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The pound-net fishery in Virginia. Part 2. Species composition of landings reported as menhaden

J. L. McHugh
Virginia Fisheries Laboratory

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THE POUND-NET FISHERY IN VIRGINIA

Part 2 - Species Composition of Landings Reported as Menhaden[1/]

By J. L. McHugh*

BACKGROUND

Pound nets have been the most important fishing gear for food fishes in Virginia waters of Chesapeake Bay since 1880 (Reid 1955) and the history of this fishery to a great extent reflects the varying fortunes of the fisheries of that State. Since 1929 the average annual catch in pound nets in Virginia has been about 50 million pounds, roughly 20 percent of which was reported as menhaden. Actually these menhaden include varying quantities of other fish species, sometimes predominantly young food fishes, too small to market as human food. This part of the pound-net catch is sometimes used as industrial fish, but in many parts of the Bay it is sold as bait for crab pots. It is commonly referred to as "scrap fish," and for convenience this term has been used here to denote that part of the pound-net catch not sold for human consumption. Concern has been expressed at various times that this harvest of small fishes is wasteful, yet no really effective action has been taken to determine the facts needed for an intelligent appreciation of the situation.

Reid (1955) has reviewed the tribulations that accompanied introduction of pound nets to Virginia waters. Early reports of the Virginia Commission of Fisheries emphasize the "destruction" caused by these nets, and in 1914 a "cull law" was enacted designating minimum sizes of fishes that may be caught (Code of Virginia, Section 28-45). It soon became apparent that the value of this law was limited, for most undersized fish were dead before culling could be done, and it was suggested on various occasions that an increase in mesh size, or closed seasons at certain times, would offer more practical solutions.

Almost as soon as these remedial measures have been proposed they have been challenged by others. Some of the objections seem reasonable, but there is an obvious thread of self-interest running through all the controversy that has been generated, and none of the arguments is supported by indisputable facts. Culling is far from a practical solution: it would be impossible in bad weather; even under the best of conditions it would be time-consuming, and many fishermen would not be inclined to make the effort for a gain that was not immediately apparent; and most fish probably would not survive the rough handling that would ensue. An increase in mesh size, although it has been a popular remedy on many occasions, is opposed by many fishermen on the grounds that fish would gill in the nets. Closed seasons, when they have been proposed seriously, have been suggested for midsummer, when pound-net catches are at a minimum and relatively unprofitable, and the benefits to be gained would be at a minimum, too.

The conviction that an increase in mesh size would allow many small fish to escape, though opposed by many fishermen who believed that gilling would interfere

1/Contributions from the Virginia Fisheries Laboratory, No. 89.

* Formerly Director, Virginia Fisheries Laboratory, now Chief, Division of Biological Research, U. S. Bureau of Commercial Fisheries.

seriously with their operations, was sufficiently strong that in 1928 the General Assembly of Virginia directed the Commission of Fisheries to conduct experiments with various mesh sizes. This was done (Houston 1929) by arrangement with certain fishermen who placed panels of $2\frac{1}{2}$- and 3-inch stretched mesh in their nets, and the following conclusion was drawn: "It is claimed that mesh larger than an inch bar (2 inches stretched) will gill fish to an extent to make it impracticable. The experiments, as reported, bore out this contention." In the absence of better documentary evidence, it can scarcely be maintained that the matter was settled adequately.

Declines in Virginia fisheries since World War II, economic as well as biological in origin (McHugh and Bailey 1957), brought the question to the fore once again, and in 1952 the General Assembly instructed the Commission of Fisheries and the Virginia Fisheries Laboratory "to determine the proper size mesh for nets in fixed fishing devices." The proponents of this bill failed to recognize the full implication of their directive, which, if it is to be complied with in full measure, will require knowledge of the effects of mesh-size changes upon the future supply of fish. This, in effect, is already one of the objectives of the work of the Virginia Fisheries Laboratory, progress toward which, although steady, has been slow by reason of limited funds and personnel and the need for more comprehensive programs of research in neighboring states, where these species are also exploited.

Samples of scrap fish after they have been culled by fishermen from pound-net catches in the lower York River and off York Spit were examined in 1954 and 1955, primarily to study size- and age-composition of the menhaden catch (McHugh, Oglesby, and Pacheco 1959). When convenient, other species in this scrap were measured and weighed. In 1958 a special effort was made to examine samples of scrap at weekly intervals throughout the fishing season, and all species in a half-bushel sample were measured and weighed individually. If more than 100 fish of a species were present, the excess usually were counted but not measured or weighed, and the total weight of that species was estimated from the weight of the first 100. Lengths were measured from tip of snout to fork of caudal fin, or in fishes like hogchoker, croaker, or gray sea trout, to the end of the longest caudal rays. In 1958 also, the total weights of individual food fish species and total weights of scrap landed were obtained whenever possible, for comparison of the numbers and weights used as human food or as industrial fish and bait.

1954 SAMPLES

The 1954 study was made by a graduate student as a term project. He identified 21 species in 21 samples, but lumped alewife and glut herring, and butterfish and harvestfish. It is fairly obvious that he failed to recognize thread herring as a distinct species, for although it figured prominently in 1955 and 1958 catches, it was not listed in 1954. Thread herring undoubtedly were confused with river herrings, for this category was recorded for every sample examined in 1954, although later experience, and

Table 1 - Species Composition of Scrap Fish Samples from Pound-Net Catches, Lower York River, Virginia, 1954, Obtained by Adding Numbers of Fishes in all Samples Examined

Common Name	Scientific Name	Total Numbers of Fish	Percentage of Samples in Which Species Occurred
Menhaden	Brevoortia tyrannus	2,100	100
Alewife	Alosa pseudoharengus	637	100
Glut herring	Alosa aestivalis		
Thread herring	Opisthonema oglinum		
Butterfish	Poronotus triacanthus	562	91
Harvestfish	Peprilus alepidotus		
Mitchill's anchovy	Anchoa mitchilli	144	43
Gray sea trout	Cynoscion regalis	90	86
Spot	Leiostomus xanthurus	77	76
Silver perch	Bairdiella chrysura	51	48
Cutlassfish	Trichiurus lepturus	41	38
Blue runner	Caranx crysos	27	19
Croaker	Micropogon undulatus	24	33
Flounder	Paralichthys dentatus	12	29
Hogchoker	Trinectes maculatus	6	29
Bluefish	Pomatomus saltratrix	6	14
Sea robin	Prionotus sp.	4	14
Puffer	Sphaeroides maculatus	2	10
Hickory shad	Alosa mediocris	1	5
Shad	Alosa sapidissima	1	5
Black sea bass	Centropristes striatus	1	5
Toadfish	Opsanus tau	1	5

previous knowledge of the migrations of river herrings, have shown that these species usually disappear from catches in July, whereas thread herring do not appear until June and remain until fall. Table 1 therefore does not show all species necessarily in their proper order of importance, and contains 22 species instead of the 21 recognized in the original work.

Table 2 - Species Composition of Scrap Fish Samples from Pound-Net Catches, Lower York River, Virginia, 1955, Obtained by Adding Numbers of Fishes in all Samples Examined

Common Name	Scientific Name	Total Numbers of Fish	Percentage of Samples in Which Species Occurred
Menhaden	Brevoortia tyrannus	1,672	100
Butterfish	Poronotus triacanthus	476	86
Gray sea trout	Cynoscion regalis	153	71
Thread herring	Opisthonema oglinum	118	29
Mitchill's anchovy	Anchoa mitchilli	93	57
Alewife	Alosa pseudoharengus	88	43
Glut herring	Alosa aestivalis		
Hickory shad	Alosa mediocris		
Scup	Stenotomus versicolor	42	21
Silver perch	Bairdiella chrysura	25	64
Spot	Leiostomus xanthurus	23	43
Harvestfish	Peprilus alepidotus	15	50
Cutlassfish	Trichiurus lepturus	8	29
Croaker	Micropogon undulatus	7	14
Moonfish	Vomer setapinnis	4	29
Black sea bass	Centropristes striatus	2	7
Hogchoker	Trinectes maculatus	1	7
Sea robin	Prionotus sp.	1	7
Puffer	Sphaeroides maculatus	1	7
Silverside	Menidia menidia	1	7

1955 SAMPLES

A few samples in 1955 were examined by the author, but most by a summer assistant who had difficulty distinguishing between alewife, glut herring, and hickory shad. Therefore, these species are grouped in table 2, and may not be in proper sequence according to numbers or frequency of occurrence. In 14 samples of scrap, 20 species were recognized. It is interesting that moonfish (Vomer setapinnis), fairly common in 1955, did not appear in pound-net catches in 1954 or 1958.

