfbeak	0	4
BELONIDAE	Needlefishes		
Belonid sp.		1	0
Strongylura marina	Atlantic needlefish	6	0
CYPRINODONTIDAE	Killifishes		
Cyprinodon variegatus	sheepshead minnow	24	4893
Lucania parva	rainwater killifish	408	31
Fundulus heteroclitus	mummichog	1209	13800
Fundulus majalis	striped killifish	84	8590
Fundulus luciae	spotfin killifish	0	25
ATHERINIDAE	Silversides		
Menidia beryllina	inland silverside	11042	30424
Menidia menidia	Atlantic silverside	1	11
Membras martinica	rough silverside	0	28
GASTEROSTEIDAE	Sticklebacks		
Gasterosteus aculeatus	threespine stickleback	5	1
Apeltes quadracus	fourspine stickleback	0	3
SYNGNATHIDAE	Pipefishes		
Hippocampus erectus	lined seahorse	28	3
Syngnathus fuscus	northern pipefish	107	36
Syngnathus floridae	dusky pipefish	5	0
PERCICHTHYIDAE	Temperate basses		
Centropristis striata	black seabass	125	105
POMATOMIDAE	Bluefishes		
Pomatomus saltatrix	bluefish	5	5

CARANGIDAE	Jacks		
Selene vomer	lookdown	2	0
Caranx hippos	crevalle jack	0	2
Trachinotus falcatus	permit	0	2
LUTJANIDAE	Snappers		
Lutjanus griseus	gray snapper	4	0
GERREIDAE	Mojarras		
Gerreid sp.		6	0
Eucinostomus argenteus	spotfin mojarra	5	0
HAEMULIDAE	Grunts		
Orthopristis chrysoptera	pigfish	18	59
SPARIDAE	Porgies		
Stenotomus chrysops	scup	3	49
SCIAENIDAE	Drums		
Bairdiella chrysoura	silver perch	307	1077
Leiostomus xanthurus	spot	1551	28
Micropogonias undulatus	Atlantic croaker	2021	9
Pogonias chromis	black drum	1	23
Cynoscion regalis	weakfish	399	39
Cynoscion nebulosus	spotted seatrout	3	0
Sciaenops ocellata	red drum	5	0
Menticirrhus sp.		3	0
Menticirrhus saxatilis	northern kingfish	47	97
Menticirrhus americanus	southern kingfish	7	0
MULLIDAE	Goatfishes		
Mullus auratus	red goatfish	0	1
CHAETODONTIDAE	Butterflyfishes		
Chaetodon ocellatus	spotfin butterflyfish	3	0
LABRIDAE	Wrasses		
Tautoga onitis	tautog	5	21
MUGILIDAE	Mullets		
Mugil cephalus	striped mullet	44	423
Mugil curema	white mullet	0	504
SPHYRAENIDAE	Barracudas		
Sphyraena borealis	northern sennet	0	4
URANOSCOPIDAE	Stargazers		
Astroscopus guttatus	northern stargazer	6	1
BLENNIIDAE	Combtooth blennies		
Hypsoblennius hentzi	feather blenny	19	0
Chasmodes bosquianus	striped blenny	7	0

GOBIIDAE	Gobies		
Gobionellus sp.		11	0
Gobionellus boleosoma	darter goby	13	0
Gobiosoma sp.		1	0
Gobiosoma ginsburgi	seaboard goby	136	1
Gobiosoma bosci	naked goby	104	48
Microgobius thalassinus	green goby	5	1
STROMATEIDAE	Butterfishes		
Peprilus triacanthus	butterfish	18	12
Peprilus alepidotus	harvestfish	2	0
TRIGLIDAE	Searobins		
Prionotus carolinus	northern searobin	109	72
Prionotus evolans	striped searobin	10	11
PLEURONECTIFORMES			
flatfish	unidentified	1	0
BOTHIDAE	Lefteye flounders		
Etropus sp.		1	0
Etropus crossotus	fringed flounder	34	6
Etropus microstomus	smallmouth flounder	351	61
Paralichthys dentatus	summer flounder	927	66
Scophthalmus aquosus	windowpane	129	21
PLEURONECTIDAE	Righteye flounders		
Pseudopleuronectes americanus	winter flounder	51	203
SOLEIDAE	Soles		
Trinectes maculatus	hogchoker	447	2
CYNOGLOSSIDAE	Tonguefishes		
Symphurus plagiusa	blackcheek tonguefish	833	11
BALISTIDAE	leatherjackets		
Monocanthus hispidus	planehead filefish	0	2
TETRAODONTIDAE	Puffers		
Sphoeroides maculatus	northern puffer	30	117
DIODONTIDAE	Porcupinefishes		
Chilomycterus schoepfi	striped burrfish	11	5

(1970) shows large numerical differences, sometimes one to two orders of magnitude, of individual species caught (Table 1). Flatfish and sciaenids comprised 12.8% and 20.3% of our total catch.