Sampling in 1955 was in some respects not as representative as in 1954 and 1958, for no catches were examined from August 13 to November 26.

1958 SAMPLES

Sampling in 1958 was more thoroughly and carefully done, and identifications were checked for accuracy. In 25 samples, 33 species were recognized (table 3.)

Table 3 - Species Composition of Scrap Fish Samples from Pound-Net Catches, Lower York River, Virginia, 1958, Obtained by Adding Numbers and Weights of Fishes in all Samples Examined

Common Name	Scientific Name	Total Numbers of Fish	Percentage of Samples in Which Species Occurred	Total Weight (Lbs.)
Menhaden	Brevoortia tyrannus	5,821	100	294,662
Butterfish	Poronotus triacanthus	1,274	84	57,106
Thread herring	Opisthonema oglinum	403	56	23,005
Gray sea trout	Cynoscion regalis	260	72	20,663
Blue runner	Caranx crysos	226	36	12,588
Spot	Leiostomus xanthurus	219	80	13,555
Alewife	Alosa pseudoharengus	207	28	12,873
Glut herring	Alosa aestivalis	177	32	29,984
Bigeye scad	Trachurops crumenophthalma	107	36	3,973
Silver perch	Bairdiella chrysura	88	72	6,274
Mitchill's anchovy	Anchoa mitchilli	80	20	142
Bluefish	Pomatomus saltatrix	34	32	2,852
Hogchoker	Trinectes maculatus	34	36	1,238
Croaker	Micropogon undulatus	25	12	2,468
Scup	Stenotomus versicolor	22	28	1,836
Harvestfish	Peprilus alepidotus	11	24	769
Hickory shad	Alosa mediocris	8	16	2,070
Shad	Alosa sapidissima	4	12	1,193
Blue crab	Callinectes sapidus	4	12	248
Black sea bass	Centropristes striatus	3	12	359
Spotted hake	Urophycis regius	3	8	112
Striped anchovy	Anchoa hepsetus	3	8	37
Silverside	Menidia menidia	3	8	22
Flounder	Paralichthys dentatus	3	12	221
Northern puffer	Sphaeroides maculatus	2	8	221
Pinfish	Lagodon rhomboides	1	4	51
Pigfish	Orthopristis chrysopterus	1	4	63
Atlantic mackerel	Scomber scombrus	1	4	81
Atlantic needlefish	Strongylura marina	1	4	5
Bluegill	Lepomis macrochirus	1	4	106
Common sea robin	Prionotus carolinus	1	4	12
Gizzard shad	Dorosoma cepedianum	1	4	346

For most samples, also, records were obtained of total weight of each species caught, so that the numbers and weights of each species used as food or discarded as scrap could be estimated (table 4). The 17 samples summarized in table 4, taken from

Table 4 - Estimated Total Numbers and Weights of Each Species in a Series of 17 Pound-Net Catches Made from April 7, to October 15, 1958, in the Lower York River or off York Spit, Virginia 1/

Species	Food Fish		Scrap Fish	
	Estimated Numbers	Total Weights (Lbs.)	Estimated Numbers	Total Weights (Lbs.)
Menhaden	-	-	207,616	23,157
Butterfish	23,250	4,650	40,838	4,333
Alewife	-	-	10,864	1,327
Thread herring	-	-	9,761	1,259
Glut herring	-	-	8,545	3,325
Spot	5,714	1,699	8,255	1,228
Gray sea trout	20,221	7,410	7,622	1,342
Blue runner	-	-	5,192	640
Bay anchovy	-	-	4,203	17
Bigeye scad	-	-	2,780	236
Silver perch	-	-	2,408	369
Croaker	22,121	20,331	1,280	295
Bluefish	25	25	1,261	234
Hogchoker	-	-	1,028	70
Scup	-	-	793	119
Harvestfish	1,400	400	565	95
Hickory shad	-	-	445	317
Shad	125	437	200	134
Spotted hake	-	-	167	14
Flounder	111	277	139	34
Silverside	-	-	132	2
Black sea bass	-	-	128	28
Striped anchovy	-	-	101	1
Gizzard shad	-	-	72	55
Bluegill	-	-	71	17
Pigfish	-	-	71	10
Needlefish	-	-	67	10
Pinfish	-	-	58	6
Blue crab	-	-	32	5
Sea robin	-	-	29	1
Puffer	-	-	29	1
Rockfish	33	66	-	-
Slender amberjack	25	25	-	-
False albacore	10	100	-	-
Mixed fishes	-	800	-	-
Total	2/73,035	36,220	314,752	38,681

1/Estimated numbers of food fishes were derived from total weight of catch multiplied by average numbers of commercial-size fish per pound. Estimated numbers of scrap fish and their total weights were derived from numbers and weights of scrap in each sample, and the total weight of scrap fish in each catch.
2/Number of mixed fishes not included.

catches in the lower York River or off York Spit from April 7 to October 15, 1958, show that roughly equal weights of food and scrap fish were landed, but that more than four times as many fish were discarded as scrap. Many scrap fish were of species that usually are not used as food, such as menhaden, thread herring, blue runner, anchovy, scad, and silver perch, but some important food fishes, such as butterfish and spot, were more numerous in scrap than in food-fish landings.

Seasonal variations in species composition and in numbers and weights of scrap fish in pound-net samples, weighted according to total catch of scrap, are given in tables 5 and 6 (which appear on page 5). In early spring, only menhaden, alewives, and glut herring were found, but a variety of species entered the catch as the season progressed. Some species appeared for a while and then disappeared, some occurred only spasmodically, others were caught regularly once they put in an appearance. Samples taken at regular intervals may not be truly representative of the relative abundance of the different species, because some fishes, like alewives and blue runner, remain in Chesapeake Bay for only a short time, while others, like menhaden, are available for most of the year.

These may have included some scup, spot, gray sea trout, croaker, bluefish, harvestfish, shad, flounder, puffer, rockfish, amberjack, drum, whiting, mackerel, mullet, spotted sea trout, Spanish mackerel, white perch, and others. These samples are not necessarily representative of the pound-net catch in the whole area of Tidewater Virginia, for our observations have shown that each locality has its own characteristic complex of species. Alewives, for example, are the most important

Table 5 - Estimated Catch, by Numbers, of Scrap Fish in Pound-Net Catches in the Lower York River, Virginia, 1958[1/]

Species	April			May		June	July				August		September			October	
	7	22	30	13	20	5	1	15	25	30	7	19	5	12	23	3	15
Menhaden	6,720	4,004	8,800	35,024	12,324	30,250	19,333	6,050	3,600	5,175	3,379	14,666	21,743	23,641	13,977	1,400	3,265
Glut herring	6,090	858	67	516	1,185	-	-	-	-	-	-	-	-	-	-	-	-
Alewife	892	2,646	6,867	194	316	-	-	-	-	-	-	-	-	-	-	-	-
Gizzard shad	-	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spot	-	1,430	2,267	838	2,133	1,080	-	40	97	46	347	-	-	65	34	117	58
Butterfish	-	-	67	774	79	3,920	6,840	8,090	6,140	3,370	916	2,733	1,054	1,500	477	1,808	3,156
Shad	-	-	-	64	158	-	-	-	-	-	-	-	-	-	-	-	-
Silver perch	-	-	-	258	632	-	64	40	97	-	63	333	36	424	375	175	-
Pinfish	-	-	-	64	-	-	-	-	-	-	-	-	-	-	-	-	-
Hickory shad	-	-	-	-	395	-	-	-	-	-	-	-	36	-	34	-	19
Croaker	-	-	-	-	1,422	-	-	-	-	-	-	-	-	-	-	-	-
Bluefish	-	-	-	-	158	250	-	430	97	323	-	-	-	-	-	-	19
Pigfish	-	-	-	-	79	-	-	-	-	-	-	-	-	-	-	-	-
Hogchoker	-	-	-	-	79	167	-	-	-	-	-	-	-	33	68	612	77
Gray sea trout	-	-	-	-	237	167	575	1,880	1,460	1,845	316	733	109	130	136	58	-
Bluegill	-	-	-	-	79	-	-	-	-	-	-	-	-	-	-	-	-
Harvestfish	-	-	-	-	-	333	-	80	-	-	-	133	-	-	-	-	19
Thread herring	-	-	-	-	-	416	383	118	7,200	740	189	333	109	-	273	-	-
Flounder	-	-	-	-	-	80	-	40	-	-	-	-	-	-	-	-	19
Spotted hake	-	-	-	-	-	167	-	-	-	-	-	-	-	-	-	-	-
Scup	-	-	-	-	-	333	-	40	-	46	-	-	-	-	34	321	19
Bay anchovy	-	-	-	-	-	-	2,872	-	65	785	442	-	-	-	-	-	38
Silverside	-	-	-	-	-	-	-	40	-	92	-	-	-	-	-	-	-
Blue crab	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-	-
Black sea bass	-	-	-	-	-	-	-	-	-	-	32	67	-	-	-	29	-
Atlantic needlefish	-	-	-	-	-	-	-	-	-	-	-	67	-	-	-	-	-
Blue runner	-	-	-	-	-	-	-	-	-	-	-	800	727	228	1,739	963	736
Bigeye scad	-	-	-	-	-	-	-	-	-	-	-	133	182	261	1,193	875	135
Striped anchovy	-	-	-	-	-	-	-	-	-	-	-	-	36	65	-	-	-
Common sea robin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-
Northern puffer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-
Number of nets	6	-	-	3	6	4	4	4	4	4	3	3	3	3	3	3	2

1/Total numbers of each species estimated from total weight of scrap in each day's catch according to the ratio of numbers to weight in each sample.

Table 6 - Estimated Catch, in Pounds, of Scrap Fish in Pound-Net Catches in the Lower York River, Virginia, 1958[1/]

Species	April			May		June	July				August		September			October	
	7	22	30	13	20	5	1	15	25	30	7	19	5	12	23	3	15
Menhaden	1,477	1,073	1,113	3,450	2,596	3,263	2,311	734	517	873	354	2,250	1,296	1,170	990	97	176
Glut herring	2,388	267	29	207	505	-	-	-	-	-	-	-	-	-	-	-	-
Alewife	335	360	499	22	126	-	-	-	-	-	-	-	-	-	-	-	-
Gizzard shad	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spot	-	245	352	105	304	174	-	8	8	2	35	-	-	+	+	17	7
Butterfish	-	-	7	91	9	316	524	826	752	435	123	360	130	165	60	229	315
Shad	-	-	-	73	76	-	-	-	-	-	-	-	-	-	-	-	-
Silver perch	-	-	-	45	98	-	9	8	19	-	8	30	5	75	60	27	-
Pinfish	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-
Hickory shad	-	-	-	-	349	-	-	-	-	-	-	-	2	-	+	-	1
Croaker	-	-	-	-	328	-	-	-	-	-	-	-	-	-	-	-	-
Bluefish	-	-	-	-	24	57	-	71	20	63	-	-	-	-	-	-	2
Pigfish	-	-	-	-	11	-	44	-	-	-	-	-	-	-	-	-	-
Hogchoker	-	-	-	-	7	6	-	-	-	-	-	-	-	+	+	48	10
Gray sea trout	-	-	-	-	48	26	99	310	285	320	46	150	20	15	15	13	-
Bluegill	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-
Harvestfish	-	-	-	-	-	46	-	19	-	-	-	30	-	-	-	-	1
Thread herring	-	-	-	-	-	52	-	17	893	98	29	60	21	-	45	-	-
Flounder	-	-	-	-	-	31	-	2	-	-	-	-	-	-	-	-	1
Spotted hake	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-
Scup	-	-	-	-	-	15	-	5	-	5	-	-	-	-	+	89	5
Bay anchovy	-	-	-	-	-	-	13	-	1	2	1	-	-	-	-	-	1
Silverside	-	-	-	-	-	-	-	+	-	2	-	-	-	-	-	-	-
Blue crab	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Black sea bass	-	-	-	-	-	-	-	-	-	-	4	10	-	-	-	14	-
Atlantic needlefish	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-
Blue runner	-	-	-	-	-	-	-	-	-	-	-	90	110	45	225	100	70
Bigeye scad	-	-	-	-	-	-	-	-	-	-	-	10	15	30	105	64	11
Striped anchovy	-	-	-	-	-	-	-	-	-	-	-	-	1	+	-	-	-
Common sea robin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Northern puffer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Number of nets	6	-	-	3	6	4	4	4	4	4	3	3	3	3	3	3	2

1/Total catch of scrap fish for each day prorated according to weight of each species in sample.
+ = Less than one pound.

species by weight in Virginia's pound-net catch, but they were of less importance in our samples from the York River, partly because early spring catches were not adequately sampled. Butterfish ranked tenth in importance by weight in 1957, but they were one of the most important species in York River samples in 1958. On the other hand there is general similarity between pound-net catches as recorded by the U. S. Bureau of Commercial Fisheries (Power 1959) and the 17 samples from the York River in 1958.

SPECIES COMPOSITION OF POUND-NET LANDINGS

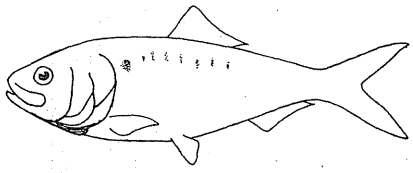
One of the first steps in a study of industrial and unmarketable food fishes is to determine what species are represented, and in what quantities. According to latest published figures pound nets in Virginia caught at least 42 species in 1957 (Power 1959). This is a minimum estimate, for certain categories in the official listing, such as alewives, catfish and bullheads, and some others, include more than one species, and scrap includes many species that are not used locally for human food, hence are not listed in official statistics. Investigations reported here showed that at least 35 species occur in pound-net scrap (table 1 to 3), at least 13 of which are not marketed in Virginia for human food. Table 7 (see p. 7) lists all species known to occur in pound-net catches in Virginia, based on 1957 landings (Power 1959), samples of scrap examined in 1954, 1955, and 1958, and observations made by various staff members of the Virginia Fisheries Laboratory while sampling catches.

Scrap-fish landings vary not only locally within the Bay and its estuaries, but also annually. It has been pointed out already that moonfish were found in our samples only in 1955. Cutlassfish, fairly common in 1954 and less common in 1955, were absent in 1958. Several other interesting changes are suggested by the figures in tables 1 to 3, but it would require more information to determine their significance. There is good reason to believe, for example, that young croaker figured much more prominently in scrap in the past when the species was more abundant, and the decline in frequency of their appearance in samples from 1954 to 1958 is suggestive that the recent increase in abundance is only temporary, a conclusion supported by other evidence (W. H. Massmann and A. L. Pacheco, personal communication).

It is convenient to treat scrap fish under two main headings: nonfood or industrial species, measurements and weights of which have considerable biological significance because the entire catch was represented in each sample; and food fishes, data from which are somewhat less useful because culling is variable, depending on the magnitude of the catch, prices, and other factors.

NON-FOOD FISHES

Menhaden (Brevoortia tyrannus):
Atlantic coast, 1957: 1,327,595,000 pounds, valued at $16,771,000.



By far the most important scrap species was menhaden, which made up nearly two-thirds of scrap catches by numbers and by weight, and was the only species that occurred in every sample examined. By weight, menhaden are an important component of pound-net landings in Virginia. According to official statistics (Power 1959) more than 25 million pounds were landed in 1957, about 46 percent of the entire pound-net catch, and nearly 10 percent of the total menhaden catch of the State. Menhaden landings as reported for pound nets probably are a collective term for all scrap fish, hence only about 16 million pounds actually were menhaden, and the remaining 9 million pounds included a variety of species as listed in table 7 (p. 7). Most menhaden caught by pound nets in Virginia

Table 7 - Species Caught by Pound Nets in Virginia, Based on 1957 Commercial Landings, Examination of Scrap-Fish Catches in 1954, 1955, and 1958 and Observations Made While Sampling Catches[1/]