Temperature and salinity were averaged over all stations at the two primary sites for the semi-monthly sampling period. They fluctuated seasonally as expected (Fig.

5). There was usually little difference between surface and bottom samples. The variation between Wachapreague and Sand Shoal was usually slight, though Wachapreague was generally a few degrees cooler in the spring and summer. Seasonal variations in salinities were greater at Wachapreague than at Sand Shoal. The station at Fisherman Island was within the marsh complex and further away from a main channel than the other sites, and therefore had markedly lower salinities.

The number of species collected by all gear at all stations shows strong seasonal variation with diversity lowest in the winter and highest in the fall (Fig. 6). There were approximately the same number of species at any time at Wachapreague and Sand Shoal which had equal sampling effort. At Fisherman Island, where there was a reduced sampling effort, fewer species were collected. The combined number of species is greater than at the individual sites, suggesting between-site differences in species composition. A seasonal cycle in abundance was seen in flatfish and sciaenids, with winter having the fewest individuals. The catch-per-unit-effort (trawl or seine) of sciaenids is an order of magnitude greater than that of flatfish in the spring and fall, but drops off to zero in the late winter (Fig. 7). The pronounced decrease in catch seen for all species in February may be an artifact of sampling error due to weather or effectiveness of gear. This seasonal pattern of relative diversity and abundance is evident when data are grouped into three-month seasons: Fall = October, November, December; Winter = January, February, March; Spring = April, May, June; Summer = July, August, September (Table 2).

Atlantic silversides (*Menidia menidia*) and bay anchovy (*Anchoa mitchilli*) were ranked among the top three across all seasons. Mummichog (*Fundulus heteroclitus*) and summer flounder (*Paralichthys dentatus*) also were ranked among the top 12 during all seasons. Eleven species, blackcheek tonguefish (*Symphurus plagiusa*), rainwater killifish (*Lucania parva*), smallmouth flounder (*Etropus microstomus*), seaboard goby (*Gobiosoma ginsburgi*), windowpane flounder (*Scophthalmus aquosus*), black seabass (*Centropristis striata*), northern pipefish (*Syngnathus fuscus*), naked goby (*Gobiosoma bosci*), striped killifish (*Fundulus majalis*), striped cusk eel (*Ophidion marginatum*), and oyster toad fish (*Opsanus tau*), were collected during all seasons resulting in a year-round fauna of 15 species. Additionally, spot (*Leiostomus xanthurus*), hogchoker (*Trinectes maculatus*), and spotted hake (*Urophysis regis*), were captured and ranked in three of four seasons. However, only nine of those species were classified among the 11 resident species described by Richards and Castagna (1970). Richards and Castagna (1970) also included sheepshead minnow (*Cyprinodon variegatus*) and spotfin killifish (*Fundulus luciae*) which were not collected in this study.

The abundance of many of the top-ranking species fluctuates according to season, with several being important during only one three-month period. This is a result of season-specific influxes of new recruits, as demonstrated by the single-season high rank of croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), and silver perch (*Bairdiella chrysoura*). Four other species, northern searobin (*Prionotus carolinus*), striped mullet (*Mugil cephalus*), red hake (*Urophysis chuss*), and American eel (*Anguilla rostrata*), ranked low in one season and were unranked, though present, in two other seasons.

TABLE 2. Top 12 most abundant species per season. Number is rank, dot indicates presence without rank in top 12, blank means species not captured that season. Overall is rank yearly abundance.