Common Name	Scientific Name	Disposal of Catch		Common Name	Scientific Name	Disposal of Catch	
		Food	Industrial Use or Bait			Food	Industrial Use or Bait
Alewife	Alosa pseudoharengus	x	x	Pigfish	Orthopristis chrysopterus	x	x
Amberjack, slender	Seriola zonata	x	x	Pinfish	Lagodon rhomboides		x
Anchovy, bay	Anchoa mitchilli		x	Pompano, common	Trachinotus carolinus	x	x
Anchovy, striped	Anchoa hepsetus		x	Puffer, northern	Sphaeroides maculatus	x	x
Barracuda	Sphyraena quachancho		x	Puffer, smooth	Lagocephalus laevigatus		x
Bass, striped	Roccus saxatilis	x	x	Rays:			x
Bigeye	Priacanthus arenatus		x	bullnose	Myliobatis freminvilli		x
Bigeye, short	Pseudopriacanthus altus	x	x	cownose	Rhinoptera bonasus		x
Blue crab	Callinectes sapidus	x	x	greater butterfly	Gymnura altevela		x
Bluegill	Lepomis macrochirus		x	lesser butterfly	Gymnura micrura		
Bluefish	Pomatomus saltatrix	x	x	spotted eagleray	Aetobatus narinari		x
Bonefish	Albula vulpes		x	stingaree	Dasyatis sabina		x
Bonito, Atlantic	Sarda sarda	x	x	Remora, shark	Echeneis naucrates		x
Bullhead, brown	Ictalurus nebulosus	x	x	Runner, blue	Caranx crysos		x
Bullhead, yellow	Ictalurus natalis	x	x	Scad, bigeye	Trachurops crumenophthalma		x
Burrfish	Chilomycterus schoepfi		x	Scup	Stenotomus versicolor	x	x
Butterfish	Poronotus triacanthus	x	x	Sea bass, black	Centropristes striatus	x	x
Butterflyfish	Chaetodon ocellatus		x	Sea robin, common	Prionotus carolinus		x
Carp	Cyprinus carpio	x	x	Sea trout, gray	Cynoscion regalis	x	x
Catfish, channel	Ictalurus punctatus	x	x	Sea trout, silver	Cynoscion nothus	x	x
Catfish, white	Ictalurus catus	x	x	Sea trout, spotted	Cynoscion nebulosus	x	x
Cobia	Rachycentron canadus	x		Shad	Alosa sapidissima	x	x
Croaker, Atlantic	Micropogon undulatus	x	x	Shad, gizzard	Dorosoma cepedianum	x	x
Croaker, banded	Larimus fasciatus		x	Shad, hickory	Alosa mediocris	x	x
Cutlassfish	Trichiurus lepturus		x	Sharks:			x
Drum, black	Pogonias cromis	x	x	brown	Eulamia milberti		
Drum, red	Sciaenops ocellata	x	x	angelshark	Squatina dumeril		x
Eel, American	Anguilla rostrata	x	x	common hammer-			
Eel, conger	Conger oceanica		x	head	Sphyrna zygaena		x
Filefish, common	Monacanthus hispidus		x	smooth dogfish	Mustelus canis		x
Filefish, orange	Alutera schoepfi		x	Sheepshead	Archosargus probatocephalus	x	
Flounder, sand	Lophopsetta aquosa		x	Silverside, Atlantic	Menidia menidia		x
Flounder, summer	Paralichthys denatus	x	x	Skate, brier	Raja eglanteria		x
Flounder, winter	Pseudopleuronectes americanus	x	x	Spadefish	Chaetodipterus faber	x	x
Gar, longnose	Lepisosteus osseus		x	Spot	Leiostomus xanthurus	x	x
Goosefish	Lophius americanus		x	Squid	Loligo pealii		x
Hake, spotted	Urophycis regius	x	x	Stargazer, northern	Astroscopus guttatus		x
Harvestfish	Peprilus alepidotus	x	x	Sturgeon, Atlantic	Acipenser sturio	x	
Herring, bigeye	Elops saurus		x	Sucker, chub	Erimyzon oblongus	x	x
Herring, glut	Alosa aestivalis	x	x	Suckers, Eastern			
Herring, sea	Clupea harengus		x	redhorse	Moxostoma macrolepidotum	x	x
Herring, thread	Opisthonema oglinum		x	Tarpon	Tarpon atlantica		x
Hogchoker	Trinectes maculatus		x	Tautog	Tautog onitis	x	x
Jack, common	Caranx hippos		x	Terrapin,			
Lamprey, sea	Petromyzon marinus		x	diamondback	Malaclemys terrapin	x	x
Lizardfish, Atlantic	Synodus foetens		x	Threadfish	Alectis crinitus		x
Lookdown	Selene vomer		x	Toadfish	Opsanus tau		x
Lumpfish	Cyclopterus lumpus		x	Tonguefish	Symphurus plagiusa		x
Mackerel, Atlantic	Scomber scrombrus	x	x	Triggerfish, common	Balistes carolinensis		x
Mackerel, Spanish	Scomberomorus maculatus	x		Tripletail	Lobotes surinamensis	x	
Menhaden	Brevoortia tyrannus		x	Tuna, little	Euthynnus alleteratus		x
Moonfish	Vomer setapinnis		x	Turtles:		x	x
Mullet, striped	Mugil cephalus	x		green	Chelonia mydas		x
Needlefish, Atlantic	Strongylura marina		x	loggerhead	Caretta caretta	x	x
Needlefish, flatside	Ablennes hians		x	snapping	Chelydra serpentina		
Perch, silver	Bairdiella chrysura	x	x	Atlantic ridley	Lepidochelys kempi		x
Perch, white	Roccus americanus	x	x	Whiting, northern	Menticirrhus saxatilis	x	x
Perch, yellow	Perca flavescens	x	x	Whiting, southern	Menticirrhus americanus	x	x

1/The assistance of W. H. Massmann and A. L. Pacheco in making available the results of their long experience with the pound-net fishery is acknowledged gratefully.

are young fish (McHugh et al 1959) predominantly age-group II (in their second year of life) in spring and early summer, and age-group I (for their first year) in late summer and fall. In 1958, age-group I fish were exceedingly abundant in Virginia: small schools were seen everywhere in the estuaries through spring and summer, and mass mortalities, a common phenomenon when a species becomes unusually abundant, were reported from many areas; these fish showed up in late summer as a dominant feature of pound-net catches in the York River area, although they were of a size that could escape through the meshes of the nets quite easily, and very few older fish appeared in samples after mid-August. The excellent catches in the menhaden purse-seine fishery in 1959 undoubtedly included large numbers of fish of the 1958 year-class. Growth of these fish in length and weight, and their relative importance in numbers and total weight each month in 1958, are illustrated in figure 1. Samples of the 1958 year-class, caught in experimental trawls or taken by other methods, are included as polygons enclosed by broken lines on a different vertical scale. They show that pound nets in the lower York River take only larger fish of the incoming year class.

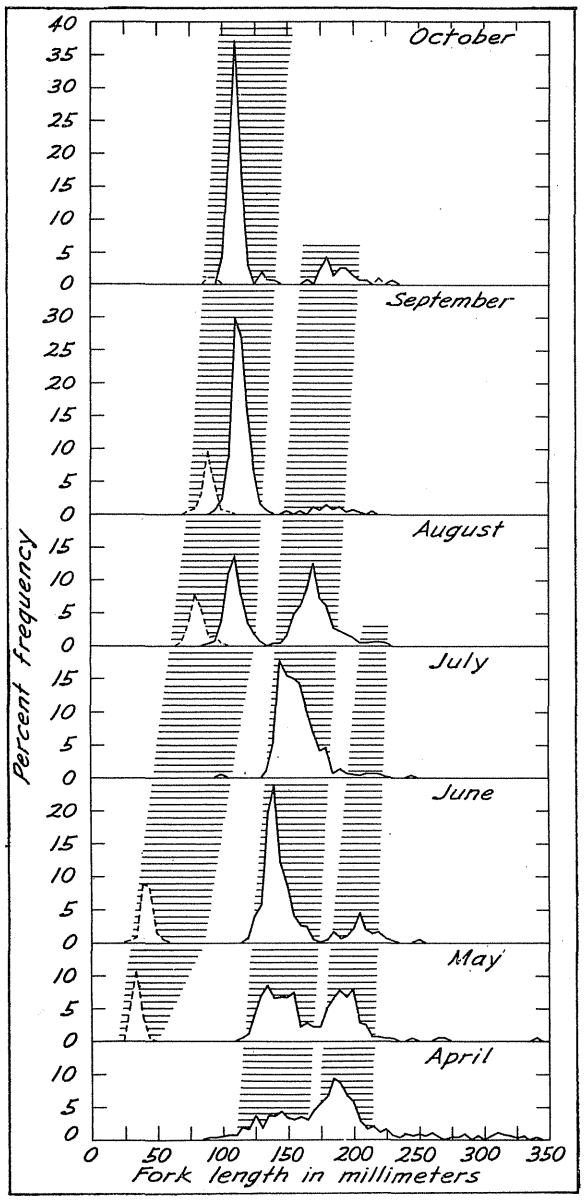
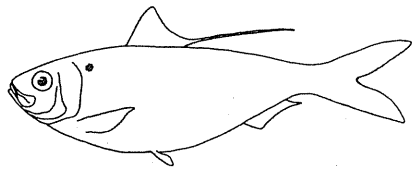


Fig. 1 - Frequency distributions of fork lengths of menhaden in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958. Shaded zones emphasize the progression of size groups to the right as the season advances, and illustrate the growth of successive age groups of fish. Broken lines represent samples of young fish caught in experimental trawls.

Thread herring (Opisthonema oglinum):

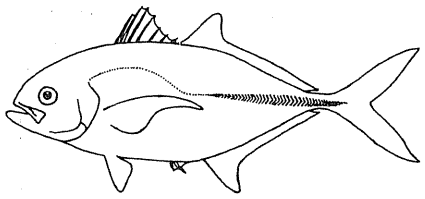
Almost half the samples examined in 1955 and 1958 contained thread herring, which first appeared in catches early in June and disappeared late in September. Hildebrand and Schroeder (1928) observed that this species appeared in the Bay about mid-May and left during October, that its spawning habits were almost completely unknown, and that fish taken in spring were thin and poor, whereas in fall they were fat. Thread herring taken in 1958 were quite uniform in size, but although mean fork length increased only slightly from spring to fall, weights increased substantially (fig. 2, p. 9). Gonads of fish caught in June were mostly in prespawning condition. In July most fish were spent or recovering from spawning, or were apparently immature, probably having recovered completely from a late spring or early summer spawning. In August and September all gonads were spent or in a resting condition. Apparently thread herring, like most other fishes, become thin and poor at spawning time but recover and fatten



quickly. The increase in weight from spring to fall is substantial, of the order of 20 percent. Females were about 5 mm. ($\frac{1}{5}$-inch) longer than males, on the average.

Blue runner (Caranx crysos):

This small fish, a member of the jack family, was prominent in



pound-net catches in 1958, but relatively unimportant in 1954, and absent in 1955. It did not appear in 1958 until after the middle of August, hence its absence in 1955 may have been caused by inadequate sampling, for no samples were examined in that year between August 13 and November 26. Hildebrand and Schroeder (1928) reported that marketable sizes ($\frac{1}{3}$ to 1 pound) were taken in small numbers at Lynnhaven Roads, Va., but that smaller fish, 5 to 8 inches long, were less common than Caranx hippos, the common jack, of about the same size. This may mean that young blue runner penetrate farther into the Bay than older fish or than common jacks, or that young were especially abundant in 1958, for no larger fish and no common jacks were known to be taken in the catches sampled. Blue runner were seen in the Fulton Fish Market, New York City, in September 1958, and dealers there say that there is a limited market for them, especially among southern Europeans, who find them similar to the "sardine" of the Mediterranean Sea.

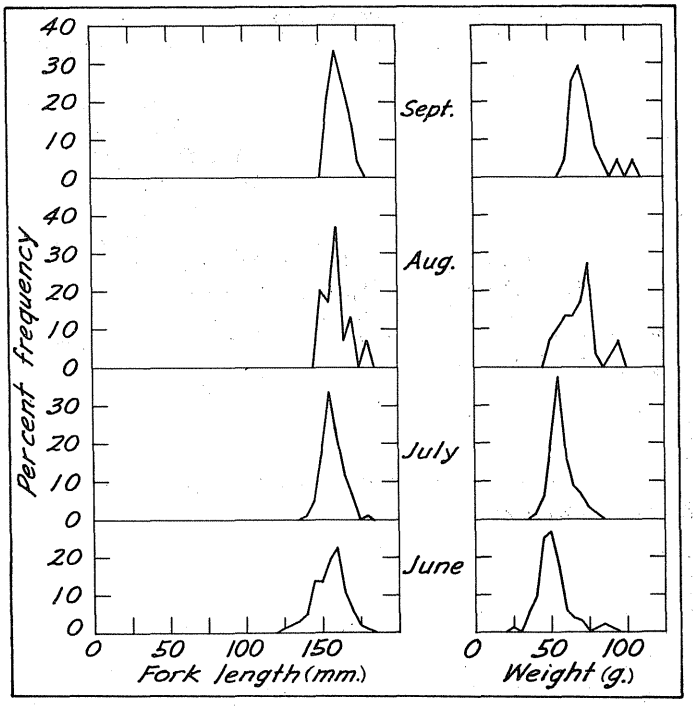


Fig. 2 - Frequency distributions of fork lengths and weights of thread herring in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958.

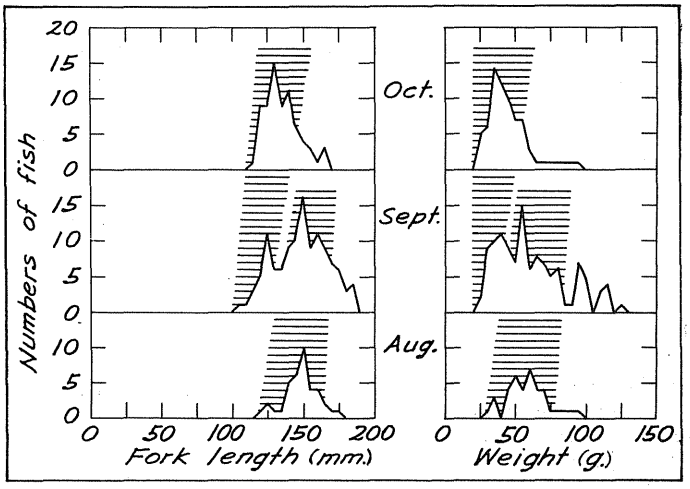
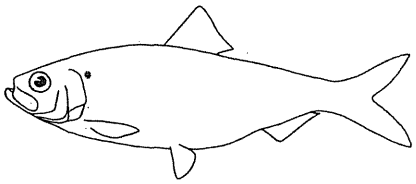


Fig. 3 - Frequency distributions of fork lengths and weights of blue runner in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958. Shaded zones illustrate the presence of two size groups of fish.

Blue runner in scrap from York River pound nets ranged in fork length from about 105 to 185 mm. (4 to 7 inches), and thus corresponded in size to the 5- to 8-inch (total length) fish reported by Hildebrand and Schroeder (1928). Those seen in the New York City market in 1958 were of similar size. All fish examined in 1958 were immature, and size-frequency distributions (Fig. 3) suggest that two successive age groups dominated the catch: the first, with modal length increasing from 150 to 170 mm., in August and September, the second 125 to 130 mm., in September and October.

Alewife (Alosa pseudoharengus):
Atlantic coast, 1957: 57,206,000 pounds, valued at $686,000.



Alewives apparently are less important in the York River fishery than elsewhere in Virginia, and those caught in this area are not sold or processed in any great numbers as human food. In certain areas, especially the Rappahannock River, considerable numbers are salted or pickled, and the roe is separated and canned. In 1958 few alewives appeared in York River pound-net catches after the end of April. In fork length these fish fell into three groups (fig.

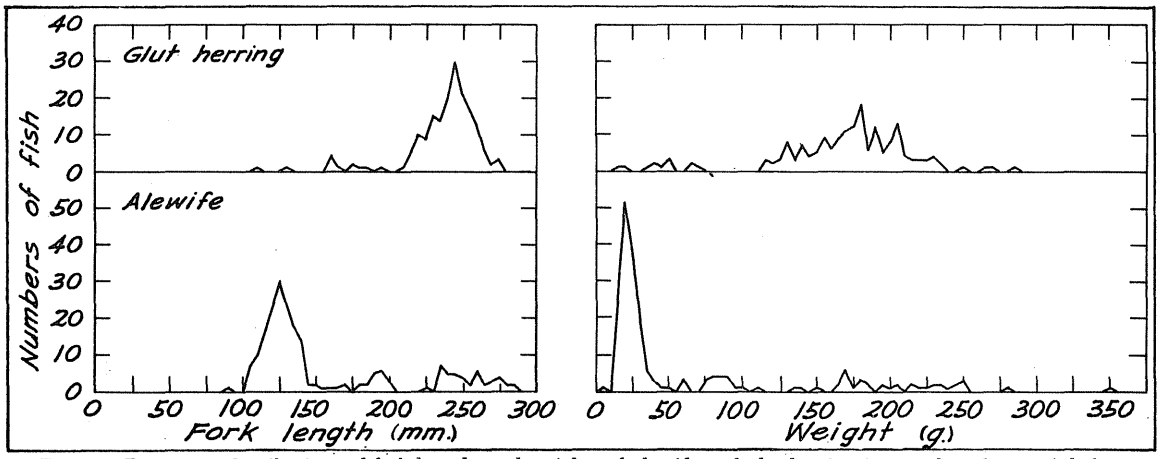
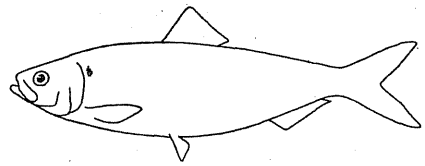


Fig. 4 - Frequency distributions of fork lengths and weights of alewife and glut herring in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958.