SPECIES	Overall	Fall	Winter	Spring	Summer
Atlantic silverside	1	2	1	2	1
Bay anchovy	2	3	2	1	2
Atlantic croaker	3	1	.		.
Spot	4	7		3	3
Mummichog	5	5	10	6	4
Summer flounder	6	8	4	4	6
Blackcheek tonguefish	7	6	.	5	9
Hogchoker	8	8		9	7
Rainwater killifish	9	4	.	.	9
Weakfish	10	.		.	5
Smallmouth flounder	11	10	8	8	.
Spotted hake	12	11	3	7	
Silver perch	13	12		.	8
Seaboard goby	14	.	7	.	.
Windowpane	15	.	6	.	.
Black seabass	16	.	.	11	.
Northern searobin	17	.		10	.
Northern pipefish	18	.	.	12	.
Naked goby	19	.	.	.	11
Striped killifish	20	.	5	.	.
Striped cuskeel	21	.	.	.	.
Oyster toadfish	22	.	.	.	12
Striped mullet	25		11	.	
Red hake	27	.	9	.	
American eel	34	.	12		.

DISCUSSION

The top two ranks were always held by Atlantic silversides or bay anchovies, except when usurped by the fall influx of croaker. Abundance of silversides is an order of magnitude higher than anchovies (Fig. 8). A site-specific difference is apparent, with the abundance of both species peaking at Sand Shoal one month before peaking at Wachapreague. Abundance was consistently lower at Fisherman Island, even for Atlantic silversides which had higher catch rates in seines than trawls. The higher abundance at Wachapreague may be due to physical parameters and habitat preferences; there is more open water at Sand Shoal and more marsh area at Wachapreague. Though abundant year-round, both of these species display a seasonal pattern, with peak abundances in the spring and summer caused by newly-spawned recruits. These seasonal patterns hold for both trawl and seine catches. Although neither species leaves the area in the winter, abundance decreases. These decreases in fish abundance may be attributed to mortality, local movement to unsampled areas, or seasonal differential in availability to sampling gear.