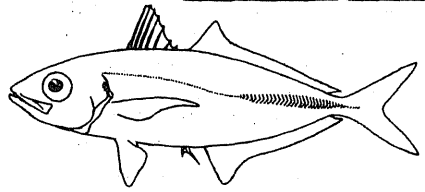
4), with modes at 125, 195, and 235-260 mm. (5, 8, and 9-10 inches), and 20, 85, and 170 to 250 g. ($\frac{1}{25}$, $\frac{1}{5}$, and $\frac{2}{5}$-$\frac{1}{2}$ pound), and probably were 1, 2, and 3 or more years old, respectively (Hildebrand and Schroeder 1928).

Glut herring (Alosa aestivalis):
Atlantic coast, 1957: landings included in figures for alewife.



Glut herring entered and left the pound-net fishery in spring perhaps a little later than alewives. Those examined in scrap samples in 1958 were larger on the average than the alewives (fig. 4). They fell into two groups according to size, with modes at about 160 and 245 mm. fork length ($6\frac{1}{2}$ to 10 inches), and 50 and 180 g. ($\frac{1}{10}$- to $\frac{2}{5}$-pound), and probably were 2 years and 3 years and older, respectively. Glut herring and alewives were among the most important pound-net species in spring, but because the fishery is seasonal they were later superseded in rank by others.

Bigeye scad (Trachurops crumenopthalma):



This small jack was almost as prominent in 1958 York River pound-net catches as blue runner, and entered the fishery at about the same time. This may explain its absence from 1955 samples which did not cover the late summer period. In 1954, however, samples were taken weekly until the end of September yet no scad were seen, which suggests that the species was less abundant, and certainly less available, than in 1958. Like the blue runner, this is

primarily a southern fish, and its appearance in Chesapeake Bay may be sporadic, for Hildebrand and Schroeder (1928) saw it only once. In 1958 scad were fairly uniform in size, but smaller fish were more frequent in October (fig. 5). Fork lengths ranged from about 105 to 160 mm. (4 to $6\frac{1}{2}$ inches), and weights from 15 to 70 g. ($\frac{1}{2}$ to $2\frac{1}{2}$ ounces). Bigeye scad of about this size were seen in the New York City market in September 1958, where they, like blue runner, are favored by certain customers because they resemble Mediterranean "sardines."

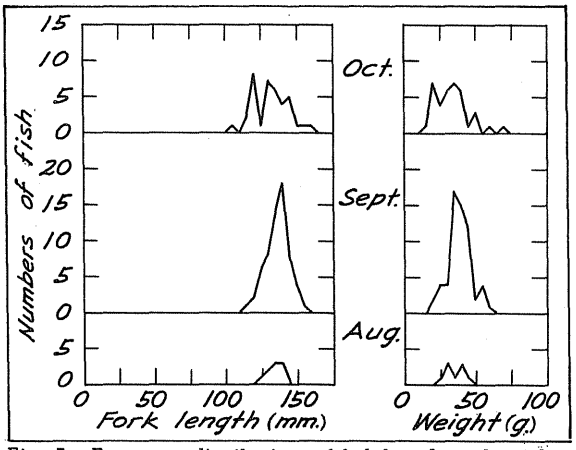
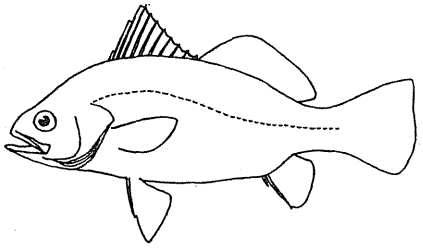


Fig. 5 - Frequency distributions of fork lengths and weights of bigeye scad in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958.

It is somewhat surprising that southern species like scad and blue runner should be unusually abundant in the Chesapeake and Middle Atlantic regions in 1958, for water temperatures along the coast were reported to be unusually low all summer. The 1958 menhaden purse-seine fishery was unusually successful in Chesapeake Bay but poor farther north. Perhaps scad and blue runner, like menhaden, became concentrated in the Chesapeake region rather than spreading out along the Middle Atlantic coast because water temperatures were too low farther north.

Silver perch (Bairdiella chrysura):



This species appeared quite frequently, but usually in small numbers, in York River catches (fig. 6). Although silver perch are abundant in Virginia and the meat is of good flavor, demand is negligible, probably because the fish are small. All silver perch caught in York River pound nets were included in scrap. They were probably in their third summer (Hildebrand and Schroeder 1928) with average length less than 175 mm. (7 inches) and average weight less than 75 g. ($\frac{1}{6}$-pound).

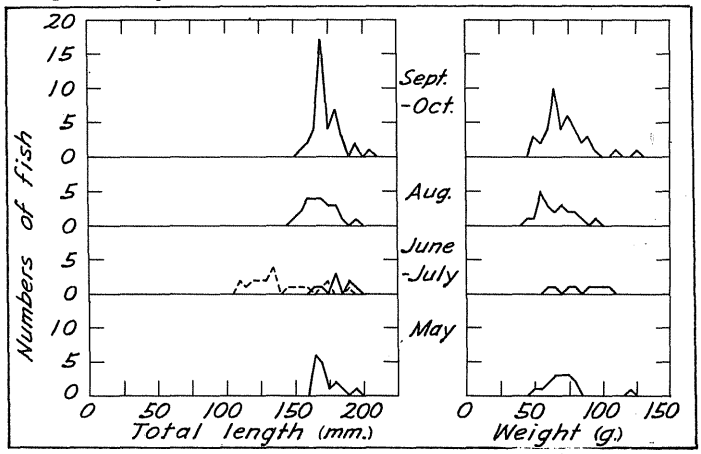
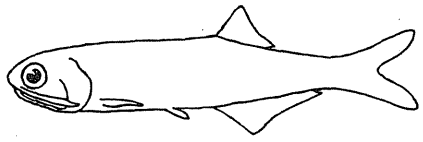


Fig. 6 - Frequency distribution of total lengths and weights of silver perch in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958. The broken line in June-July represents a sample from the York River pound-net fishery examined in 1955.

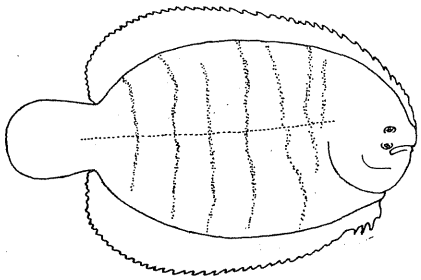
Bay anchovy (Anchoa mitchilli):



This anchovy is one of the most abundant fishes in Chesapeake Bay, undoubtedly important as food for many other species. Although it can escape easily through pound-net meshes, some fish are caught when schools stray into the nets. It is possible that some anchovies in pound-net scrap were regurgitated by larger fishes, but most were too fresh and undamaged to have

been caught in this indirect fashion. More than a third of all samples contained Bay anchovy, which, though an insignificant component of scrap by weight, was one of the principal species in terms of numbers caught. Fork lengths ranged from 53 to 72 mm. (about 2 to 3 inches).

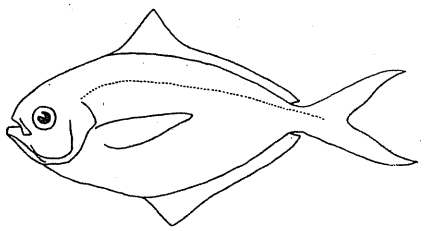
Hogchoker (Trinectes maculatus):
Atlantic coast, 1957: 7,000 pounds, valued at $421.