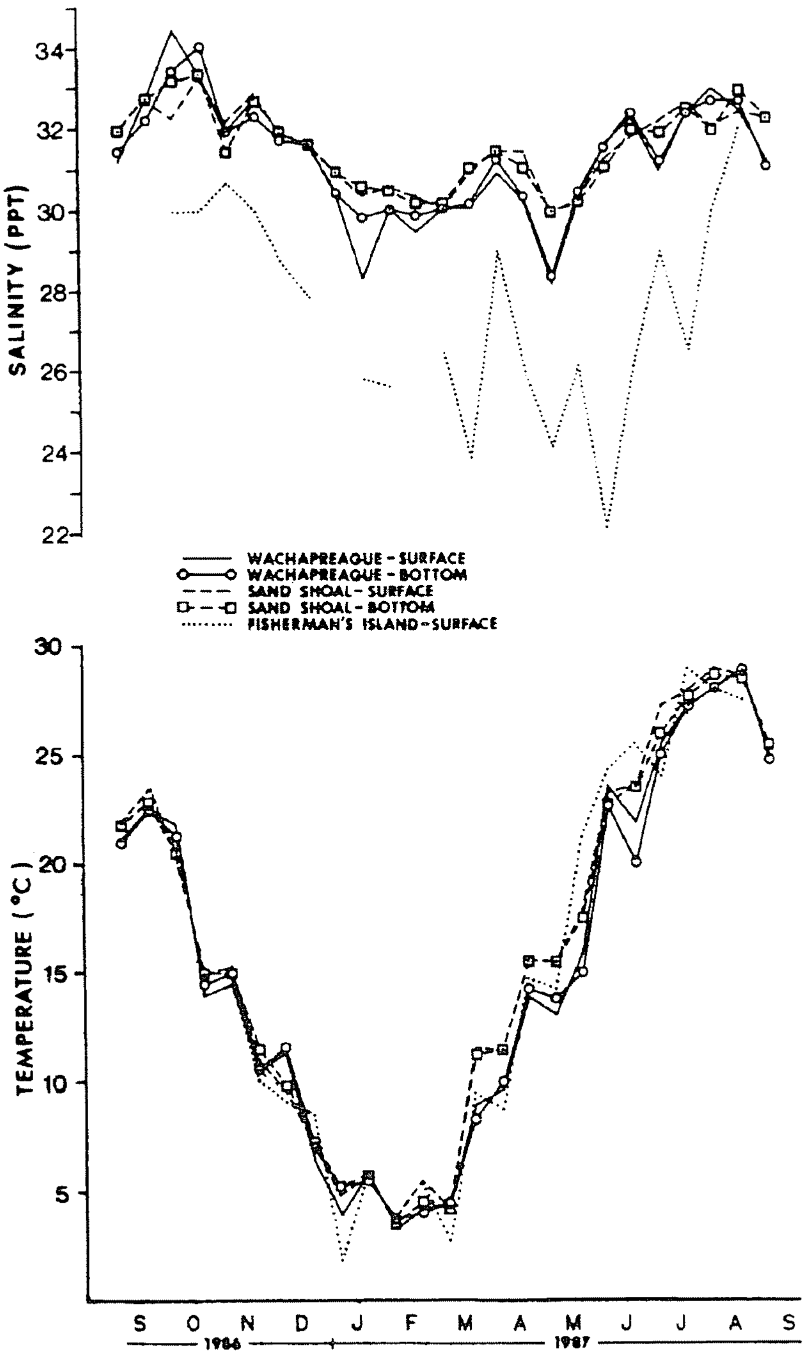

FIGURE 5. Semi-monthly surface and bottom salinity and temperature averaged over all stations at each site, September 1986 - September 1987.

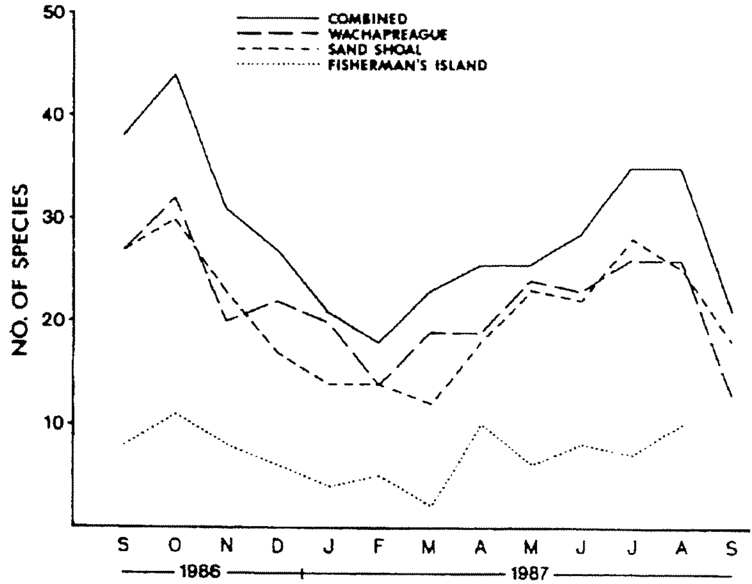

FIGURE 6. Number of fish species collected at each site and sites combined each month, September 1986 - September 1987.

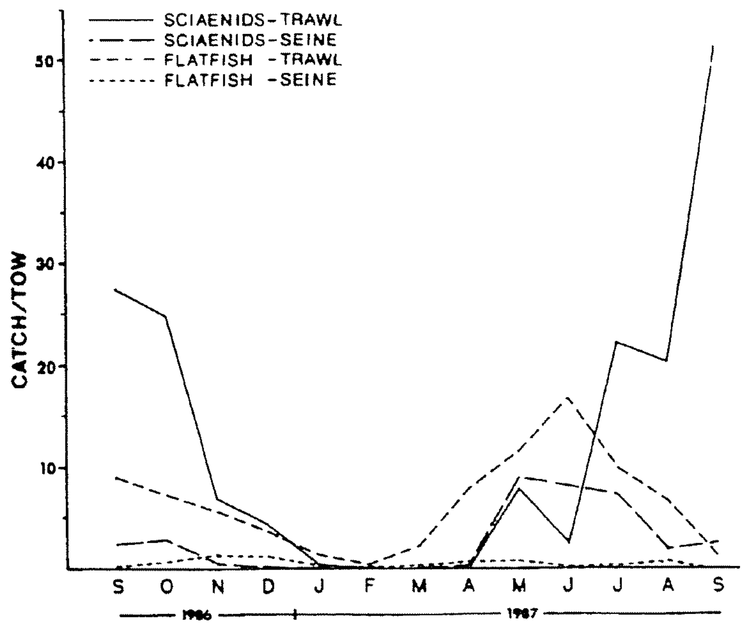

FIGURE 7. Catch/tow (5 min trawl or 25 m seine) of sciaenids and flatfishes by gear, sites combined, September 1986 - September 1987.

Mummichog, rainwater killifish, and spotted hake (Fig. 9) are the only other non-flatfish and non-sciaenid species among the overall top 12. Again, a seasonal pattern is observed, with decreased numbers in January, February and March for the two summer-spawning marsh killifish. Rainwater killifish are only found at Fisherman Island. Although fairly abundant at Sand Shoal in the fall, mummichogs are most abundant at Fisherman Island in the spring and summer. In contrast, spotted hake exhibited a reverse pattern, with no individuals captured in the summer months. Spotted hake spawn offshore of the Chesapeake Bay from September through March (Hardy, 1978), coincident with the pattern of abundance noted in this study (Fig. 9).

After small marsh fishes, sciaenids are the next most abundant group. As a group they exhibit a pattern similar to that of the other species, *i. e.*, low abundance in the winter and high in the spring, summer and fall. However, individually this pattern is not seen (Fig. 10). Seasonal occurrence of recruits reflects the spawning seasons of the four sciaenids, croaker - fall, spot - winter, weakfish and silver perch - summer (Johnson, 1978). Most of the sciaenids captured in this study were newly recruited juveniles. At time of first appearance, croaker were as small as 6 mm, silver perch - 12 mm, weakfish - 14 mm, and spot - 17 mm. Seasonal patterns do not appear consistent between years, as the abundance of all sciaenids differs greatly between September 1986 and September 1987. Spot is the only sciaenid that occurs in abundance in seine catches and was therefore collected at Fisherman Island.

Flatfish consistently occur in the barrier island lagoons, but at levels of abundance one to two orders of magnitude smaller than silversides, anchovies and sciaenids. They are rarely captured at Fisherman Island, perhaps because they are less susceptible to capture by seine. Seasonal fluctuation of flatfish abundance on the seaside of the eastern shore is quite pronounced (Fig. 11) as the flatfishes migrate out of the study area in the winter. Summer flounder are the only flatfish present all year with winter and spring abundance consisting mainly of recently recruited individuals. A spring influx can be seen beginning in March or April for all species with winter flounder as small as 10 mm, summer flounder - 13 mm, smallmouth flounder and blackcheek tonguefish - 17 mm, and windowpane flounder - 29 mm. Summer flounder of all sizes are consistently more abundant at Wachapreague, the "flounder capital of the world."

Richards and Castagna (1970) collected consistently larger numbers of killifishes (Cyprinodontidae), silversides (Atherinidae), and mullets (Mugilidae) than this study and we consistently captured larger numbers of flatfish (Bothidae, Soleidae, Cynoglossidae), drums (Sciaenidae), hake (Gadidae), cusk-eels (Ophidiidae), pipefishes (Syngnathidae), and gobies (Gobiidae) than captured in their study. Both studies used the same size trawl, but these differences in abundance can be partially attributed to the small-mesh net (6.4 mm versus 32 mm) and liner (3.2 mm versus 13 mm) we used which captured smaller newly recruited fish than the earlier study. Another factor contributing to the difference was station location. Our only site not adjacent to a main channel was Fisherman Island. The lower salinity and fish abundance at that site demonstrates the bias introduced by site selection. Richards and Castagna (1970) had several stations within tidal