This is the most abundant flatfish in Chesapeake Bay, and its meat is said to be well-flavored, but it has little market value, probably because it is small. Atlantic coast commercial landings in 1956 were all in Maryland. Hogchokers appeared only sporadically in pound-net catches in spring and summer but increased in numbers in early October, probably during fall migration from the upper York River to the deeper waters of the Bay. Lengths ranged from about 95 to 170 mm. (4 to 7 inches), and weights reached a maximum of 85 g. ($\frac{1}{5}$-pound). Mansueti and Pauly (1956) concluded that hogchokers in the Patuxent River, Md., grew slowly, reaching a mean standard length of only 131 mm. (total length about 159 mm.) and a weight of 80 g. (about $\frac{1}{5}$ pound) at the end of 7 years. If York River fish grow as slowly, these fish were from 3 to more than 7 years old.

FOOD FISH

Butterfish (Poronotus triacanthus):
Atlantic coast 1957: 10,267,000 pounds, valued at $848,000.



This was the most important food fish in York River pound-net scrap in 1954, 1955, and 1958 (tables 1 to 3). Almost two-thirds by number and one-half by weight of all butterfish caught in the York River fishery in 1958 were sold as scrap (table 4), and the species was found in 86 percent of all scrap samples examined. Detailed studies have not been made of size composition of the entire catch of butterfish in Virginia pound nets, but examination of one sample from the food-fish catch suggested that there is considerable overlap in sizes retained for market or included in scrap (fig. 7, September). The smallest butterfish in all samples

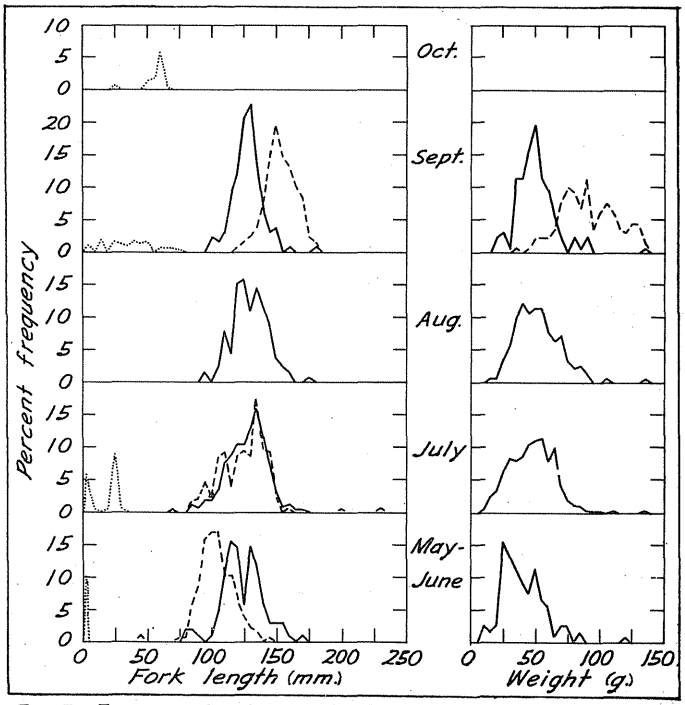
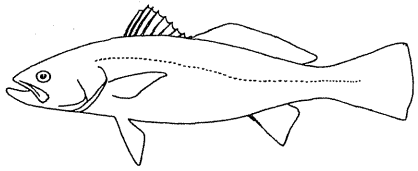


Fig. 7 - Frequency distributions of fork lengths and weights of butterfish in samples of scrap frish from pound-net catches in the York River area, Virginia, 1958. Dotted lines represent samples of young taken by Perlmutter (1939) near Long Island. Broken lines in May, June and July represent samples from the York River pound-net fishery measured in 1955. Broken lines in September represent a sample from the pound-net catch in 1958 after scrap butterfish had been culled out.

was 81 mm. ($3\frac{1}{4}$ inches) in fork length and weighed 10 g. ($\frac{1}{3}$ oz.); the largest 179 mm. and 136 g. (almost $\frac{1}{3}$ pound). Obviously, as Neville and Perlmutter (1941) observed in the Long Island fishery, sorting of the catch is not efficient; many fish of marketable size are sold as scrap, and many small fish are not culled from those shipped to fresh fish markets. Fish dealers in the cities believe that this lack of attention to careful culling affects selling prices adversely.

Very little is known about butterfish, although it is a fairly important species from Chesapeake Bay north to New England. Perlmutter (1939), in the vicinity of Long Island, took young-of-the-year that ranged in total length from 2 to 94 mm. ($\frac{1}{10}$ to $3\frac{1}{2}$ inches) or 2 to 77 mm. fork length (fig. 7), and Bigelow and Schroeder (1953) estimated that fish caught off the New Jersey coast, ranging from 4 to $5\frac{1}{4}$ inches total length, were in their second year, and a group of larger fish, from $7\frac{1}{2}$ to $10\frac{1}{2}$ inches total length, were in their third summer, and some perhaps in their fourth. Hildebrand and Schroeder (1928) concluded that butterfish in Chesapeake Bay increased from a mean total length of 4 inches in May to about $5\frac{1}{4}$ inches in October. Spawning, as deduced from observations of gonad development, occurs in early summer in Chesapeake Bay. On this evidence we can assume that most butterfish in pound-net scrap in Virginia were in their second year of life, and most of those sold as food were in their third year or older.

Gray sea trout or weakfish (Cynoscion regalis):
Atlantic coast, 1957: 8,150,000 pounds, valued at $622,000.



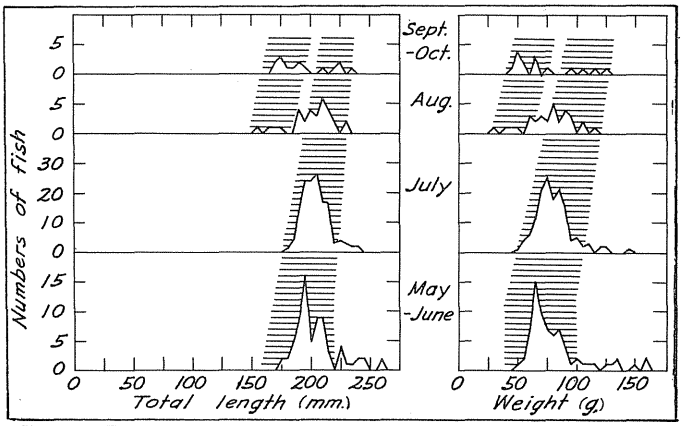
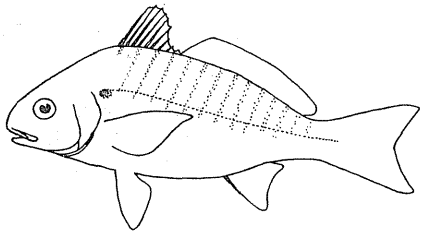


Fig. 8 - Frequency distributions of total lengths and weights of gray sea trout in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958. Shaded zones emphasize the progression of size groups to the right as the season advances.

This was the second most important food fish in scrap samples examined. It occurred in about three-quarters of all samples, and ranked fourth of all species by weight. Sizes were fairly uniform, and most fish probably were in their second year of life (Nesbit 1954), with a few in their third year or older early in the season, and a few larger yearlings in late summer (fig. 8). In spring and summer many of these small trout contained well-developed gonads, and it seems probable that they would have spawned that season. By number, more than one-quarter of the gray sea trout catch in the York River fishery was discarded as scrap (table 4).

Spot (Leiostomus xanthurus):
Atlantic coast, 1957: 9,032,000 pounds, valued at $623,000.