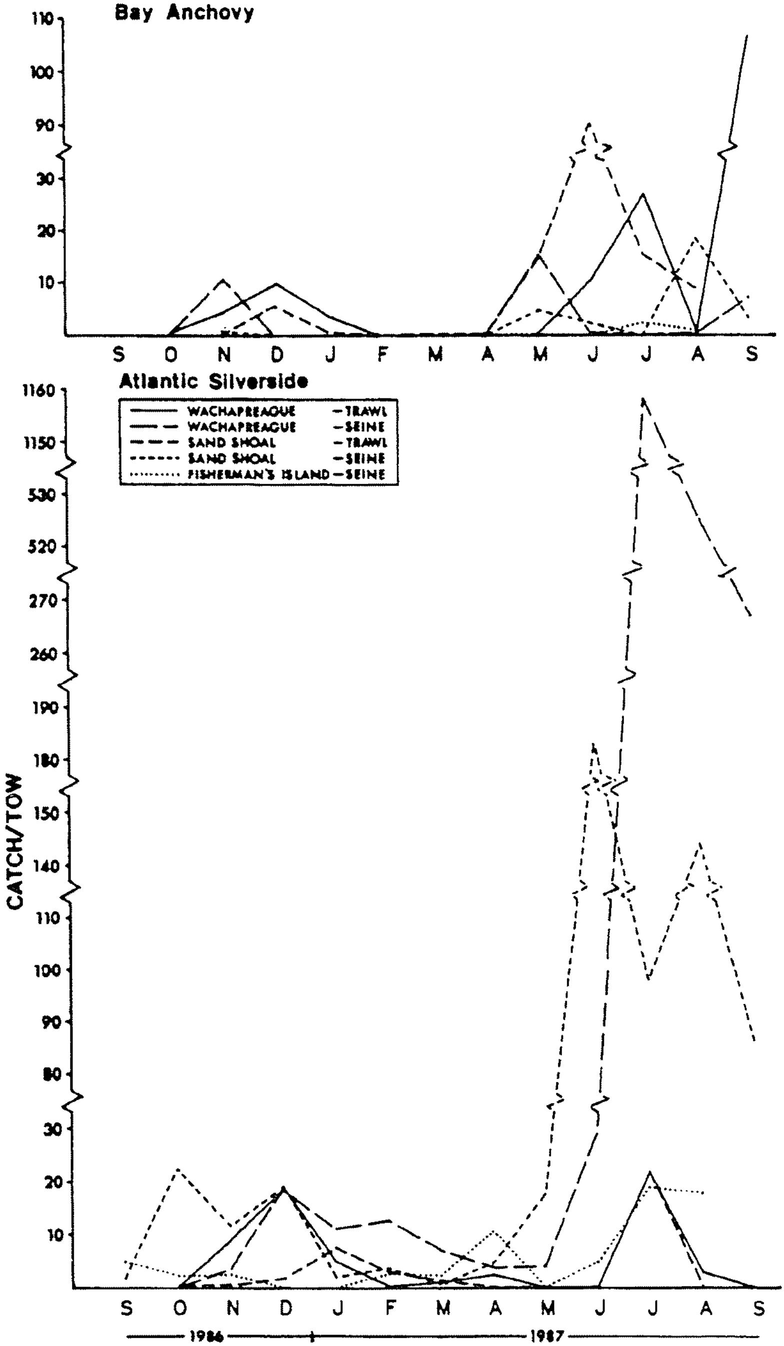

FIGURE 8. Catch/tow (5 min trawl or 25 m seine) of Atlantic silverside and bay anchovy by site, September 1986 - September 1987.

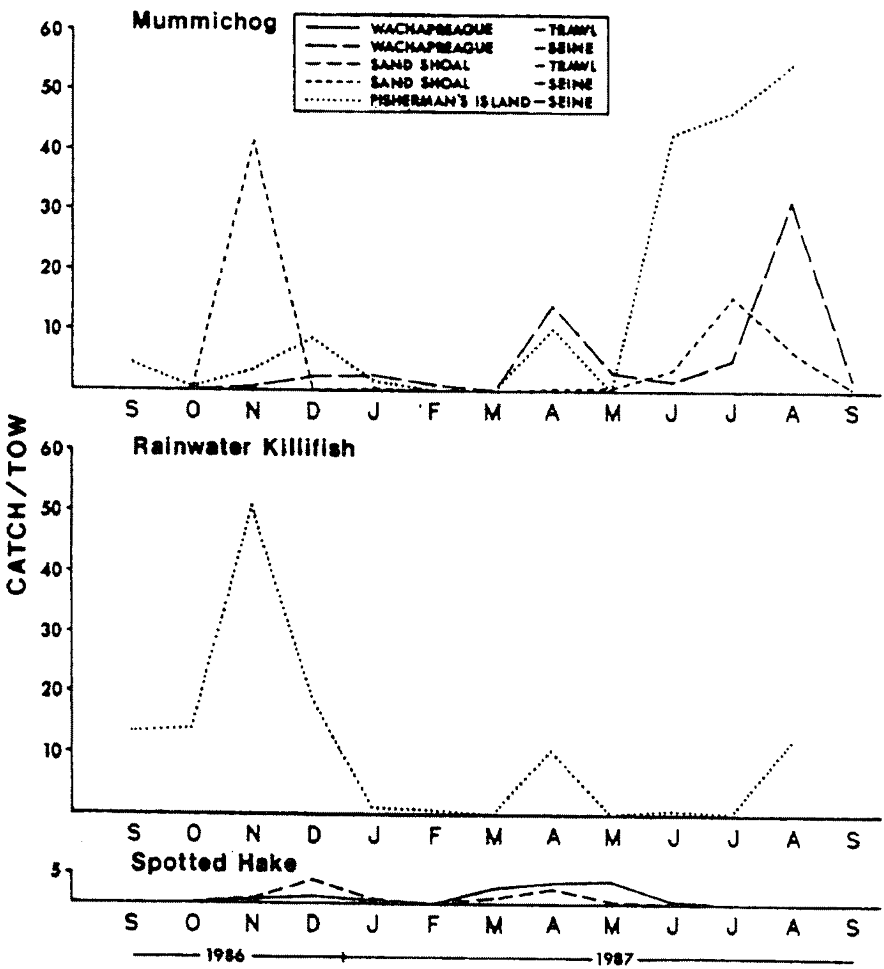

FIGURE 9. Catch/tow (5 min trawl or 25 m seine) of mummichog, rainwater killifish and spotted hake by site, September 1986 - September 1980.