Spot also was an important food fish in pound-net catches, and young appeared rather frequently in scrap. More than two thirds of of all scrap samples contained small spot, which almost equalled gray sea trout in numbers, although not in total weight. Spring catches contained two size groups of spot (fig. 9), probably fish in their second year and in their third

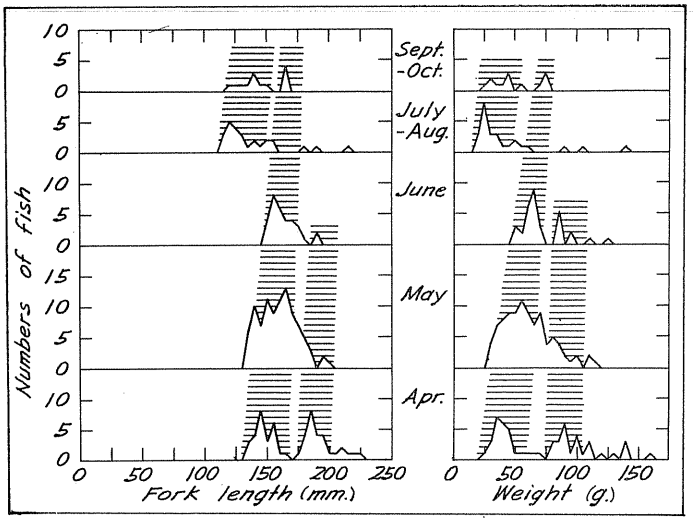
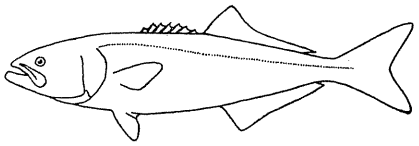


Fig. 9 - Frequency distributions of fork lengths and weights of spot in samples of scrap fish from pound-net catches in the York River area, Virginia, 1958. Shaded zones emphasize the progression of size groups to the right as the season advances.

year or older (Pacheco 1957). The relative abundance of larger and older spot in scrap at this season probably reflects small catches of this species, typical of the spring fishery. When only a few individuals of edible size were taken they were not saved for market. By midsummer most spot in scrap samples were young, nearing the end of their first year of life.

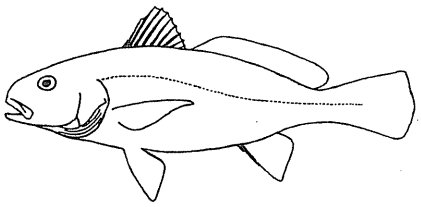
Bluefish (Pomatomus saltatrix):
Atlantic coast, 1957: 3,742,000 pounds, valued at $493,000.



Young bluefish were relatively important in 1958 samples of scrap from the York River, but less important in 1954. Their absence in 1955 may have been related to the pattern of sampling in that year for no samples were examined in late summer and fall. On the other hand, almost all bluefish in 1954 and 1958 were taken in May, June, or July, months equally well sampled in 1955. Bluefish are erratic in their movements, and their occurrence in the Bay in 1958 may have been governed by the same unusual temperature conditions that brought blue runner and bigeye scad to these waters in apparently unusual numbers. It has been reported that in 1958 bluefish were less abundant along the Middle Atlantic coast and appeared later than usual.

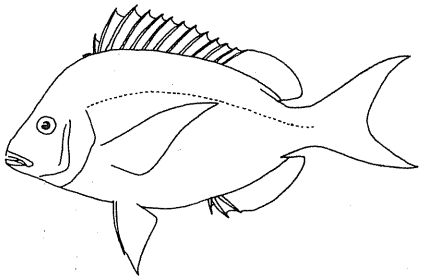
Bluefish in scrap were rather uniform in size, about 150 to 210 mm. (6 to 8 inches) fork length, and 45 to 125 g. ($\frac{1}{10}$- to $\frac{1}{4}$-pound). Average size tended to decrease through the fishing season, probably because younger fish appeared later.

Croaker (Micropogon undulatus):
Atlantic coast, 1957: 18,918,000 pounds, valued at $1,943,000.



Young croakers were encountered in 7 out of 21 scrap fish samples in 1954 and ranked eleventh in number. In 1955 they were found in only 2 samples out of 14, and in 1958 in only 3 out of 25, and ranked fourteenth in number in both years. Total lengths of 32 fish from scrap samples examined in 1955 and 1958 ranged from 145 to 245 mm. (6 to 9 inches) and weights reached a maximum of 165 g. ($\frac{1}{3}$-pound). Young croakers probably were more common in scrap in previous years when the species was more abundant, and their scarcity in 1958 was not unexpected in view of the absence of yearlings, born in fall and winter of 1957-58, from the waters of Chesapeake Bay and the estuaries in 1958, as observed by W. H. Massmann and his associates at the Virginia Fisheries Laboratory. Large catches of croakers were made in the spring of 1958, and it would be expected that small fish, if they had been present, would have been culled from these hauls.

Scup (Stenotomus versicolor):
Atlantic coast, 1957: 34,108,000 pounds, valued at $2,008,000.



This species does not enter Chesapeake Bay in great numbers, and most Virginia landings are caught in the ocean by trawlers. Nevertheless, a few are taken by pound nets in the lower part of the Bay, and some of these enter the scrap. Scup occurred in about 1 of every 4 samples examined in 1955 and 1958, but not at all in 1954. Catches were distributed more or less randomly through the fishing season, but there were striking seasonal changes in size and probably age of fish in 1958 (table 8). Those taken in June and July (fork length 4 to 5½ inches) probably were in their second year of life, those caught in fall (fork length 7 inches) probably in their third year.

Table 8 - Frequency Distributions of Fork Lengths and Weights of Scup (Stenotomus versicolor) in Pound-Net Scrap, York River, Virginia, 1958.

Fork Length mm.	Numbers of Fish			Weight G.	Numbers of Fish		
	June	July	Sept.-Oct.		June	July	Sept.-Oct.
				15	1	-	-
				20	1	-	-
				25	3	-	-
				30	2	-	-
				35	-	-	-
				40	-	-	-
				45	-	-	-
90	1	-	-	50	-	1	-
95	-	-	-	55	-	-	-
100	1	-	-	60	-	1	-
105	2	-	-	65	-	-	-
110	3	-	-	70	-	-	-
115	-	-	-	75	-	-	-
120	-	-	-	80	-	-	1
125	-	-	-	85	-	-	-
130	-	-	-	90	-	-	-
135	-	1	-	95	-	-	-
140	-	1	-	100	-	-	-
145	-	-	-	105	-	-	-
150	-	-	-	110	-	-	1
155	-	-	-	115	-	-	4
160	-	-	-	120	-	-	1
165	-	-	-	125	-	-	3
170	-	-	4	130	-	-	-
175	-	-	6	135	-	-	1
180	-	-	3	140	-	-	2

SUMMARY AND CONCLUSIONS

Many other species, some valued as food, others of little appeal, occurred in relatively small quantities in pound-net scrap (tables 1 to 7). If our examination of samples from the York River was at all representative, none of these minor species is caught in sufficient quantity to offer any great threat to the resource, but catches of some others, particularly butterfish, gray sea trout, and spot, are sufficiently large so that investigation of the effect of such removals upon future stocks of adult fish would be desirable. Some of the investigations now under way at the Virginia Fisheries Laboratory are laying the groundwork for solution of this problem.

It is pertinent to ask whether scrap fish now caught by pound nets and other fishing gear in Virginia are being put to best economic use. As long as there is no great shortage of protein food in the United States, preferences and prejudices will control economic value of fish to a great extent, but it appears that much of the choice as to whether a fish is scrap or human food rests with the primary producer or the middleman, and the consumer has little or no opportunity to choose. One cannot help but wonder whether some enterprising middleman might not profit, and the consumer benefit also, by experimental marketing of some of the scrap fish we have described, like blue runner, bigeye scad, silver perch, or hogchoker. It seems to be established that these fishes are quite palatable, and ojections on the basis of size seem rather incongruous when such species as butterfish, equally small, apparently are in great demand. Displayed in attractive packages, as frozen-dressed panfish, irrespective of species, these now-despised varieties might find a ready market. Economic effects of fluctuations in abundance of individual species would be minimized by selling under a general, rather than a specific, name, and other species that appear only spasmodically might be marketed equally well.

One rather formidable obstacle to development of methods to allow small fish to escape the nets, or to utilize scrap for human food, is presented by the crab-pot

fishery. Demand for scrap as bait is so strong that at times we were unable to secure samples for scientific study. Yet there are several ways in which a steady and more convenient supply of bait could be provided, e. g. by freezing menhaden in blocks of suitable size, or developing a prepared bait of uniform quality and high attraction power. If such developments are not forthcoming there may be no unanimous support for scientific measures designed to create an optimum sustained yield of food fishes, no matter how well-founded such measures might be.

Some of the conclusions drawn in this investigation may be too sweeping in view of the limited area of sampling and the knowledge that many species are not distributed uniformily through the waters exploited by the pound-net fishery. Catches in other areas certainly should be examined if this study is to continue, and it would be well also to secure information on relative quantities and species composition of scrap taken in haul seines and other gears.

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