creeks which we did not, thus accounting for their capture of more high marsh, lower salinity species.

CONCLUSIONS

The lagoonal areas behind the Virginia Barrier Islands have a dynamic fish population. This study provides an assessment of seasonality, distribution, and abundance of finfish in these waters. It is the first documentation of juvenile finfish use of these waters and demonstrates the presence of at least one juvenile sciaenid or flatfish during every season. The differences between the results of this study and that of Richards and Castagna (1970) can be attributed to size selectivity of the gear, inclusion of juvenile lifestages, and sampling locations. Because of the

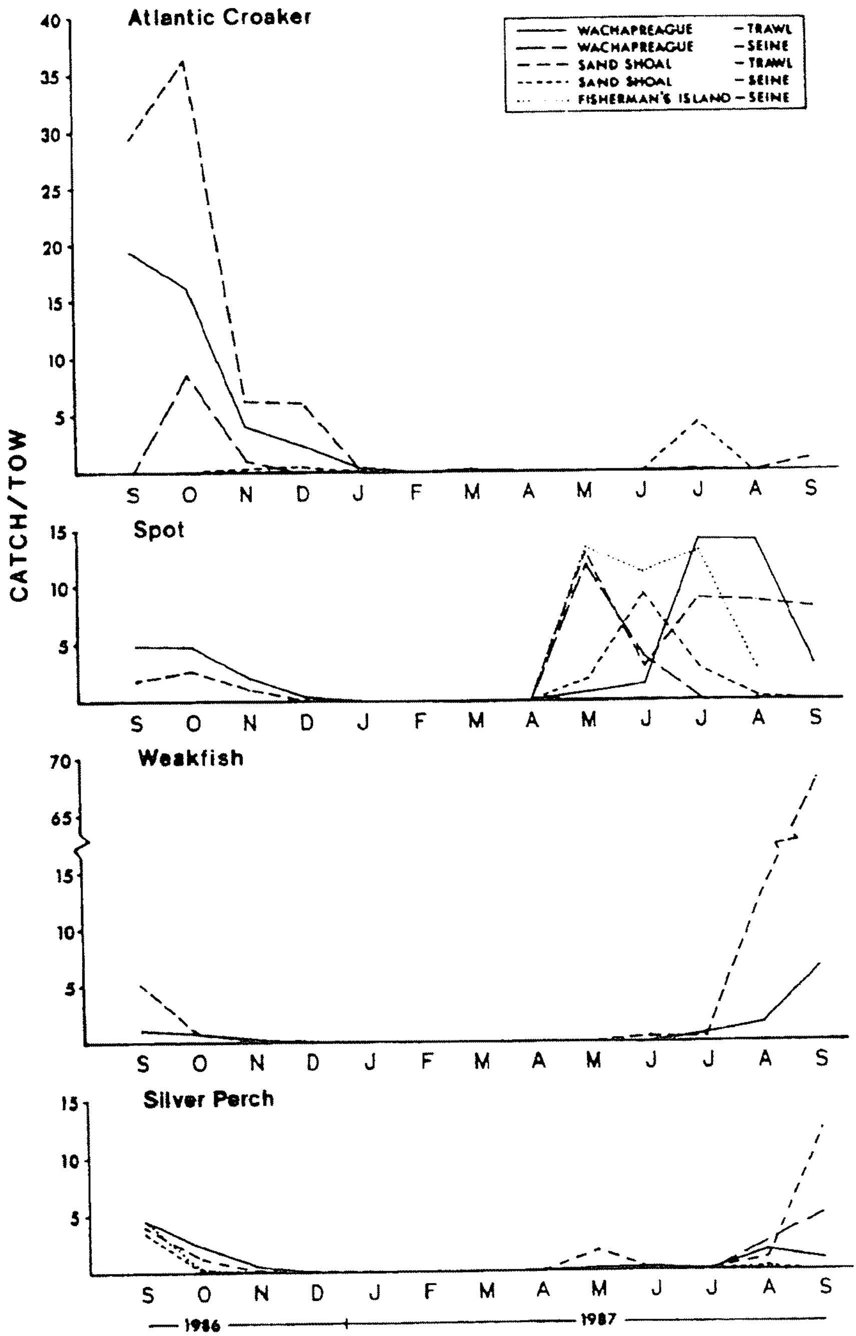

FIGURE 10. Catch/tow (5 min trawl or 25 m seine) of dominant sciaenids by site, September 1986 - September 1987.

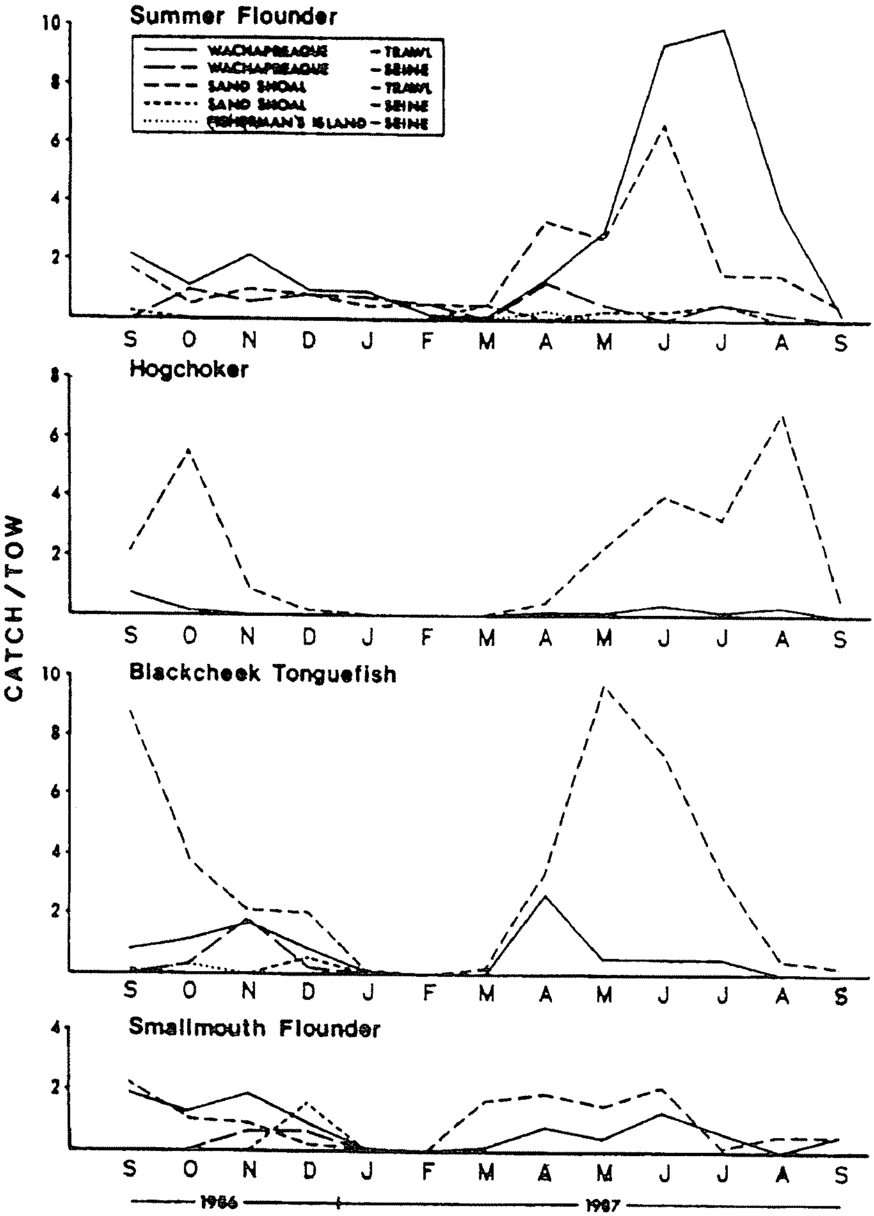

FIGURE 11. Catch/tow (5 min trawl or 25 m seine) of dominant flatfishes by site, September 1986 - September 1987.

different techniques employed, no conclusions can be made regarding relative changes in species composition over time.

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